

Four Years of Progress: Strengthening the Engineering Graduate Pipeline through the S-STEM Program at the University of Massachusetts Lowell, Award Number 2130403

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Abstract

The UMass Lowell S-STEM program (NSF Award #2130403) supports high-achieving, low-income engineering students who are interested in graduate schools. The program offers scholarships, professional development, and mentoring for students from the last two years of their bachelor's degrees to the completion of a masters degree or qualifying exam as part of a doctoral program. This paper presents a four-year evaluation update across three cohorts using surveys and meeting evaluations. Results show increased student preparedness for graduate school, improved knowledge of application processes and academic pathways, and greater confidence in pursuing advanced degrees. Students indicated increases in understanding graduate school funding, application steps, and faculty career pathways, along with increased intention to pursue doctoral studies. Qualitative findings emphasize the value of structured mentoring and reflective activities in supporting identity development and goal setting. Program refinements included relational recruitment efforts and expanded professional development workshops.

Introduction

Access to graduate education remains a persistent challenge in engineering, despite substantial growth in undergraduate enrollment (Board, n.d.). A lack of representation among engineering faculty limits access to in-group role models, constrains mentoring pathways, and negatively impacts student persistence and sense of belonging (Aish, Asare, & Miskioğlu, 2017). Addressing this challenge requires intentional, longitudinal interventions that reduce financial barriers while simultaneously supporting students' academic, professional, and identity development.

The University of Massachusetts Lowell (UMass Lowell) Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) program was established in response to this national and regional need and is supported by the National Science Foundation (NSF Award #2130403). The program was designed to recruit three cohorts of low-income, high-achieving engineering students and support them from their junior year of undergraduate study through early graduate education. The long-term objective is to strengthen the pipeline of candidates from low-income populations to pursue graduate education in engineering.

This paper provides a four-year longitudinal update on the UMass Lowell program, drawing on external evaluation data, participant surveys, and focus groups. We examine how the program's integrated mentoring and professional development model has evolved and the extent to which it has enhanced students' preparedness for graduate school, knowledge of higher education pathways, and confidence in pursuing advanced degrees.

Program Overview

The UMass Lowell S-STEM program is a four year program that was designed to target two key transition points in the academic pipeline, the undergraduate-to-graduate transition and the early stages of graduate education, where access to mentoring, information, and financial stability are particularly critical and leads to the loss of many low income students (Nuis, Segers, & Beausaert, 2023).

The program recruited three cohorts of eight engineering students (24 total scholars) who meet documented financial need, have high academic performance, and have demonstrated interest in pursuing graduate schools. S-STEM scholars are supported from their junior year of undergraduate study through either the completion of a master's degree or the completion of a qualifying exam during

progression toward doctoral candidacy. S-STEM scholars major in many disciplines in engineering including biomedical, chemical, civil, electrical and computer, mechanical, and plastics engineering. Each scholar receives need-based financial support along with structured programming focused on graduate school readiness, professional identity formation, pedagogy, and socially conscious engagement with engineering practice. Over the course of the program, scholars engage in monthly cohort meetings, mentorship with internal and external faculty, and professional development workshops addressing graduate school applications, research experiences, fellowship opportunities, and professional communication. In addition, scholars participate in reflective activities including Individual Development Plans, River of Life exercises, and intercultural development programming.

Evaluation Methods

The S-STEM program is evaluated by an external evaluation conducted by the UMass Lowell Center for Program Evaluation (CPE). Evaluation activities included Pre- and post-program surveys assessing preparedness for graduate school, interest in program components, higher education intentions, and knowledge of higher education pathways, and Post-meeting evaluation forms assessing perceived usefulness and relevance of program activities. Quantitative data were analyzed using descriptive statistics and frequency distributions, while qualitative data were analyzed using content and thematic analysis with Nvivo. This study was reviewed by the UMass Lowell Institutional Review Board and was determined to be exempt from IRB oversight.

Key Findings

Pre- and Post- program evaluation surveys indicate that the UMass Lowell S-STEM program has made consistent progress toward its stated objectives of improving graduate school readiness and expanding access to academic career pathways for low-income engineering students. Pre-program surveys conducted at the beginning of the program indicated that many scholars report only moderate levels of preparedness for graduate school (Table 1), especially on topics of financial planning, application processes, and understanding career trajectories. Post-program survey results across cohorts demonstrate differences in overall preparedness, showing increased confidence in managing academic expectations, navigating application timelines, and communicating professionally. Scholars' knowledge of higher education pathways also increased over time (Table 2), indicating improved understanding of the structure and funding of graduate programs, distinctions between master's and doctoral study, and the realities of graduate education.

Table 1: Pre- and Post- Program Survey Data for Three Cohorts

	<i>PRE- MEAN</i>	<i>POST- MEAN</i>
Graduate preparedness	3.38	3.54
Knowledge of grad pathways	3.10	3.95
Intention to apply	3.67	4.14

Note. Means are based on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Pre-survey n = 19; Post-survey n = 7–8 depending on item response.

Table 2. Change in Scholars' Knowledge of Graduate Education Pathways (Pre–Post Survey Results)

	PRE-SURVEY MEAN	POST-SURVEY MEAN
Knowledge of faculty positions in higher education	3.11	4.29

Knowledge of how to fill out a graduate school application	2.42	4.29
Knowledge of steps involved in applying to graduate school	2.58	4.29
Knowledge of how to become a competitive graduate school candidate	2.89	3.86
Awareness of financial resources for graduate school	3.17	3.86
Awareness of academic support resources	4.00	4.00
Awareness of socioemotional support resources	3.58	3.86
Overall knowledge composite mean	3.10	3.95

Note. Means are based on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Pre-survey n = 19; Post-survey n = 7–8 depending on item response.

Students' intentions to pursue graduate education also increased from pre- to post-survey across multiple cohorts (Table 3). Students indicated interest to pursue master's and doctoral programs, with a larger difference in intent to pursue PhD programs and faculty positions. Qualitative responses indicated that students thought the program helped them clarify goals and make informed choices. One student said "Now I have a better understanding on how to start the grad school search. I will be applying soon and starting with researching faculty." Another student mentioned "I think I will apply for a master's degree because I want to be a more qualified applicant and more specialized in my field."

Table 3. Change in Scholars' Intentions to Pursue Graduate Education (Pre–Post Survey Results)

	PRE-SURVEY MEAN	POST-SURVEY MEAN
Intend to apply to a master's degree program	4.53	4.71
Intend to apply to a doctoral (ph.d./ed.d.) Program	3.14	4.17
Intend to apply for a faculty position	3.43	4.14
Most important people think i should apply to graduate school	3.56	3.57
Overall intentions composite mean	3.67	4.14

Note. Means are based on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Pre-survey n = 19; Post-survey n = 7.

Students participated in monthly cohort meetings and these meetings were consistently rated as helpful and a valuable use of time (Supplemental Table 1). Identity-focused activities, such as the River of Life and intercultural development programming, were described as meaningful experiences that helped students reflect on their academic journeys, recognize challenges they've seen, and share their experiences on overcoming barriers.

Program Refinements and Lessons Learned

Through the four years of program implementation, there were many lessons learned and programmatic changes. First, the program recruitment activities has changed significantly from year to year. Early recruitment efforts relied heavily on mass communication with e-mails and flyers. However, evaluation

data and student feedback indicated that these approaches did not engage the students who had limited prior exposure to graduate education. In response, the program shifted toward more relational recruitment strategies, including faculty-mediated outreach with coffee hours, targeted workshops on near-term opportunities such as REU applications, and training of academic advisors to advise students on graduate school as an accessible and supported option.

Evaluation results also indicated the importance of clearly framing program activities as something that supported graduate school readiness and future career success. In earlier program years, some students reported uncertainty about the relevance of particular activities. Program leaders responded by strengthening the connections between activities and graduate preparation outcomes. This was especially important for workshops that focused on reflection, mentoring, and professional development. This reframing in the beginning of workshops helped students understand how these skills can be translated directly to graduate school success.

Student feedback also indicated a need for more practical skill-building activities related to graduate applications and professional communication. In response, sessions on resumes, curriculum vitae, cover letters, and application timelines were offered along with workshops on the financial aspects of graduate school such as funding mechanisms, application fee waivers, and fellowship opportunities.

Conclusion

This paper provides a four-year update on how the UMass Lowell S-STEM program supports engineering students' successful transition to graduate education. The external evaluation data shows that the program's combination of financial support, structured mentoring, targeted professional development, and explicit demystification of graduate pathways can meaningfully improve students' preparedness, confidence, and ability to navigate the graduate school application process. Students showed increased knowledge of graduate education options, improved readiness to meet academic and professional expectations, and greater confidence in making informed decisions about whether, when, and how to pursue graduate study.

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Supplemental Table 1. UMass Lowell S-STEM Meeting Topics and Evaluation Results

Date	Content	Meeting was helpful		Meeting was valuable use of time	
		Mean	SE	Mean	SE
OCTOBER 25, 2022	Orientation, social identity activity	4.7	0.333	5	0
NOVEMBER 29, 2022	Intercultural development inventory (IDI)	4.67	0.333	4.67	0.333
FEBRUARY 21, 2023	IDI results and intercultural development plan development	4.33	0.333	4.333	0.333
MARCH 21, 2023	River of life activity	4.33	0.333	4.333	0.333
APRIL 18, 2023	Mentors' career journey panel	4.5	0.5	4.5	0.5
SEPTEMBER 11, 2023	Orientation	4.64	0.133	4.64	0.133
OCTOBER 16, 2023	Individual development plan: mentoring network map	4.58	0.149	4.58	0.149
NOVEMBER 20, 2023	Individual development plan: career exploration	4.25	0.131	4.25	0.131
JANUARY 22, 2024	Individual development plan: goal planning	4.25	0.179	4.25	0.179
FEBRUARY 26, 2024	Cultural competency and intercultural development inventory	4.2	0.2	4.3	0.213
APRIL 23, 2024	Conferences and internships	4.45	0.157	4.36	0.203
SEPTEMBER 25, 2024	Orientation (cohort 3)	4.37	0.114	4.42	0.116
OCTOBER 30, 2024	Grad school and funding (cohort 1 and 2)	4.67	0.126	4.53	0.133
	Reu programs (cohort 1 and 2)				
NOVEMBER 30, 2024	IDI introduction (cohort 3)	4.41	0.123	4.24	0.202
	Job applications and linkedin (cohort 1 and 2)				
FEBRUARY 3, 2025	IDI assessment (cohort 3)	4.64	0.169	4.57	0.173
	River of life activity (cohort 3)				
MARCH 3, 2025	Cover letters, resume (cohort 1 and 2)	4.7	0.153	4.5	0.163
	External mentor career path sharing				
APRIL 14, 2025	River of life activity (cohort 2)	4.31	0.237	4.38	0.18
	Grad school panel (cohort 1 to 3)				