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

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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

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

UK College of Engineering minority graduates

Class	African American	Hispanic	Native American	Total BS Graduates	Minority % of the total
2008	5	1	0	324	1.85%
2009	10	3	0	298	4.36%
2010	2	3	0	337	1.48%
2011	7	5	1	346	3.76%
2012	7	2	1	349	3.44%

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

Participant's level	Undergraduate				Graduate			
Year	F	S	J	S	1	2	3	4
Skills to be developed								
1. Academic and study skills	■							
2. Research skills	■	■			■			
3. Communication skills		■	■			■	■	
4. Teaching skills			■	■	■	■		
5. Funding procurement and project management skills							■	■
6. Outreach skills	■	■	■	■	■	■	■	■

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

CAER mentors

- Teach technical skills particular to research being performed
- Teach ancillary skills such as proper lab notebook upkeep, report preparation, and lab etiquette

Other CAER staff

- 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

Other UK units

- 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

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

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

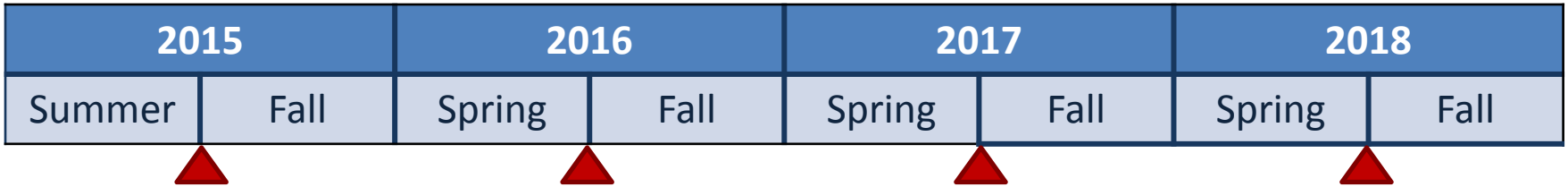
External funding/student support will be emphasized for graduate students and student support for UGs

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



▲ Recruitment of 10 UG students and 1 or 2 graduate students

Past UG engineering students engaged in research at CAER

Year	2013	2012	2011	2010	2009
Eng. UGs supported	35	35	49	63	48

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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