BOARD # 449: S-STEM Project Overview: Supporting Low-Income Engineering and Computing Students with Scholarships for Higher Degree Attainment

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Abstract

This S-STEM project at Miami University addresses the national need for a well-educated engineering and computing workforce by supporting the retention and graduation of low-income students with demonstrated financial need and strong academic potential. The project focuses on creating pathways that allow students to progress from an associate's and bachelor's degree (at the regional campus) in technology to a bachelor's and possibly even a master's degree in engineering and computing at the main campus. This has been achieved by creating curricular pathways and providing infrastructure and support to encourage higher degree attainment by participating students while reducing graduation time. Over six years, this project aims to provide scholarships to 132 full-time students pursuing Associate, Bachelor's, and Master's degrees in Engineering, Computer Science, and related fields. So far, through this project, three cohorts of students have been recruited through a holistic review process, with recruitment strategies involving high school visits, outreach events, and collaborations with community colleges. As of Fall 2024, 45 students have been funded, with $256,125 in scholarships awarded. The diverse body of S-STEM scholars includes ~27% female, 11% African American/Black, 11% Asian, and ~7% Hispanic students. So far, ten students have graduated with a bachelor's degree who started with an associate's degree, and one student who started with an associate degree has completed a master's program. This supporting paper associated with the poster highlights the various aspects of this project, including recruitment strategies, curricular pathway development, cohort building, etc. We anticipate that this project will generate data on recruiting and retaining low-income, academically talented students, with findings related to fostering community and identity among scholarship recipients through mentoring and peer support, promoting excellent retention and workforce development.

Background and Rational of the Project

The need for higher degree attainment, from Associate to bachelor's and master's degrees in engineering and computer science, is rooted in several key factors:

- **Growing Demand for STEM Graduates**: The Bureau of Labor Statistics projects faster growth in STEM occupations (10.4%) compared to all other fields (3.6%) between 2023 and 2033 [1]. STEM jobs offer median annual wages ($87,750), almost double that of non-STEM jobs ($45,700), with over 93% of STEM roles paying above the national average [2]. Advanced degrees also yield substantial salary premiums, with Master's degree holders earning 18-33% more than Bachelor's degree holders in STEM fields [3].
- **National and Regional Needs**: Computer science and mechanical engineering are highlighted as in-demand majors due to their alignment with national trends and regional economic demands. For example, Ohio's manufacturing industry contributes 17% to the state's gross product and employs 700,000 workers. Growth in software development, cybersecurity, and industrial engineering aligns with the need for a skilled workforce nationally and locally [4-5].

- **Challenges and Barriers**: Many students face financial barriers, family responsibilities, and academic hurdles, with over one-third of college students receiving Pell Grants. These barriers are compounded for low-income and non-traditional students, who are more likely to attend regional campuses or community colleges with limited resources [6].
- **Potential for Curricular Pathways**: At Miami University, we are developing clear pathways from Associate to bachelor's and master's degrees, including two-year associate programs (e.g., AAS-CIT, AAS-MET), four-year Bachelor's programs (e.g., BS-CSE, BS-MME), and graduate programs (e.g., MS-CS, MS-ME). Such structured pathways facilitate upward degree mobility and meet workforce demands [7].
- **Supportive Interventions**: Scholarships are central to addressing financial barriers, but the program also emphasizes mentoring, advising, and community support to help students navigate academic and administrative challenges. These interventions are designed to increase enrollment, retention, and graduation rates, particularly for underrepresented groups, including women and racial or ethnic minorities [8].

Scholarships are crucial in enhancing higher education attainment and supporting upward mobility in STEM fields, helping increase enrollment, retention, and graduation rates among academically talented, low-income students. Miami University provides an ideal academic setting for the development of this project because the University has a main and two regional campuses with academic degrees ranging from a two-year degree, Associate in Applied Science (AAS), four-year degrees, Bachelors in Applied Science (BAS) in engineering and information technology programs, and Bachelor of Science (BS) to a graduate degree, Master of Science (MS) in Mechanical Engineering (ME) and Computer Science (CS). Furthermore, many students enrolled in regional campuses are non-traditional and face more socio-economic challenges. This S-STEM project is targeted at students from both campuses and will open multiple curricular pathways for completing the STEM programs of their interest.

Program Overview

The project aims to recruit, retain, and graduate low-income, academically talented students pursuing various engineering and computer science degrees by providing scholarships, overcoming curricular barriers, and fostering community among S-STEM scholars. The targeted outcomes of this project are:

- Providing a total of 128 scholarships to academically talented low-income students with demonstrable financial need pursuing Associate, baccalaureate, or graduate degrees in the STEM disciplines of Computer Science (CS), Software Engineering (SE), Computer Information Technology (IT), Mechanical Engineering Technology (MET), and, Mechanical and Manufacturing Engineering (MME).
- Facilitating students' movement (relocation) across programs, from an associate to a baccalaureate degree program or from an undergraduate to a graduate program, by providing multiple curricular pathways and developing new bridge courses.
- Ensuring successful completion of S-STEM scholar's academic degrees by developing a holistic S-STEM scholar recruitment plan with academic support, faculty mentoring, learning communities, and various enrichment programs towards successful completion.

Offering Multiple Curricular Pathways for Higher Degree Attainment: The singularly distinctive feature of this project is the development of a multi-tier curriculum plan, which extends from recruitment to new pathways for selected scholars from Associate Degree level to a Master's degree. The barriers to pursuing higher degrees have been analyzed at various levels, and the measures proposed to overcome them range from the individual to the institutional level. Figure 1 illustrates the academic tracks made available to students, enabling them to advance from high school to graduate-level programs without academic program impediments.

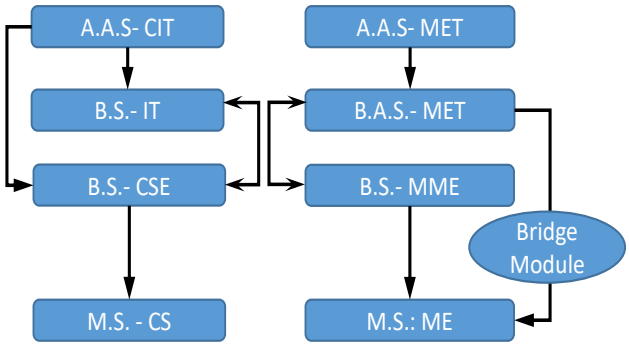

Figure 1: Potential available pathways for S-STEM Scholars towards upward curricular mobility

Bridging Curricular Pathways: The computer science program offers track course sequences to help students transition from an Associate (two-year program) to a Bachelor's (four-year program) degree, ensuring they acquire the necessary prerequisites for Master's level success. For the Mechanical Engineering track, the requirements of calculus and calculus-based science are being addressed through state-level transfer pathways [9]; however, for several engineering technology courses (both associate's and bachelor's level, there existed a mismatch of student learning outcomes in some foundational courses, which was prohibitive for students in Engineering technology track to pursue BS and/or MS in Mechanical Engineering. This mismatch has been addressed by creating online bridge modules. These modules, worth one credit each, cover topics like heat transfer and system dynamics, enabling students to meet pre-requisite requirements without retaking entire courses. This approach prepares students effectively for advanced studies, enhancing their readiness for Master's programs.

Program Components: Miami University's S-STEM program, aimed at enhancing STEM education through scholarships, unfolds through several structured components:

- Recruitment Process: Recruitment targets students from regional campuses, local community colleges, and high schools, including career and technical programs. The program maintains a detailed website [10] outlining the scholarship and curricular pathways.
- Application Process: Applications are collected online, requiring demographic information and responses to open-ended questions about challenges to academic success and career aspirations. The process includes information sessions, application reviews based on multiple criteria, and notification of award offers. A standard STEM release form is required for scholarship acceptance and disbursement setup.
- Cohort Selection for Scholarship: Applications are evaluated by a group of faculty using a scoring rubric covering academic achievement, financial need, recommendation letters, essay quality, and career goal alignment.
- Cohort Development, Advising, and Mentoring: A Canvas site supports community building among scholars through announcements, forums, and resource sharing. Scholars are assigned mentors from faculty in technology and engineering programs for ongoing support

throughout their participation. Mentors use tools like EAB's Student Success Collaborative for academic tracking and can intervene academically or connect students to career services.

- Cohort Activities: These include speaker events, networking sessions, job and internship fairs, and research projects. Special pre-internship programs and opportunities for rapid certification in the semiconductor industry are also offered [11].

Progress Summary

As of Fall 2024, three cohorts of S-STEM scholars have been selected and participated in this program, summarized in Table 1. The total number of S-STEM scholars differs from the original recruited cohort numbers as students receive scholarships when they continue to pursue their respective degrees and/or move to higher degrees. For example, of the Cohort 1 students, three graduated, and six transitioned from associate-level programs to Bachelor (five students) and Bachelor to master (one student) [12]. Similarly, eight students from cohort 2 have graduated by Spring 2024 (6 from the Bachelor's program and two from the Master's program), and two have transferred from the University. We have recruited students on a continuous basis in both the Fall and Spring semesters and work with students regarding their plans for higher degree attainment. The scholarship award amounts ranged from $2500 (for Associate and Bachelor standing students) to $4500 (for master level students) per student per semester.

Table 1: Snapshot of S-STEM scholars in the program

	# of Applicant Pool reviewed	# of selected new S-STEM scholars	# Total number of S-STEM scholars	Scholarship awarded (in $)
Cohort 1 (F22-Sp23)	65	12	12	111,900
Cohort 2 (F23-Sp24)	70	16	25	95,575
Cohort 3 (F24)	113	17	29	49,650
Total (till Fall 2024)	**248**	**45**	**66**	**256,125**

Table 2 summarizes the demographic profiles of Cohort 1, 2, and 3 S-STEM Scholar groups, highlighting the demographics and the number of students selecting higher degree attainment through this scholarship support.

Table 2: S-STEM Cohort Demography

		Cohort 1 (# students)	Cohort 2 (# students)	Cohort 3 (# students)	Total Cohort (# students)	Total Cohort (% students)
Gender	Male	8	11	14	33	73.3%
	Female	4	5	3	12	26.7%
Race/ Ethnicity	White/non-Hispanic	8	11	10	29	64.4%
	White/Hispanic	0	2	1	3	6.7%
	Black/non-Hispanic	1	1	3	5	11.1%
	Black/Hispanic	1	1	0	2	4.4%
	Asian/non-Hispanic	2	1	2	5	11.1%
	Not reported/Other	0	0	1	1	2.2%
First-Generation Status	First-generation student	5	7	12	24	53.3%
	Not First-generation student	4	4	3	11	24.4%
	Both parents attended college	2	5	2	9	20.0%
	Not reported	1	0	0	1	2.2%
Starting Program	Entering – Associate Degree	6	3	0	9	20.0%
	Entering – Bachelors Degrees	6	4	8	18	40.0%
	Choosing Associates to Bachelors	0	8	5	13	28.9%
	Choosing Bachelors to Masters	0	1	4	5	11.1%

Plans

Moving forward, the focus is on expanding student recruitment and program offerings in disciplines like cybersecurity, manufacturing engineering, and electromechanical engineering technology to enhance opportunities for higher degree attainment. Future initiatives will increase S-STEM scholar interaction, improve academic interventions, and provide active advising and management of summer research. Support will also extend to part-time students and those whose scholarship eligibility may change due to financial needs. The project features a comprehensive assessment and evaluation plan to track scholar outcomes, including degree attainment and transitions within STEM education. This includes analyzing demographic, enrollment, and performance data, conducting surveys, and exit interviews. We are analyzing the data as of Fall 2024 and plan to disseminate our findings to the community.

Acknowledgments

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