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Broadening participation in a distributed research center

Background

For the US to maintain its role as a global leader in science and technology it is critical that a talented and innovative STEM workforce be cultivated. Jobs in STEM are the fastest growing employment sector in the US but changing demographics present a challenge with respect to generating a first-rate STEM workforce. The minority population is increasing rapidly and the US is on track to be a majority minority country in just a few decades; yet minority groups are seriously underrepresented in STEM fields and constitute an overlooked source of future science and technology professionals. In order to engage the best and the brightest in STEM it is vital that we tap the talents of all Americans. A number of programs aimed at building a workforce that is more representative of the US population have been developed throughout the STEM enterprise, and while modest progress has been made in the awarding of bachelor's and graduate degrees to women and underrepresented minorities, their representation is still very scarce in chemical science professions, especially as one looks up the ranks. There is great deal of work to be done still to encourage these individuals to study chemistry and to retain them in the pipeline.

CENTC

A NSF Center for Chemical Innovation (CCI), CENTC was a widely distributed chemistry research center with 20 senior investigators at 14 universities across North America and one national laboratory. The Center conducted highly collaborative research aimed at discovering catalytic processes with potential to enable efficient and environmentally responsible production of fuels and chemicals from common and sustainable feedstocks. Due to its distributed nature, CENTC relied heavily on cyberinfrastructure to facilitate communication among researchers who also included as many as 60 students, postdocs and visiting faculty.

Diversity was a core value for CENTC and, in developing our diversity activities, we kept in mind CENTC's strengths and the areas where we had some control. For example, it was difficult to influence admissions to the graduate programs, but we could keep diversity in mind in forming our advisory board, adding new senior investigators or selecting speakers for educational programs. With only a few researchers at each of our institutions it wasn't feasible to develop departmental- or institutional-level programs requiring large numbers of CENTC personnel; instead we looked for opportunities in how we might use our strength in cyberinfrastructure to facilitate connections to minority chemists and allow our minority participants to communicate with one another.

Research Partnerships with Minority Serving Institutions

One of our initial diversity initiatives was to develop research partnerships with minority serving institutions (MSIs), including Historically Black Colleges and Universities (HBCUs), with the goal of building research capacity at those institutions. Our partnership model was to provide resources for research partners to conduct research at their own institutions thereby improving research experiences for URM students and other faculty at their home institutions. Other summer research programs for minority faculty to conduct research in host labs exist, but aren't feasible for those with family obligations or other factors that preclude extended times away from their homes. The strategy adopted by CENTC was rather that MSI partners could conduct research at home while keeping in communication with CENTC scientists. By participating in collaborative research with CENTC, early career researchers from MSIs would advance their careers by increasing their research productivity and expand their professional networks by developing professional connections with CENTC investigators. With access to videoconferencing technology, partners could attend CENTC's monthly meeting to learn more about CENTC research and receive feedback from all of our researchers as well as keep in more frequent contact with direct collaborators. Faculty in smaller departments often lack colleagues with similar research interests and the intellectual stimulation and feedback on their scientific ideas that comes with interacting with others in their fields, so access to other professionals in their fields is a valuable resource.

In 2009 CENTC initiated a collaboration with an assistant professor from a small master's degree granting HBCU with an enrollment of approximately 2,800 and a small chemistry department of less than ten faculty. The collaborative research project was selected to best utilize his expertise. CENTC provided chemicals and lab supplies for the experiments as well as a computer and other equipment for he and his students to participate in CENTC's monthly videoconferences. This research partnership was confronted with a number of challenges, primarily due to the significant differences between R-01 and smaller institutions. With the heavy teaching loads and limited research facilities typical of HBCUs, our partner was challenged for time to devote to research and felt that a truly equal partnership was missing.

However, as these issues became clear, our partner proposed a more effective way for CENTC to achieve our goal of increasing research capacity at the HBCU. Without ready access to an NMR the contributions he could make to the CENTC project were significantly limited and this fact was leveraged to persuade his university to support him in a NSF Major Research Implementation (MRI) Program proposal to acquire an NMR for his department. CENTC staff provided feedback on the proposal and provided a letter of support. The successful MRI proposal allowed the department to acquire instrumentation that not only supported the research activities of our partner and his colleagues, but also provided students with up to date research and instrumentation experience.

CENTC Undergraduate Summer Research Program

A mainstay of our diversity initiatives was our summer research program for undergraduates. It is widely known that involving students in research experiences is one of the best ways to retain them in STEM and influence their decision to go on to graduate school. We targeted students from populations underrepresented in the chemical sciences, including women and those from diverse academic and cultural backgrounds, four our undergraduate summer research program.

CENTC's Undergraduate Summer Research Program (USRP) was distinguished from typical undergraduate research programs in several ways:

- Students participated in collaborative research projects
- Research labs were distributed around the country, with only one or two undergraduate students in each lab
- Videoconferencing technology was used routinely to communicate with remote research collaborators, attend monthly center-wide videoconferences and meet weekly with the whole USRP cohort and program coordinator for research updates and professional development sessions
- Students participated in CENTC's annual meeting

We reached out to women and minority students through mailings of advertising materials and emails to MSIs, HBCUs, women's colleges and universities and other institutions with high minority enrollment and through targeted social media promotions. At conferences of organizations supporting the advancement of minorities in science we contacted students, faculty and advisors directly with information about the program. We posted our program on the Pathways and SACNAS websites and others that list internships and research opportunities that target minorities.

Of the 123 students who participated in our USRP, 63% were women and 23% were URMs. The percentage of URM participants increased over time, ranging from 9% to 36%.

Partnering with Minority Serving Professional Societies

Professional societies that promote the success of URMs in STEM, such as the Society for the Advancement of Chicano and Native American Scientists (SACNAS) and the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE), provide excellent opportunities to promote center activities as well as to contribute to programming at their national conferences. We found that SACNAS conference content and attendance were heavily weighted towards biological sciences and saw an opportunity to increase

the profile of chemistry at their conferences by organizing technical symposia on chemistry with the goal of introducing conference participants to the practical importance of research in the chemical science as well as to attract more chemistry students and professionals to attend the conference. We organized a panel discussion on professions open to PhD chemists and a workshop on different summer research and internship programs available to URMs at research centers, government labs, etc.

We joined other CCIs in recruitment efforts through informational booths at both SACNAS and NOBCChE. Visitors to these booths included students as well as advisors from MSIs, HBCUs and community colleges. We did get applications from a few students we reached at these conferences. But when we surveyed applicants to our USRP, only one or two reported learning about the program through a conference. The vast majority found us via an internet search or through a faculty member.

With diversity, as in research, it is important to be looking for and pursuing opportunities as they come up. As an example, a CENTC postdoc who was active in NOBCChE, together with two other women, created a NOBCChE travel award to honor Winifred Burks-Houck, the first female president of NOBCChE. The Winifred Burks-Houck Undergraduate and Graduate Leadership Award recognizes students who demonstrate leadership and have made significant contributions to science in their community. This created an opportunity for us to contribute to NOBCChE by administering the awards in its initial years, which entailed reviewing applicants, selecting awardees and providing funds for the travel awards.

Lessons Learned

With respect to partnerships to advance broadening participation, communication is critical as in all partnerships. Collaborative relationships must be reciprocal for both parties to benefit. While videoconferencing has its place in communicating across distance, in-person meetings are essential, especially when developing a new partnership. Ask potential partners what they need or want. Be flexible to adapt to obstacles as they arise and to recognize new opportunities.

Resources

Mathematics Engineering and Science Achievement (MESA) – www.mesausa.org/
an organization with chapters in nearly a dozen states that provides academic enrichment for students and teachers and sponsors engineering competitions from the local to the national levels.

Females Excelling More in Math, Engineering and Science (FEMMES)
provides hands-on STEM activities for girls and introduces them to female students, postdocs and faculty.

Society for the Advancement of Chicano and American Scientists (SACNAS)- www.sacnas.org
National organization dedicated to advancement of Chicanos/Hispanics and Native Americans from college students to professionals, in education, careers, and positions of leadership in STEM. Many local chapters.

National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE)- www.nobcche.org
Dedicated to helping black and other minority students achieve success in academic, professional, and entrepreneurial pursuits in chemistry and chemical engineering. Hosts science bowl and other outreach activities associated with national conferences and at regional levels. Local chapters.

National Alliance for Broader Impacts (NABI) - www.broaderimpacts.net
An international network working to advance broader impacts. Develops and disseminates programs and resources for broader impacts.
Pathways to Science –www.pathwaystoscience.org
Connects underrepresented students with funding and research opportunities. Provides resources to help promote practices to keep underrepresented students in STEM.

Louis Stokes Alliance for Minority Participation -
www.nsf.gov/pubs/2003/nsf03520/nsf03520.htm
NSF program aimed at increasing quality and quantity of students successfully completing science, technology, engineering and mathematics (STEM) baccalaureate degree programs and pursuing graduate study. Programs are achieved through alliances formed between two- and four-year higher education institutions, businesses and industries, national research laboratories, local, state, and Federal agencies.

Annual Biomedical Research Conference for Minority Students (ABRCMS) - www.abrcms.org
Students attend this conference to present their research, enhance professional development skills, explore graduate schools, and network.