

BOARD 436: Challenges and Celebration a NSF S-STEM Supported Program

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Accomplishments and Challenges of a NSF S-STEM Supported Program

Introduction

The NSF *S-STEM SEER: Supporting, Engaging, Empowering and Retaining New Scholars in Science, Technology, Engineering and Mathematics* project (#1930437), builds upon lessons learned from two successful NSF S-STEM grant programs (#0849881 and #1458714) [1, 17, 20,]. New York City College of Technology (City Tech), the designated college of technology in the City University of New York (CUNY) system and a Hispanic Serving Institution, ranks 16th among public schools and 18th in social mobility according to US News and World Report [3]. Around one-third of our students self-identify as Black (non-Hispanic, 28%) and as Hispanic (34%); along with 21% as Asian/Pacific Islander, 11% as White (non-Hispanic), 2% as Other, and 4% as non-residents [19]. Eighty percent (80%) of incoming first-year students and 67% of continuing students receive need-based financial aid. Fifty-five percent (55%) of students report working 20 or more hours per week while more than 61% report household income less than \$30,000 [2]. Improving retention and graduation to increase the participation of underrepresented minority (URM) [8,9,18] or female students in STEM undergraduate and graduate programs [4,5,15] and in the New York City workforce are essential programmatic goals, with the purpose of providing life-transforming socio-economic opportunities to our students that should lower the equity gaps in the wider community.

The overall goal of this project is to increase STEM degree completion of low-income, high-achieving undergraduates with demonstrated financial need, by increasing the number of URM graduates and shortening the time to graduation. Over its 5-year duration, this project has continued to fund on average 40 scholarships per year to students who are pursuing bachelor's degrees in Applied Chemistry, Applied Computational Physics, Applied Mathematics, Biomedical Informatics, and associate degrees in Computer Science and Chemical Technology. Students continue to receive support if they maintain a qualifying GPA with a full-time credit load. Based on evidence from research studies, successful programs at other universities, and evidence of success from our current and previous NSF S-STEM grants, we are implementing a holistic programmatic approach [10, 11, 16] to support STEM students in the following ways: a) increased student exposure to research experiences [14]; b) student participation in various programs as a cohort; c) a mandatory academic advisement and one-on-one faculty mentoring of STEM students [13]; d) seminars and informal meetings with STEM researchers and professionals, women and URM included, to develop a professional STEM identity. Because little is known about structural factors that foster STEM identities, this project explores student perceptions of the effectiveness of program interventions in supporting their persistence and success. The project is particularly concerned with generating useful knowledge about academic success, retention, transfer, graduation, and academic/career pathways of low-income students [6, 7, 8] that could be replicated elsewhere.

Project SEER: Supporting, Engaging, Empowering and Retaining New Scholars in Science, Technology, Engineering and Mathematics

Through this project’s multi-tiered support system [12], we were able to achieve the following: (1) Significant increase in retention rates of our URM scholars on average. (2) Notable recruitment numbers for female scholars, varying between 48% to 68% between Spring 2020 and Spring 2022. (3) Effective recruitment of URM scholars in general, varying between 21% to 44% during two years of the grant period. (4) About 77% scholars reported (via surveys) involvement in scholarly research and/or internship activities. (5) Between Fall 2020 to Spring 2022, our scholars graduated with considerably high GPA with an average of 3.65 (N=22). Moreover, approximately 60% of our S-STEM graduates received either *cum laude*, *magna cum laude*, or *summa cum laude* awards, among them two outstanding female scholars who were tapped to be Valedictorian and Salutatorian for their respective graduating classes. Scholars reported verbally during one-on-one interviews, mentoring, and during conference visits the value of more research experience, real-life programming experience, improvement in presentation skills, and informal/social meetings with the cohorts and the leadership team. An overwhelming number of students favorably reported either in survey or verbally the importance of inviting alumni speakers. In addition, we note that all supported students are also required to open or update LinkedIn accounts to maintain a professional STEM identity and possibly connections that can open up future opportunities.

We note here our observation that URM students were more severely affected than their peers due to pandemic across many measures, and thus necessitated more interventions as a result. We acknowledge that there were challenges that the project faced in the execution of various activities and interventions during the COVID pandemic. These challenges sprung from the necessary isolation of the scholars from one another and from their classmates in their course work and their mentors and program advisors. Because the project leaders had become aware of particularly high withdrawal rates of City Tech students from their courses, more intensive one-on-one interventions over Zoom became an integral part of the strategy to keep scholars on track. The SEER initiative also continued to host talks and seminars online, including informal forums featuring previous scholars, while also seeking out webinars and seminars offered by other institutions as well as opportunities for virtual field trips. The goal was to sustain a level of engagement through different avenues to keep the scholars connected within a community, despite being online.

Table I: NSF S-STEM Scholarship Recipients

	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022
Male (%)	17(51%)	13(52%)	14(52%)	6(37.5%)	6(32%)
Female (%)	16(49%)	12(48%)	13(48%)	10(62.5%)	13(68%)
Total Scholars	33	25	27	16	19
Total Awards	\$82,600	\$65,795	\$76,324	\$40,800	\$54,441
URM					
Male (%)	8 (57%)	5(50%)	6(55%)	2(50%)	2(29%)
Female (%)	6 (43%)	5(50%)	5(45%)	2(50%)	5(71%)
Total URM (%)	14 (42%)	10(40%)	11(44%)	4 (25%)	7(32%)

Biomedical Informatics					
Male (%)	2 (29%),	1(25%)	1(25%)	1(25%)	1(25%)
Female (%)	5 (71%)	3(75%)	3(75%)	3(75%)	3(75%)
Applied Chemistry & Chemical Technology					
Male (%)	2(22%)	3(37.5%)	3(37.5%)	0(0%)	3(37.5%)
Female (%)	7(78%)	5(62.5%)	5(62.5%)	5(100%)	5(62.5%)
Applied Mathematics & Computer Science					
Male (%)	11(73%)	8(73%)	7(64%)	3(60%)	1(25%)
Female (%)	4(27%)	3(27%)	4(36%)	2(40%)	3(75%)
Applied Computational Physics					
Male (%)	2(100%)	1(50%)	3(75%)	2(100%)	2(67%)
Female (%)	0(0%)	1(50%)	1(25%)	0(0%)	1(33%)

During the pandemic and post-pandemic period, we conducted individual interviews with 12 racially and gender-diverse student participants in order to determine their perceptions of the effectiveness of program interventions in supporting their persistence and success during such challenging times. Here we provide highlights of the ways in which student participants perceived the SEER program as contributing to the successful completion of their degree program, and their preparation for a STEM career.

Participants reported that during the COVID epidemic, the SEER program has provided critical multidimensional support, including financial aid and mentorship, that allowed them to persevere through their studies. Financial support throughout SEER was found to be essential; participants reported that it was crucial in relieving some of the pressures on their families or themselves, and in helping participants focus on their study. Peer support and advisement was also found to be decisive in terms of keeping up with course work, planning and executing research projects, and other initiatives that the participants took part in, including planning in relation to STEM studies and career. As one participant put it, “[it is] not so much about which class or when to take a class, but more about what do I do next.”

From the interviews, it appears that SEER was successful in creating a supportive community, which nurtured its participants amidst a welcoming and encouraging environment. It also brought forth multiple support networks comprised of peers, alumni, mentors, and researchers, which helped to sustain productive relationships among participants. The community helped participants to be more active, more confident, better-connected to peers, and positioned to take advantage of the learning opportunities that the college and the program offered. As one participant put it: “[the community] made me get out of my comfort zone and network.” Another participant reported: “I got to connect to other students... more confident to talk to people...to experience more of the school I feel like it just makes the college feels less like something that I have to do, and more like something I like to do.”

The participants reported that the SEER program was instrumental in helping them “apprentice” for STEM careers. The program was not only effective in informing them about internship and research opportunities, but also in creating opportunities for participants to be introduced to

research methods, and to participate alongside mentors in the preparation, delivery, and presentation of research studies, in. As one participant observed, “I don't think classes are enough ...in terms of learning, you know, in terms of getting oriented towards a profession. I think that most of the things that helped me be more prepared for the workforce was the emerging scholars [program], getting internships, and doing research outside of school and actually talking to [STEM] professionals.”

Finally, the SEER program helped participants to imagine a future STEM trajectory for themselves. Participants felt that it was important for them to hear from STEM professionals, not only about the paths that led them to a STEM career, but to be informed as to their job responsibilities and current projects. Participants reported that this gave them “a better outlook on their future [as STEM professionals],” and helped them to imagine various STEM pathways for themselves.

Conclusion

This project aims to improve retention and graduation in STEM fields by linking scholarships with effective mandatory supporting activities, including academic advising, cohort meetings, one-on-one end-of-semester meeting, undergraduate research experiences, graduate school preparation, and participation in discipline-specific conferences. Because City Tech is a minority-serving institution, this project impacts underrepresented students, and especially women, in STEM undergraduate and graduate programs and consequently the New York City technology work force. This project continues to develop successful evidence-based interventions that support the retention, graduation, and STEM workforce entry of undergraduate STEM scholars. Scholars are encouraged to participate in non-academic endeavors such as enrichment and extracurricular activities designed to engender a sense of community.

The research agenda embedded in this project has generated new knowledge about student perceptions of the effectiveness of program interventions designed to support student persistence and success, and in particular the effect on their experience during the COVID pandemic. We have distinguished vital experiences that might contribute to positive STEM identity, development and socialization, especially among underrepresented minorities and women. We have also aimed to identify key characteristics of academic or non-academic spaces, structured by the program, that foster STEM identity development.

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