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Retention of student participants in an S-STEM funded program versus comparable students in engineering

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Retention of student participants in an S-STEM funded program versus comparable students in engineering

Abstract

In Fall 2018 our small liberal arts university with a new engineering program was awarded an NSF S-STEM grant. Now with three cohorts admitted to the program, we present the retention data of students that have participated in the program versus a comparable control data set from the School of Engineering. The students under study range from those currently in their second year of undergraduate engineering to those that have graduated in the past two years. Thus, the data include those students that have both graduated and those that continue to seek a baccalaureate degree. In the analysis, the two comparable data sets are broken into demographics for comparison where appropriate, including race, ethnicity, GPA, starting university math course, and gender. We investigate the degree to which elements of the S-STEM program (faculty and peer mentoring, career services, and professional development trainings) yield higher retention data for the S-STEM group. With the analysis, we explore whether any of these demographic factors moderate the relationship between program participation and retention.

Retention

In Fall 2018 our small liberal arts university with a new engineering program was awarded an NSF S-STEM grant[1]. In spring 2022, we funded our fourth cohort in the program. The NSF Scholarships in STEM program is aimed at giving scholarships to low-income academically talented STEM students. The focus of this S-STEM includes all students in engineering. Scholarships start in the spring and are annually renewed if students continue to meet eligibility criteria. We offer additional evidence-based practices to encourage student persistence including peer and faculty mentoring and professional development sessions[2-4]. Students are assigned a different faculty mentor each year and meet with them 2-4 times per semester. Peer mentoring was added in year 2 of the program, where students already in the program receive training to become peer mentors, and the incoming students are peer mentees. We also offer professional development sessions, where a consultant gives three sessions per semester on topics like motivation, focus, stress, and values.

This paper focuses on comparing retention rates of the first three cohorts of S-STEM students with the rest of the engineering student population. Information is provided based on race, gender, Pell grant eligibility, and tier status. Tier status in our School of Engineering (SoE) is determined by ACT/SAT scores. Tier 1 has Math ACT less than 22 and Math SAT less than 540. Tier 2 has ACT and SAT scores of 22-24 and 540-580, respectively. Tier 3 has ACT and SAT scores of greater than 24 and 580, respectively. The tier then determines the placement for the first math and engineering courses that students take.

We examined retention in the SoE from years 1 to years 2. We included student data from 2016-17, 2017-18, 2018-19, 2019-20, and 2020-2021 which had a total of 307 students. We examined retention of S-STEM students, which includes four cohorts of students. We award new S-STEM scholarships in the spring. The first cohort was awarded in Spring 2019 and the most recent in Spring 2022. A total of 55 scholars have received funding. A student who is retained in the S-

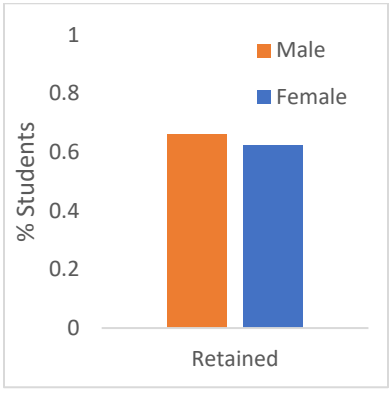
STEM program means they did not become ineligible for the program either because of a low GPA or because they left the university.

It is important to note that the S-STEM program requires students to be academically talented, so this limits the application pool. Students must have a cumulative GPA of 2.5 or higher to enter the S-STEM program. To stay eligible, they need a term GPA of 2.8. We do offer a recovery semester for students to raise their GPA if it is below 2.8. Of the 55 total students we have supported, only 3, or 5%, have left the program either by becoming academically ineligible or leaving the university.

Gender

The gender breakdown for the SoE students and for the S-STEM program can be seen in Figures 1a and 1b. Of the 53 females that entered the SoE, 38% of them were retained from 1st year to sophomore year. Of the 254 males that declared an engineering major, 66% of them were retained. The S-STEM program has supported 17 female and 41 male students so far. All 17 females and 92% of the males were retained.

a)



b)

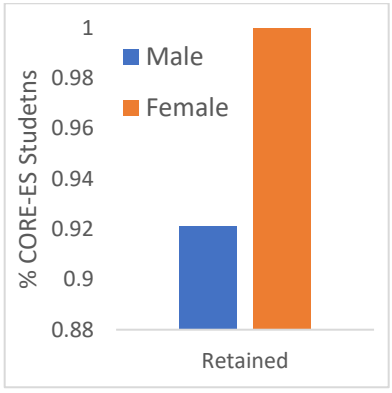


Figure 1: a) Percent of male and female students retained from years 1-2 in the SoE; b) Percent of male and female students retained in the S-STEM program.

Race

Figure 2 summarizes retention rates by race/ethnicity. For the entire SoE consisting of 307 students, the first to second year retention rates were: 71% or 140 White students, 80% or 12 for Hispanic students, 60% or 6 for Native American students, and 38% or 14 for Black students. The S-STEM program has not supported any Asian American or Hawaiian/Pacific Islander students. Their numbers are low in our SoE. They have been retained at rates of 100% or 7 Asian American and 78% or 3 Hawaiian / Pacifica Islander, respectively. The S-STEM program has retained 100% of White, 100% of Native American, 67% of Hispanic and 67% of Black students. Finally, of the students with unknown race 26 total, 86% have been retained.

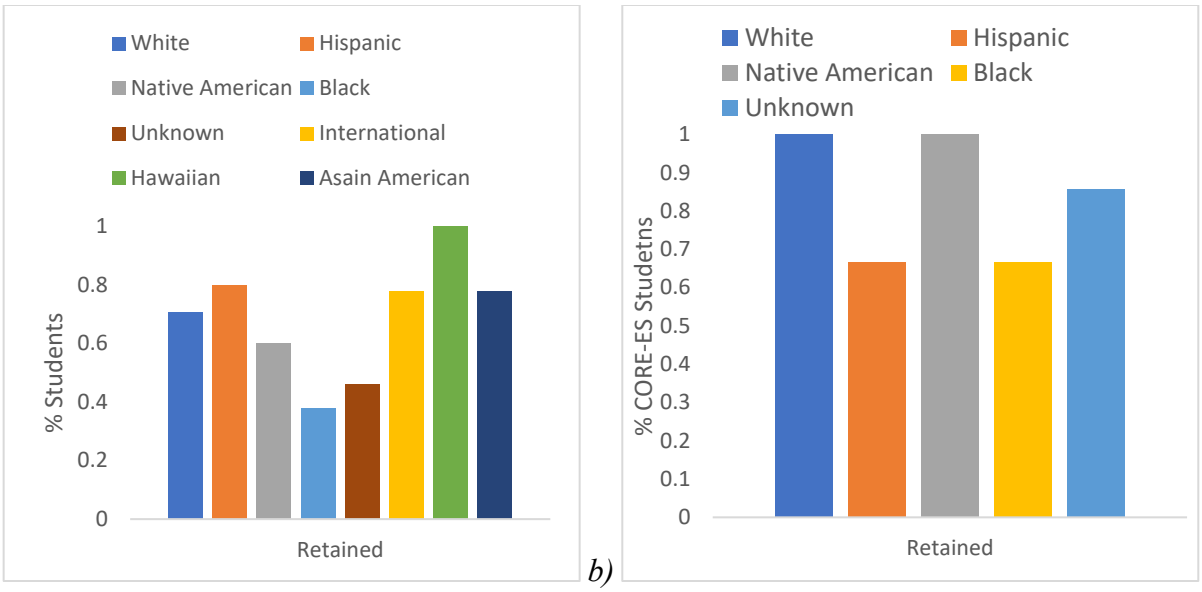


Figure 2: a) Percent of students by race retained from years 1-2 in the SoE; b) Percent of students by race retained in the S-STEM program.

Tier

Any student that is admitted to the University is allowed to study engineering. Placement in the first engineering course depends on their ACT/SAT score. Students in Tier 1 start in Introductory Mathematics and subsequently would take College Algebra and Introductory Engineering Applications. Students in Tier 2 start in College Algebra and Introductory Engineering Applications and would subsequently take Pre-calculus and Foundations of Engineering Design I. Students in Tier 3 start in Pre-calculus (or Calculus if they have AP credit) and Foundations of Engineering Design I. Students who transfer in with calculus are grouped with Tier 3. For all of the SoE students, 42% have been in Tiers 1 or 2, while 58% have been in Tier 3. The retention rates have been 48% for Tiers 1/2 and 73% for Tier 3. By comparison, the corresponding retention rates for S-STEM students have been 82% for Tiers 1/2 and 98% for Tier 3.

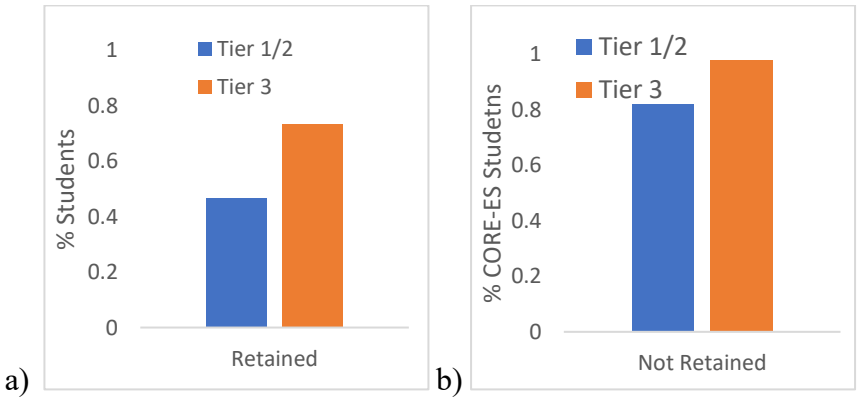


Figure 3: Percent of students by tier retained from years 1-2 (a) in the SoE and b) in the S-STEM program.

Pell Eligibility

Pell eligibility is based on Expected Family Contribution (EFC) as determined by FAFSA. As a reference point, the EFC cutoff for Pell eligibility in 2021-22 is $5846. In our S-STEM program, we define low income as having unmet need defined by FASFA. Most Pell eligible students qualify for our S-STEM program (some with significant other scholarships may not), and this is an analysis of how they have been retained in both SoE and S-STEM. In the SoE, 23% of our incoming students are Pell eligible, and 87% have been retained first to second year. In the S-STEM program, 48% are Pell eligible and 91% of them have been retained. In the SoE, it is somewhat surprising that we have retained more students that are Pell eligible than those that are not Pell eligible. This may be because Pell eligible students have experienced low-income families and are highly motivated to complete a degree in engineering. However, other research has indicated that students with lower socio-economic status tend to have lower academic outcomes than those of higher socio-economic status. More investigation of why Pell eligible students in our SoE are being retained at higher rates than non-Pell eligible students would need to be done to better understand this effect.

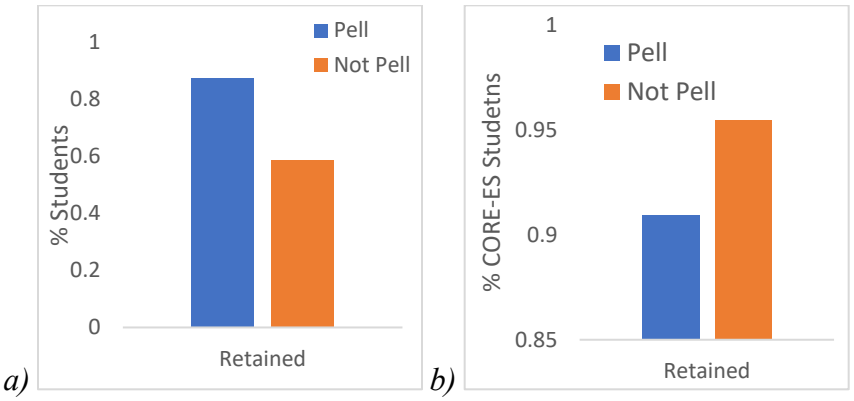


Figure 4: Percent of students by Pell eligibility retained from years 1-2 (a) in the SoE and (b) in the S-STEM program.

Taken together, the S-STEM program has retained more students in all categories than the SoE. However, it is important to note that the S-STEM is a subset of the SoE students who are both eligible and motivated to apply for the S-STEM. The academically talented requirement also eliminates students who may be considering leaving engineering because of low GPA and academic performance. Another factor in the 1st to 2nd year retention bump for S-STEM is that students are not eligible for the S-STEM scholarship until spring of their first year. Some of the students that would not be retained from years 1 to 2 have already left the SoE by their spring semester. While the large difference in retention rates between all engineering and S-STEM cannot be entirely attributed to the S-STEM program, the retention analysis suggests that the S-STEM program is likely having a positive effect. An interesting finding is that all students who were not retained in S-STEM are male and of those males more of them are Pell eligible than not Pell eligible.

Conclusions

This paper reports on data comparing retention on key demographics of gender, race, tier, and Pell eligibility in the School of Engineering and an S-STEM program. In all cases, the S-STEM program retained more students than the SoE as a whole. S-STEM students have to meet a GPA requirement to be eligible for the program. Because of this, the subset of SoE students that are eligible for S-STEM are academically talented and more likely to be retained. Nevertheless, the positive retention findings for S-STEM encourage us to seek ways to provide similar support (mentoring, etc.) to a larger number of students.

Acknowledgements

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References

1. "NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)," *NSF*. [Online]. Available: https://www.nsf.gov/pubs/2021/nsf21550/nsf21550.htm. [Accessed: 02-Feb-2022].
2. C. A. Melissa and B. F. Erin, "Strategies for enhancing diverse mentoring relationships in STEM fields." *International Journal of Evidence Based Coaching and Mentoring*, vol. 13, no. 1, pp. 58–69, 2015.
3. K. Kricorian, M. Seu, D. Lopez, E. Ureta, and O. Equils, "Factors influencing participation of underrepresented students in STEM fields: matched mentors and mindsets," *International Journal of STEM Education*, vol. 7, no. 16, pp. 1–9, 2020.
4. M. J. Graham, J. Frederick, A. Byars-Winston, A.-B. Hunter, and J. Handelsman, "Increasing persistence of college students in STEM," *Science*, vol. 341, no. 6153, pp. 1455–1456, Sep. 2013.