BOARD # 423: Preliminary Findings of an NSF-supported track-III S-STEM STAR Project

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Preliminary Findings of an NSF track-III S-STEM STAR Project

Abstract:
This NSF-supported Track III S-STEM scholarship project is a synergistic effort between the University's College of Engineering (CoE) and a neighboring 2-year Community College (CC). The project addresses an institutionally identified need of increasing recruitment of financially challenged, academically talented, 2-year CC transfer engineering students as well as retaining and graduating them. Major elements of this effort are: provide need-based financial assistance to academically talented engineering students; enhance transfer engineering students' math proficiency through a Summer Math Boot Camp (SMBC); enhance Students' Self-Efficacy, Growth Mindset, and Engineering Identity through metacognition- and cohort-based activities; and assess students' academic performance using data analytics. The key preliminary findings indicate S-STEM financial support is the top-rated element of the program followed by professional preparation, community building, and progressive growth of scholars in various aspects of engineering identity.

Introduction and Motivation

Undergraduate enrollment grew 2.5% in Spring 2024 after years of decline during and after COVID19 pandemic [1]. The bulk of this growth (55.7%) is happening in community colleges (CC), growing 4.7% since Spring 2023. In aggregate, the enrollment in CCs increased by 8.8% between Fall 2022 and Fall 2024 [2]. *The two main driving factors of CCs' growth appear to be the difficulty of admission to 4-year colleges, which are increasingly selective in their admissions, and cost.* In line with the former, our local university raised the high school GPA admission requirement from 2.5 to 2.75 in 2016, which led more students attending local CCs.

In anticipation of an increase in transfer students, the university and the CC launched a transfer pathway in Fall 2016. The pathway program enrolled 551 students in Fall 2016 through Spring 2017, rising to 1206 in Fall 2023 and Spring 2024 (an increase of more than 200%). Student demographics of the full-time first-time (FTFT) STEM population at the community college indicates 73% Hispanics, 60.4% females, and 67% Pell eligible, of which about 36% have HS GPA greater than 2.75 (minimum acceptance HS GPA for university) but chose not to enroll at the university, mainly due to lower tuition costs. *Thus, there is a significant talented population of STEM majors from underrepresented groups with financial need.* In brief, these statistics not only highlight an institutional and regional-sociodemographic problem, but also indicate an urgent need to address this problem. To this end, the present Track-III S-STEM program started in March 2020. In this brief manuscript, we highlight the impact of the S-STEM scholarship on financial support, professional preparation, community building, influence on major/career, engineering identity scale responses, increase in confidence, and career pathways. Other aspects of the program including Summer Math Boot Camp and peer tutoring will be reported separately.

Methods

A. Participants

The participants in this study are a cohort of community college students who intend to transfer to the college of engineering (CoE). These scholars were enrolled between Fall 2020 and Fall 2024. As of Fall 2024, 57 students were in the program, 41 transferred to four-year engineering college with 16 still at the community college. 11 have graduated from the engineering college and 7 dropped out within 1-2 semesters of joining the program. The cohort is 78% male, 22% female, 68% Hispanic and 32% non-Hispanic. Engineering major distribution after transferring to CoE is as follows: 29% Mech/Aerospace,

25% Electrical and Computer, 12.5% each Civil Engineering and Engineering Technology, 8.3% Chemical, and 4% remaining majors like Industrial Engineering and Engineering Physics.

B. Interventions and Activities

The S-STEM Scholarship provides up to $10,000 annually based on unmet-needs determined through FAFSA. The cognitive and noncognitive activities of the program support students' academic preparation through Summer Math Boot Camp (SMBC), Self-Efficacy and Growth Mindset through metacognition-based workshops, Engineering Identity through cohort-based activities in Engineering Learning Communities (ELCs), time management skills, one-on-one relationships with near-peer and faculty mentors, and a cohort model. The program conducts yearly SMBC and monthly meetings comprising presentations, workshops, and cohort-building activities. In the following pages, some of the preliminary findings pertaining to the impact of the program in terms of financial support, professional preparation, community building, influence on majors and careers, and engineering identity are reported below. The findings pertaining to SMBC, metacognition, and peer mentoring are under preparation and will be reported later.

C. Instruments and Data Collection

The instruments used to collect the data consist of surveys and interviews, administered through an external evaluator working with this program. In the spring of 2024 (at the end of Year 4), 33 students in the S-STEM STAR program responded to a survey about their experiences in the S-STEM program. The survey items were designed to understand the impact of S-STEM scholarship on three broader categories, namely, Financial Support, Professional Preparation, and Community. In each sub-category the number of survey items were 4, 9, and 3, respectively. Additional survey items and interviews were administered to understand "additional" or "other ways" the S-STEM program has had influence on students' thoughts about their majors and career plans. Similarly, with respect to Engineering Identity, a 13-item survey called the Engineering Identity Scale (EIS) taken from Godwin, 2016 [3] was administered to 26 students in the Fall of 2022.

Preliminary Findings and Discussion

Depicted below in Table 1 are percentages of students (N = 33) who either "agree" or "strongly agree" with various survey statements. As is evident from these responses, the S-STEM scholarship is instrumental to help students reduce their job hours, and presumably enabling them to spend more time on their studies. Similarly, S-STEM scholarship has helped them in their professional preparation and development and in community building.

Another survey indicates how the S-STEM program has benefitted them in other ways. Figure 1 below provides the number of students who indicated that they received various types of support or benefits from the program. In addition, Figure 2 illustrates the influence S-STEM program has had on students' thoughts about their major or career plans.

Engineering Identity: In the fall of 2022, 26 students in the S-STEM STAR program responded to the EIS survey (consisting of 13 prompts [3]), grouped in three broader categories focusing on recognition as an engineer, interest in the field, and performance/competence. As shown in Figure 3, on aggregate, the responses represented by "Agree" or "Strongly Agree" stand at 71%, 90%, and 69%, respectively for Recognition as an Engineer, Interest in the Engineering Field, and Performance/Competence in Engineering.

Table 1. Impact of S-STEM Scholarship

Because of the S-STEM Scholarship…	**Percentage Agreement**
Financial Support	
I was able to reduce my hours at a job.	*88%*
I am contributing more money to my family's basic needs (rent, bills, food).	*85%*
I can "get ahead" financially.	*85%*
I am able to pay off student loans.	*73%*
Professional Preparation	
I am more confident in my major.	*100%*
I am more likely to continue in engineering.	*100%*
I have more opportunities to learn engineering.	*97%*
I have greater knowledge of career and education options.	*97%*
I have more professional opportunities.	*94%*
I feel more prepared for advanced coursework in engineering.	*94%*
I feel more prepared for a career in engineering.	*94%*
I feel more prepared for graduate school.	*91%*
I will graduate earlier than expected.	*69%*
Community	
I am more likely to work with other students on my coursework.	*97%*
I have more contact/communication with faculty.	*94%*
I am on campus more often.	*91%*

Similarly, depicted in Figure 4 below are percentage changes in EIS surveys over time. These were conducted at two different times, during Spring 2021 and Spring 2024. Eleven (85%) out of a total of 13 survey prompts in EIS have seen growth (in terms of Agree and Strongly Agree) between Spring 2021 and Spring 2024 surveys.

Conclusions and Future Work

The initial focus of the results reported here is to highlight the impact of the S-STEM scholarship on financial support offered through the program, professional preparation, community building, and influence on major/career. We also explored some other benefits of the program such as “Learned New Knowledge” and “Increased Confidence.” Further, there is a significantly high percentage of scholars in the program who identify themselves as an engineer, show interest in the engineering field, and considers themselves competent in engineering fields. In brief, the S-STEM program is positively impacting the scholars in terms of their professional development and preparation, community building, increase in confidence, career pathways, and transforming their engineering identities.

This work is not complete yet. We have additional data to be analyzed and reported on the metacognition and growth mindset, SMBC and its impact on students’ persistence, Peer tutoring, etc. After completing those analyses, we will report our findings to make further contributions to the field in this area.

Acknowledgements

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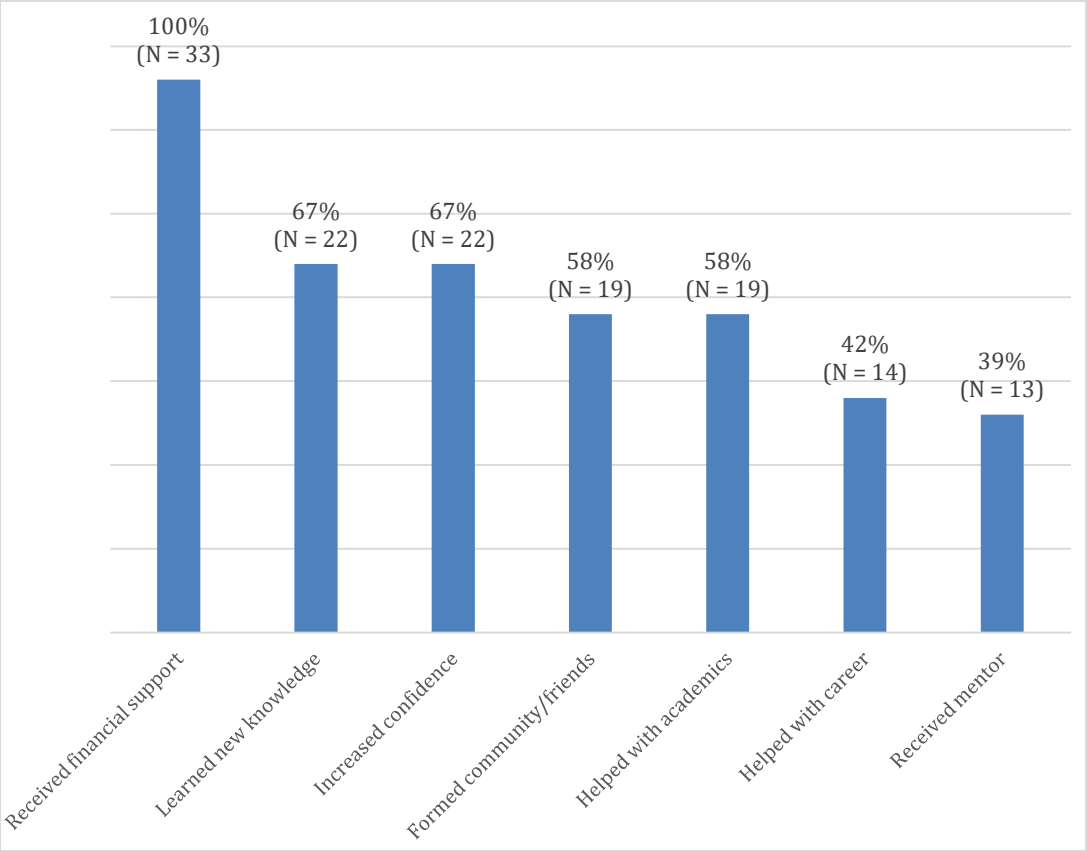

Figure 1. Benefits of S-STEM Program (N = 33)

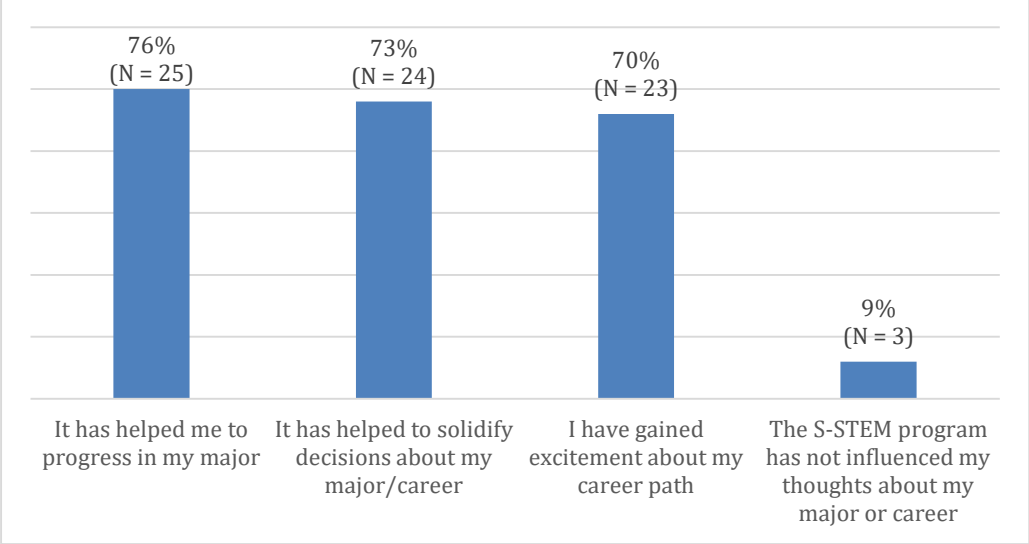

Figure 2. Influence on Major/Career (N = 33)

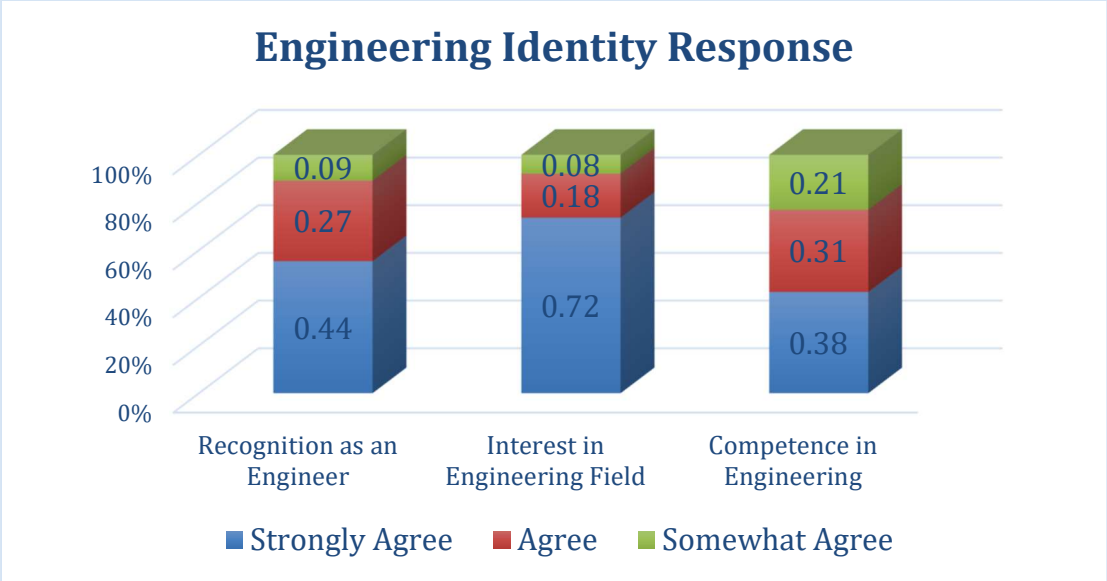

Figure 3. Engineering Identity Scale (EIS) grouped in three broader categories

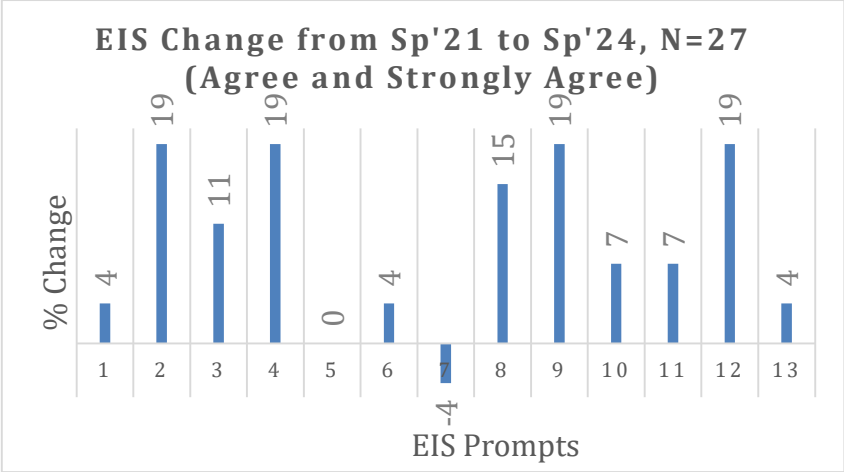

Figure 4: Engineering Identity Scale (EIS) growth over time from Spring 2021 to Spring 2024. EIS prompts are same as shown in Figures 3-5.

References

1. Current Term Enrollment Estimates: Spring 2024, National Student Clearinghouse Research Center, https://nscresearchcenter.org/current-term-enrollment-estimates/
2. Stay Informed with the latest enrollment information, October, 2024, National Student Clearinghouse Research Center, https://nscresearchcenter.org/stay-informed/#:~:text=Declines%20in%20freshman%20enrollment%20are,private%20nonprofit%204%2Dyear%20institutions.
3. Godwin, A., "The Development of a Measure of Engineering Identity," ASEE's 123rd Annual Conference and Exposition, New Orleans, LA, June 26-29, 2016