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BOARD # 453: S-STEM: Increasing the success of talented engineering students with unmet financial need with scholarships, culturally-responsive curriculum, and mentoring

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S-STEM: Increasing the success of talented engineering students with unmet financial need with scholarships, culturally-responsive curriculum, and mentoring

Abstract

Currently, participation of key student populations in the engineering workforce is limited, in large part due to student financial need[1]. Students from historically underrepresented groups (URGs) in Science, Technology, Engineering and Mathematics (STEM) including Latino/a/x, African American, and first-generation college students disproportionately experience financial need[2, 3], higher levels of stress and anxiety[4], and longer times to graduation[5]. To compound the problem, URGs, through no fault of their own, face additional challenges that decrease persistence in engineering including inadequate mentoring and absence of a sense of belonging[6]. In a step towards addressing these challenges, this project provides financial scholarships to talented, domestic Biomedical Engineering and Chemical Engineering (BECE) students with documented financial need at the University of Texas at San Antonio (UTSA), a Hispanic Serving Institution (HSI), to relieve some financial pressure and enable scholars to academically thrive and pursue successful careers as engineers. UTSA enrolls approximately 45% first-generation college students; 49% of undergraduates come from low-income communities. Because of ineffective structural support in students' educational pathways, an education debt[7] prevents us from properly identifying students' academic talents[8]. Current systems often identify academic talent with grades or test scores; these methods may highlight a lack of opportunity rather students' true achievement[9]. Additionally, traditional methods of instruction are still used in most engineering courses even in high poverty and low-income areas. Scholarships are coupled with evidence-based, culturally relevant and culturally responsive (CR^2) curricular and co-curricular activities informed by BECE specific needs. Using the theory of identity development and by implementing student-centered CR^2 curriculum in core BECE courses, all BECE students will benefit from curricular and pedagogical improvements. This paper presents considerations, challenges, and decisions made in the initial stages of recruitment, selection, and faculty CR^2 professional development.

Eligibility criteria. To recruit the first cohort for the S-STEM program, scholars were required to meet financial and academic eligibility criteria. Financially, students met UTSA's definition of a "low-income student" or a student with documented unmet financial need (UFN) per the records of the Office of Institutional Research (OIR). This meant that a student was (a) eligible to receive a Federal Pell Grant for the award year for which the determination was made; or (b) with a Free Application for Federal Student Aid (FAFSA) reported a combined family income at or below $50,500. UTSA defined the UFN as the difference between a student's FAFSA reported family contribution and UTSA's annual cost of attendance (CoA). The current UTSA CoA is $22,860 for in-state students living at home with their parents, $30,362 for students living on campus, and $30,564 for students living off campus. Academically, students were enrolled in Biomedical Engineering (BME) or Chemical Engineering (CME) at UTSA and completed their first semester at UTSA successfully with a grade point average (GPA) of 2.5 or higher. Because UTSA does not collect standardized data for students admitted directly from high school, we chose to admit students to the S-STEM program after their first semester at UTSA after they earned a semester's GPA. Finally, to be awarded an S-STEM scholarship, only U.S. citizens were eligible to apply, as defined in section 101(a) of the Immigration and Nationality Act (INA), refugees as defined in section 207 of INA, or permanent residents.

Definition of academic talent. A number of approaches for defining talent have been reported in the literature with the majority focused on GPA. Published studies used a 3.0 GPA for admissions criteria into competitive programs as a rationale for academic talent[10-13]. While using GPA as a metric for defining talent is a common practice, several studies suggested that other metrics should be included, particularly for low-income students. For example, a previous study found no correlation between GPA and student achievement[14]. Similarly, graduation rates for students with a first-semester GPA of 3.0 compared to a GPA of 2.5 differed by less than 10%[15]. In a study that investigated whether raising the GPA requirement for new hires improved the quality of the workforce, results indicated that GPA was not related to job performance and recommended that hiring managers should consider work sample problems, situational exercises and interviews, and personality type measures when making hiring decisions including [16].

Motivated by the above, we opted to be flexible in our definition of talent to consider as many students rather than excluding them because of the impact of financial need on academic outcomes. This flexibility in defining talent does not mean that we are lowering the standards but is rather meant to identify talented students with financial burdens or academic under-preparation resulting from systemic inequalities. Admitting a wider range of low-income, talented, underrepresented students to our program and equipping them with education and tools necessary for them to be successful in the market aligns well with US needs to remain a global economic leader. The 4.5 million, low-income, first generation students make up 24% of undergraduate populations[17]. For these students, the path to graduation is long and uncertain compared to other peers[17]. Despite such expected gaps, low-income, first-generation students were seven times more likely to earn bachelor's degrees if they started in four-year institutions, but only 25 percent of them did so[17]. As such, to facilitate the retention and graduation of these students, studies recommend providing financial aid in college. This is exactly what S-STEM is doing. With adequate resources, more talented, low-income, first-generation students could afford to enroll in four-year institutions or attend full-time, both of which would increase their chances of earning four-year degrees[17].

Identifying students' pool. To determine students who meet the S-STEM eligibility criteria, we reached to OIR. However, OIR informed us that they can't share info of eligible students without obtaining signed consents from students. Challenged by that, we discussed options with them and reached out to the option of listing our scholarship application on UTSA's scholarship hub[18]. UTSA students can submit a general application to the hub and they consent to release their financial info. UTSA matches students with new scholarships they meet the eligibility criteria to. With that said, we have listed our application on the hub early October 2024 and started collecting applications as will be described later. To increase the pool of applicants, we have shared a flyer of the program with all faculty who teach general freshmen STEM courses. Further, once we identified eligible students on the scholarship hub, students were sent text messages with the S-STEM program link to application to encourage them to apply. Flyers of the program were also posted on social media channels as well as on bulletin boards in STEM buildings.

Application. The S-STEM application consisted of four parts. The first part covered general information including name, gender, race, ethnicity, hometown and zip code, name of high school, status of first-generation, residential info, freshmen or transfer, how many hours per week do they work, and names and contact phone number and email addresses for two references who can attest to students' academic performance. The second part explored student's academics and asked the student to: (1) list STEM classes they have taken; (2) declare midterm grades obtained for STEM course taken at UTSA; and (3) list their UTSA major. The third part asked students about their skills and to tell us from a list of workshops provided to them, what skills are of interest for them to develop. The list included study habits, time management, prioritizing tasks, asking for help, dealing with stress, teamwork, forming study groups, being resourceful outside classroom, growth mindset, mentoring, performing research in a lab, performing an internship, and connecting coursework to career. The fourth part was essay questions that targeted the potential impact of the scholarship. These included asking the student how would a scholarship that covers their UFN would help them accomplish their personal and academic goals?; What personal and academic challenges would a scholarship help them to overcome?; Explain whether their GPA reflects their true academic potential; What factors contributed to their academic success this past semester?; and Tell us how their culture, background, and/or personal experiences have informed their selection to major in BME or CME?

Analysis of the pool of applicants. By end of Dec., we received a total of 63 applicants of which only 6 were eligible. Of the eligible candidates, the mean annual UFN was $23,822 which is much higher than the $15k allowed by the program. Eligible candidates were split equally between males and females and were 2 BMEs and 4 CMEs. The average GPA for the candidates was 3.31. The candidates identified as a pacific islander, 2 Asian American, 1 African American, and 2 Hispanics.

Selection of applicants and admission to the program. To select applicants from those eligible, every eligible student was invited to a 30-minute interview with the PI and the engineering education co-PI. While the 2.5 GPA minimum was a determining aspect of admission to the program, additional aspects included answers to written short essay questions asked in the application, quality of reference letters, experiential skills, and the outcomes of the interview with the leadership team. Interview questions were standardized amongst all applicants. These were: (1) Please tell us about yourself; (2) Why did you apply to the S-STEM scholarship program?; (3) What made you choose to major in Biomedical or Chemical Engineering?; (4) Tell me about your academic record in STEM courses, and whether you feel that your grades reflect your true capabilities; (5) What experiences, obstacles, and instruments shaped your academic career so far?; (6) What are your goals/plans after completing your bachelor's degree?; (7) What motivates you in personal and academic spheres?; (8) What habits or skills helped you to get to where you are now? Is there anything you would like to change, add, or learn to do better to improve your success?; (9) Tell us about a recent project or class that you found particularly engaging and why?; and (10) How would this scholarship help you reach your goals?

Students will be scored using a two-step approach. First, scholars will be quantitatively screened using three-point scale with a point each given to financial need (weighted by need), academic potential (weighted by GPA) and impact of scholarship (discretion of PIs). The second step will be a qualitative screening based on the interview outcome. Discussions amongst the PI team will then take place and students will be selected for admission. At the time of this paper, we are holding the interviews to admit our first cohort of students. Students selected for admission will be provided with an admission letter detailing the scholarship metrics and conditions to remain eligible for the scholarship. Students will be given two weeks to sign the admission letter and accept the offer. Up to date, 5 scholars were interviewed and admitted for the program.

Faculty CR^2 professional development. The faculty professional development initial activities include support for faculty interested in incorporating CR^2 in their teaching practice. One individual support meeting and one professional development workshop were designed to begin training faculty within the department about CR^2. The goals of these initial activities include that, after the initial training event, faculty will be able to: (1) define CR^2 pedagogy, and (2) identify CR^2 teaching practices, projects, or other curricular elements that can be incorporated into their courses. The initial activities did not include designing lesson activities, but support to design these activities was offered by the engineering education faculty. During the workshop, many CR^2

examples in engineering courses were provided that helped faculty understand how the teaching practices could be implemented in their courses and adapted to fit their students' needs. Faculty were also encouraged to create new routines and structures that could engage students in a variety of ways, not simply verbal or written, and ways to provide feedback to faculty that would affirm their experiences and validate the expertise and skills they bring to the course.

Faculty initial response to CR^2 professional development. During the workshop, a discussion arose about the tenets of culturally relevant pedagogy. A lot of attention was drawn to the first, "teachers believed that all the students were capable of academic success"[19] (p. 478). Faculty also gave examples of the ways in which students did not positively respond to, what they believed were, culturally relevant pedagogy and culturally responsive teaching. They also presented their beliefs about their roles as educators in engineering courses. The workshop leader was careful to address the concerns while centering on the practices and pedagogies of CR^2, bringing attention to how these beliefs affect teaching practices[20].

Initial faculty cohort. While the workshop attendance included seven (7) faculty, the initial faculty cohort involved in integrating CR^2 includes two educators who teach introductory BECE courses in the Spring 2025 semester. They understand how to create an environment conducive to engaging all learners using CR^2 practices and will incorporate CR^2 in their own creative ways.

Future teaching observations. In the Spring 2025 semester, teaching observations will be conducted to focus on the following research questions aimed at assessing CR^2 teaching and learning: (1) How does the teacher engage with the students? (2) How do the students respond to the teacher? (3) How does the teacher elicit participation from the students? From all students? (4) How do the students respond to other students in the classroom? Are they supportive, respectful and helpful towards each other? (5) Does the teacher spend an equitable amount of time with each group or person? (6) What are the identities of the students and how are they incorporated into the teaching methods, content, and/or assessments? Special attention will be given to the ways in which social and political controversies and challenges in engineering technologies and knowledge are presented. Another consideration will be the ways in which the faculty engages with students, Question 1, and observations will detail how beliefs are being communicated through the teaching engagement with students. The ways in which students respond to faculty, Question 2, will also have specific considerations for the ways in which students feel validated and comfortable to share their personal and professional experiences in the course.

Collaborating to develop CR^2 teaching and learning culture. This observation data will be collected and communicated with the faculty members for the introductory courses. They will have an opportunity to ask questions of the engineering education researcher(s) and will be able to think about ways to incorporate the recommendations into their course structures, content, or activities. Collaboratively, the engineering faculty and engineering education researcher will determine new goals and strategies to implement CR^2. Faculty will communicate when they would like to have a second observation in their course to determine whether their collaborative goals were met. Additionally, another faculty professional development workshop may be facilitated to include other interested faculty within the department in learning more about CR^2.

Connection to the student educational experience. The goal of incorporating CR^2 into engineering courses is to ultimately engage students in different ways and gain a deep interest in solving societal problems within BECE. This interest will be assessed using follow-up data collected from students' academic experiences, artifacts and products developed in their courses, and quantitative retention and grade point average data. These data can be compared to previous cohorts of students who have not intentionally received culturally responsive teaching and culturally relevant pedagogical education practices within their courses.

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