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NSF S-STEM Project Update: Supporting Low-Income Engineering and Computing Students with Scholarships for Higher Degree Attainment

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Abstract

This NSF S-STEM project was awarded in Fall 2021, and its aim is to address the national need for a well-educated engineering and computing workforce. This will be achieved 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 and bachelor's degrees (at a regional campus) in technology to a bachelor's, and possibly even a master's, degree in engineering and computing at the main campus. 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. Beyond the financial support, a standout development in the project has been the creation of efficiently packaged learning, or bridge, modules available using Miami University's Canvas learning management system (LMS). The objective is to avoid having students repeat courses, thereby reducing the time to graduation. The self-paced online content is designed to address gaps in learning outcomes across programs, which can create significant academic and financial setbacks for students aspiring to advance from a two-year program to higher degrees. Bridge modules of 0.5 to 1.0 credit hours can be paired with previously completed courses to enable students to efficiently meet pre-requisite requirements of the higher degree. To date, four 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 2025, 52 students have been funded, with more than $381,015 in scholarships awarded. The diverse body of S-STEM scholars includes 27% female 28% non-white students. Currently, 21 students are being provided scholarships through the program. This paper/poster will highlight progress and specifically detail the prerequisite bridge modules developed for students in mechanical engineering technology programs pursuing bachelor's and master's degrees in Mechanical and Smart Manufacturing Engineering.

Project Background and Overview

This project addresses the surging demand for STEM graduates, who earn nearly double the median wage of non-STEM roles. Advanced degrees further increase earnings by 18-33%. The manufacturing industry employs 700,000 workers in Ohio, highlighting the need for skilled engineers [1]. Despite this, low-income and non-traditional students face significant financial and academic barriers. To overcome these hurdles, we are leveraging our regional and main campuses to create structured pathways from Associate to Master's degrees. By providing scholarships, mentoring, and bridge modules, the S-STEM project fosters upward mobility and academic success for talented students across diverse backgrounds.

This S-STEM project supports low-income, academically talented students in engineering and computer science through several strategic goals:

- Financial Support: Providing 128 scholarships for Associate, Bachelor's, and Graduate degrees in fields like CS, IT, and Mechanical Engineering.

- Curricular Mobility: Creating multi-tier pathways and 0.5-1.0 credit online bridge modules (e.g., Heat Transfer) to resolve learning outcome mismatches and facilitate transitions from technology tracks to BS or MS engineering programs.
- Student Support: Implementing a holistic plan including faculty mentoring, academic tracking via Miami University's academic advising platform (Navigate), and a dedicated Canvas site for community building.
- Enrichment: Engaging scholars in networking, research projects, and specialized semiconductor industry certifications [2].

As of the start of Fall 2025, the S-STEM program has reviewed 289 applicants and selected 52 unique scholars across three cohorts. A total of $381,015 in scholarships has been awarded, with individual awards ranging from $2,500 (undergraduates) to $4,500 (graduate) students/semester.

The S-STEM program successfully facilitates upward mobility, and scholars in this program have been awarded 46 degrees, with many students receiving more than one degree. Five students were awarded Master's degrees in Mechanical Engineering and Computer Science. Twenty-four students were awarded Bachelor's degrees, and seventeen students were awarded Associate's degrees. Many Associate graduates continued on to the Bachelor's programs and earned their 4-year degrees in engineering or computer science.

The poster associated with this project summary update details the S-STEM scholarship cohorts, structure, and the impact of specialized bridge modules.

Bridge Pre-Requisite Modules

To resolve learning outcome mismatches between technology and engineering tracks [3-4], we are implementing online bridge modules in key topics: System Dynamics, Instrumentation and Controls, and PLC programming based on the student curricular path (Associate to Bachelor's and Bachelor's in Technology to Master's). These modules enable students to satisfy prerequisites for BS or MS programs in Mechanical Engineering without retaking full courses. The poster presents data on how these interventions enhance readiness for advanced studies while fostering community and professional identity through dedicated mentoring and peer support. Some highlights of these modules are summarized below.

Module Title: Foundational Electronics and Signal Analysis for Instrumentation

- Purpose: Covers the knowledge to bridge Measurement and Instrumentation Topics, which can be a prerequisite for higher-level Mechanical and Smart Manufacturing Engineering courses (both majors are offered in the college).
- Topics: Operational Amplifiers (Op-Amps), Analog Filters, Signal Composition and Mixed Frequencies, and Time-Frequency Domain Conversion.
- Content: Lecture notes, book chapters, and videos.
- Assessment: Multiple choice quizzes for each topic, Data analysis project.

Module Title: Computational Modeling and Simulation of Dynamical Systems and Control

- Purpose: Bridges prerequisite knowledge in computational modeling, numerical simulation, and systems analysis needed for upper-level Mechanical Engineering courses in dynamics, vibrations, controls, and system modeling.

- Topics: MATLAB fundamentals, numerical solution of ordinary differential equations, time-domain response, frequency-domain analysis using FFT, and state-space modeling.
- Content: Instructional videos, Canvas learning pages, MATLAB Live Scripts, example code files, and selected MATLAB documentation and tutorials.
- Assessment: Topic-based multiple-choice and numeric quizzes, MATLAB programming assignments, and an integrated module quiz assessing computational modeling and system analysis skills.

Module Title: Introduction to PLC Programming

- Purpose: Provides foundational knowledge in programmable logic controller (PLC) programming to prepare students for advanced coursework in automation, smart manufacturing, and industrial control systems.
- Topics: PLC hardware and processor configuration, digital and analog I/O concepts, Ladder Logic, Structured Text (ST), Sequential Function Charts (SFC), Function Block/Ladder Diagram (FB/LD) programming, and PLC wiring fundamentals.
- Content: Online instructional videos, lecture notes, software demonstrations using GX Works 3, guided programming exercises, and hands-on ladder logic examples.
- Assessment: Topic-based multiple-choice quizzes, PLC configuration and programming exercises, and a programming assignment focused on ladder logic and PLC application.

Future plans

Moving forward, the focus is expected to be on expanding student recruitment and increasing program offerings in disciplines such as cybersecurity, manufacturing engineering, and electromechanical engineering technology. Future initiatives will increase S-STEM scholar interaction, improve academic interventions, and provide active advising and summer research management. The program will continue to support part-time students and will reconsider the eligibility of those whose scholarship 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 conducting exit interviews. We are analyzing the data as of Fall 2025 and plan to disseminate our findings to the community in the future.

Acknowledgments

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