NSF S-STEM EPIC Scholarship Program

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Elizabethtown College's Practices with Impact Cohort (EPIC) NSF S-STEM program

Goals of the S-STEM program

Elizabethtown College's Engineering Practices with Impact Cohort (EPIC) Scholarship program was launched with an NSF S-STEM grant awarded in 2013. The program developed a targeted pathway for academically talented and women with financial need interested in engineering to successfully enter the STEM workforce. The program targeted three critical stages:

1) recruit talented women into the ABET accredited engineering program at Elizabethtown College by forming a cohort of scholars,
2) leverage and expand existing high impact practices (including an established matriculation program, living learning community, collaborative learning model, focused mentoring, and undergraduate research) to support women scholars during their college experience, and
3) mentor scholars as they transitioned to the STEM workforce or graduate programs.

The goals of the scholarship program were to increase the number and percent of women entering engineering at Elizabethtown and to increase the graduation/employment rate of EPIC scholars beyond that of current Elizabethtown engineering students and beyond that of national levels for women engineers.

Major Activities

Under goal (2) we leveraged and expanded existing high impact practices for the EPIC scholars, which also expanded and improved these programs for other historically excluded identities[1] as well. This list is taken from our proposed list of activities for the grant.

- First-Year Common (Cohort) Experiences and Mentoring: With a couple of exceptions for athletic pre-season scholars, all EPIC scholars participated as a subgroup in Momentum, a highly successful pre-orientation mentoring program for first-year, historically excluded and first-generation college students.

- Undergraduate Research: There were 11 research experiences at Elizabethtown undertaken by EPIC scholars either during the semesters or the summer, including an NSF REU at another campus. These were primarily undertaken by two scholars, one of whom has continued on to a PhD program in biomechanics. Additionally, one EPIC

[1] As suggested at one of the 2018 CONeCD conference keynotes, we are using the term 'historically excluded identities' here in place of underrepresented minorities

scholar is participating in an NSF REU this summer after the end of the grant. These experiences include research presentations at multiple internal mini-conferences, as well as two national conferences.

- Living Learning Communities: All EPIC Scholars were placed in a living-learning community specifically for women engineering students (The Partners In Engineering (PIE) Floor), housed with the College Honors students, and mentored by two upper year engineering Resident Advisors and two faculty sponsors. EPIC Scholars often (but not always) also served as the RAs.

- Collaborative Learning and Projects: All EPIC scholars completed a service project in the sophomore year and a three-semester Capstone project in the junior and senior years. EPIC Scholars also were offered study group sessions run nightly by upper year EPIC scholars, right in their living-learning community.

- Focused Mentoring: All EPIC scholars were assigned either one of the PIs or another women faculty as their academic advisor and informal faculty mentor.

- Community Building: EPIC scholars were part of a college club and Society of Women Engineers Interest Group that provided mentorship, socializing, programming, and leadership opportunities. EPIC scholars were frequently (if not always) the club officers.

Under goal (3), transition students into the workforce, the following activities were carried out:

- Professional Association Participation: EPIC scholars are members of SWE and many are also members of new campus chapters of ASME, IEEE and NSBE. If they attend 2 professional society meetings for any society, we have paid for their membership.

- Strategic Industry Relationships: Develop with the Department of Engineering strategic relationships designed to place students in internships, co-ops, and employment. Local companies Phoenix Contact and Frito-Lay are companies that both partnered with us to hire interns and graduating EPIC Scholars.

- Prestigious Scholarships Program: Partner with the College's Prestigious Scholarships Program to identify and support the highest achieving students to apply for prestigious scholarships and awards, particularly for STEM graduate programs. Most EPIC Scholars wanted to directly enter the workforce, but the one scholar who entered a PhD program worked with this program to apply for the Goldwater Fellowship twice (with no success).

Results

Under goal (1), we have roughly doubled the number of women (22.7%) and historically excluded students (14%) in the engineering program. This is comparable to the 2016 national average of 20.9% women and 20.6% historically excluded bachelors graduates in engineering. We have also remained at a consistently high level of enrollment and retention of low-income

(18.6% Pell eligible) and first-generation college students (61%). Incoming **women** went from a 5-year baseline before the grant of 14% (about 4 out of 30 incoming students) to a high of 27% of the first-year class (11 of 41) and a 5-year average during the grant of 21%. More importantly, all cohorts have had at least 6 women (most over 8) which has formed a critical mass. Overall in the department, the total number of women in the department across all four years increased from a baseline of 11% before the grant to almost 23%, more than doubling and creating a robust group of about 35 women total. Incoming **historically excluded** students went from 4 (6.8%) before the grant started to a high of 7 (16.3%) and a 5-year average during the grant of 13%, roughly doubling this population in the incoming cohort. Overall in the department, the total number of historically excluded students in the department across all four years increased from 10 (7.8%) the year before the grant to 21 (14%) in the final year of the grant, more than doubling this population in our department. Before the grant, we had a robust history of serving **low-income and first-generation** students with a population of about 18% Pell-eligible and 66% first-generation students the year before the grant recruiting started. During the grant, we remained about the same proportion of Pell-eligible students overall, with a high of 25% one year. We also remained about the same proportion of first-generation college students (around 60%). With the challenges facing higher education and the trend for low-income and first-generation college students toward public institutions and community colleges, retaining this strength of our program is considered a win. Regarding first-generation college students, we have done well with retention. The proportion of first-generation students in our department over all four years is slightly higher than when the grant started (61.3% vs 57.8%).

Under goal (2), 83% of the scholars have been retained in the engineering program or have graduated with an engineering degree, which is above the institutional and national average. The remaining scholars transferred to another major but have been retained at the institution. All of the scholars participated in a living-learning community, tutoring, focused mentoring, and a women engineers club. Almost all participated in a pre-matriculation program. 17% of the scholars additionally had an undergraduate research experience and 28% studied abroad.

Under goal (3), 100% of the scholars had engineering workforce jobs or graduate school acceptances at the time of graduation. To date, 8 scholars have graduated (all have done so in four years): 1 entered a fully-funded PhD program at UDelaware; 7 are employed as engineers; all had jobs before or just after graduation. This is a 100% placement rate of scholars into the engineering workforce or graduate school. This program successfully increased the population of historically excluded, low-income, and first-generation women entering the engineering workforce.

Impacts

The broader impacts from this grant are seen in several areas: curriculum, research, and human resources. First, in closely observing the challenges and opportunities with these women, we have revised two areas of our curriculum: 1) changing the math and physics sequence to add an applied math/physics course for college math fundamental in the first semester for students with a relatively weak math background, then starting Physics I and Calculus I in the second semester for those students, and 2) moving all foundational courses in the first three semesters (applied

college math fundamentals, Physics I and II, Statics, Circuits, and Dynamics) to be mastery-based. This approach allows students to be self-paced, have more control over their grade, attempt tests multiple times, and master foundational content more deeply and completely than previously.

Second, inspired by this grant, one of the PIs was awarded an NSF PFE-RIEF grant to study the impact of internship experiences on professional engineering identity for first-generation and low-income students. Both PIs are also pursuing engineering education research on mastery-based learning, including an institutional grant to pilot a study in collaboration with a psychology faculty on the impact of the mastery-based course approach on student anxiety, particularly for historically excluded identities. Early results suggest that the mastery-based approach evens the playing field for historically excluded identities, resulting in no statistical difference in test anxiety in mastery-based courses.

Third, the grant has impacted human resources both in the workplace and at our institution. Our first two cohorts of graduating EPIC Scholars are all successfully into the engineering workforce or engineering graduate school and increasing the representation of women, Hispanic, and African-American engineers in their companies. Local employers Phoenix Contact and Frito-Lay, in particular, have been able to increase their intern and entry-level engineer pool by hiring more women through the partnership with this program. Currently Phoenix has hired EPIC Scholars for two internships/co-ops and two full-time positions, and Frito-Lay has hired two EPIC interns, one of whom became a full-time position. This grant also helped our engineering department increase enrollment and add new concentrations in Industrial and Systems Engineering, Biomedical, and Civil Engineering which resulted in a new tenure-track line from the institution. In that position we were able to hire a Hispanic male Assistant Professor, increasing our department diversity to be over 50% of our engineering faculty that are historically excluded identities (2 women and 2 Hispanic men). Somewhat indirectly, this project helped facilitate efforts in recruiting local Hispanic populations to engineering and STEM by forming an institutional organization of Spanish-speaking faculty and admissions officers to develop resources and outreach activities in Spanish, included a summer engineering camp for historically excluded identities launching in Summer 2020. Some of the Spanish-speaking EPIC Scholars helped make the initial videos and conduct early engineering outreach activities to a Hispanic-serving church in a nearby urban area.

Conclusions

This program achieved the goals to increase the number and percent of women entering engineering at our institution (doubled the number of women and historically excluded identities), and to increase the graduation rate (83%) and employment rate (100%) of EPIC scholars beyond that of current engineering students and beyond that of national levels for women engineers. The program activities targeted three critical stages: 1) recruiting talented women into the ABET accredited engineering program and forming a cohort of scholars, 2) leveraging and expanding existing high impact practices (including an established matriculation program, living learning community, collaborative learning model, focused mentoring, and undergraduate research) to support women scholars during their college

experience, and 3) mentoring scholars as they transitioned to the STEM workforce or graduate programs. Impacts of the program were felt in our engineering curriculum, ongoing research, and local and institutional human resources.

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