

Board 375: Reporting the Progress and Performance Evaluation of an Ongoing Integrated Program for Recruitment, Retention, and Graduation of High-Achieving, Low-income Engineering Students

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Reporting the Progress and Performance Evaluation of an Ongoing Integrated Program for Recruitment, Retention, and Graduation of High-Achieving, Low-income Engineering Students

Abstract

The present paper reports an update on an NSF-funded S-STEM program currently in its last year at the University of Illinois Chicago. Lessons learned during the project implementation are also listed in the paper. A summary of the paper materials will be presented at the ASEE 2023 Annual Conference and Exposition as part of the NSF Grantees Poster Session.

The project's objectives are 1) enhancing students' learning by providing access to extra and co-curricular experiences, 2) creating a positive student experience through mentorship, and 3) ensuring successful student placement in the STEM workforce or graduate/professional degree program. As part of this project, students are provided with financial assistance. A total of three Cohorts of students are supported by the project: Engineering students who started as freshmen, including 18 students of Cohort I and 13 students of Cohort II, and 19 students who transferred from various community colleges to Cohort III. More than 60% of the students are classified as minorities.

This project has resulted in the creation of several support and intervention programs, including a Summer Bridge Program, an Engineering Success Initiative course, a Service Learning Project course, and an integrated mentoring program that matches each student with an academic mentor (a faculty) and an industry mentor. The paper will summarize the lessons learned from the support programs.

Out of the 18 students recruited by this program as Cohort I, all have already graduated, and 16 have started a job. Cohort II students will graduate in Spring 2023, and Cohort III students will graduate in Spring or Fall of 2023. Two students dropped out of the University in their first year, and three dropped out of the University in their second year. More information is provided in this paper regarding student retention and performance (Grade Point Average).

Introduction to the Scholarship

Surprisingly, despite decades of significant investment in organization and funding, low-income engineering students and professionals are a very small proportion of the engineering population [1][2]. In addition to being a research-intensive, urban, minority-serving institution, the University of Illinois Chicago (UIC) also has the designations of Hispanic Serving Institution

and Asian American Native American Pacific Islander Serving Institution. UIC's College of Engineering (COE) serves a diverse student population from various ethnic and economic backgrounds; however, academically talented, low-income students do not graduate as frequently as high-income students who are academically talented. Therefore, it is crucial that academically talented, low-income students are retained and graduated.

The S-STEM project at the University of Illinois Chicago was started in 2017 to support academically talented low-income engineering students. The project's objectives are: 1) enhancing students' learning by providing access to extra and co-curricular experiences, 2) creating a positive student experience through mentorship, and 3) ensuring successful student placement in the STEM workforce or graduate/professional degree program. In the five years of the project, students have been provided with financial, academic, professional, and social support through evidence-based activities such as the Summer Bridge program, engineering initiatives, Service Learning Project courses, and mentorship programs from faculty and industry.

This paper summarizes the project's tasks that have been completed since the project began and describes the activities projected for the remainder of the project.

S-STEM Scholars First, Second, and Third Cohorts

In 2018, the first cohort of scholars was recruited, interviewed, and selected. The second cohort of 13 scholars was also recruited, interviewed, and selected by the end of the spring semester of 2019. Moreover, the third cohort of 19 scholars were recruited, interviewed, and selected in the fall semester of 2020. Scholars from all three cohorts received financial assistance in addition to the support program based on their individual needs.

Scholars' demographics, such as gender, race, and majors, are represented in Table 1.

Information		Gender		First Generation	Race ¹					Major ²						
		F	M		H	AA	A	AI	W	BioE	ChE	CME	ECE	CS	IE	ME
Number of Scholars	Cohort I ³	6	10	7	6	2	3	2	3	1	2	3	0	4	2	4
	Cohort II	5	8	3	0	1	5	0	7	1	1	1	1	7	0	2
	Cohort III ³	5	11	10	6	2	4	1	3	2	0	1	2	8	1	1
	Total	16	29	20	12	5	12	3	13	4	3	5	3	19	3	7

¹ H: Hispanic, AA: African American, A: Asian, AI: American Indian, W: White.

² BioE: Bioengineering, ChE: Chemical Eng., CME: Civil & Materials Eng., ECE: Electrical & Computer Eng., CS: Computer Science, IE: Industrial Eng., ME: Mechanical Eng.

³ Originally, there were 18 Scholars recruited for the first cohort, but one dropped out of the University after the first year, and the other dropped out after the second year. Also, three of the third cohort's students dropped out—one after the first year and the others after the second year.

As Table 1 presents, out of 45 scholars, 16 are female, and 29 are male. They represent the majority of engineering majors in the College of Engineering. Moreover, 20 scholars are first-generation college students, five identify as Black/African American, and 12 as Hispanic.

Progress and State of the Scholarship

This section will report on the progress of the project. Different types of activities have been designed for scholars. Further subsections will describe feedback and lessons learned from completed tasks and progress on ongoing tasks.

Feedback and Lessons Learned from the Completed Tasks

S-STEM Scholars *Eligibility and Selection*. The main criteria for scholar selection were described in Darabi et al. [3]. 45 students were interviewed to select the first cohort of scholars. Eighteen of them were offered the scholarship, and all of them accepted it. Among 36 potential scholars interviewed for the second cohort, 14 were offered, and 13 accepted the offer. Also, for the third cohort, among 35 candidates who were interviewed, 19 were offered, and all of them accepted the scholarship.

Table 2 shows the average high school GPA and cumulative GPA for all three cohorts of scholars.

Cohort/Metric	Number of Scholars	Average High School GPA (out of 4.00)	Average Cumulative GPA (out of 4.00)
Cohort I	16*	3.76	3.50
Cohort II	13	3.92	3.84
Cohort III	16**	3.41	3.25
Total	45	3.67	3.53
* Two of the first cohort scholars left the program because of personal issues.			
** Three of the third cohort of scholars dropped out of the University.			

Summer Bridge Program (SBP). The Summer Bridge Program provides residential and immersive experiences to prepare scholars for College. Cohort I and II attended the SBP the summer before entering the university (the summer of 2018 and 2019, respectively). During the SBP, scholars from cohorts I and II were paired with undergraduate ambassadors to be guided with academic, professional, and social questions as they became acquainted with the University and their major. Nazempour et al. [4] provide more details regarding the SBP structure, execution, and assessment.

Summer Bridge Program for cohort III was held virtually via Zoom in the Spring of 2021 due to the COVID-19 pandemic. During this 2-hour online workshop, cohort III of scholars became acquainted with the program, faculty mentors, and some cohorts I and II scholars. There was also a Q/A session in that cohort III scholars asked questions from scholars of other cohorts and faculties.

Mentorship Program. To ensure that all scholars have access to resources and feel supported, each scholar was assigned to a faculty mentor from the academic department corresponding to the scholar's major. Cohort I and II scholars were assigned to their faculty mentors during the Summer Bridge Program, and cohort III scholars were assigned to the faculty mentors before the SBP.

Scholars will be mentored by their assigned faculty mentors during their undergraduate years at the university. They can meet with their mentors several times a semester and be assisted in academic fields and with their time management, graduate study goals, internship application preparation, and grade improvements.

Introductory Engineering Course (ENGR194). This course was designed to create the opportunity for scholars to interact with professionals of different disciplines and cultural backgrounds and attend seminars and symposia on various subjects. For cohort I, Engineering Success Initiative (ENGR194) was offered for the first time in Fall 2018. The course was also provided to cohort II scholars in the Fall of 2019 after minor modifications. The ENGR194 implementation and its impact on student's academic success and retention were described in detail in Nazempour et al. [4].

In Spring 2022, ENGR194 was offered to cohort III of scholars for the third time. The course has been modified based on our evaluations of the same course offered in Fall 2018 and Fall 2019. The course content included math and science discussion groups, four-year study plan development, major selection, entrepreneurship challenges, time and stress management, introduction to undergraduate research projects and internship, engineering identity construction, and introduction to math application in engineering disciplines.

Guaranteed Paid Internship Program (GPIP). As part of the College of Engineering's GPIP program, qualified, academically talented students are offered a paid internship or research opportunity if they commit to returning the following fall. Cohorts I and II participated in the Guaranteed Paid Internship Program (GPIP) in the 2019 and 2020 Summers.

To evaluate the impact of COVID-19 on the scholars' internship status in the Summer of 2020, members of the Award Committee developed a survey. The results showed that 44 percent of the

confirmed internships were canceled because of COVID-19, and the remaining changed to a virtual environment.

Progress of the Ongoing Tasks.

Execution of a Service Learning Project Course (SLP). In the Fall of 2019, cohort I was the first cohort to take this course. Cohorts II and III also attended the SLP in the Fall of 2020 and 2021, respectively. Every cohort of scholars was divided into different groups, each led by a mentor, and every group presented their progress to their mentors and classmates weekly. Throughout this course, scholars can engage with their local community. Table 3 describes a summary of the scholars' projects.

Table 3. SLP projects summary

Cohort	Project Title	Impacted Community	Expected Impact of the Project	Status
I	Project Makerspace	Berwyn, Illinois (Chicago Suburb)	Introduce students to Makerspace and engineering careers.	Completed
I	Undocwiki	Undocumented students in Chicagoland and the state of Illinois	Increase the transition rate of undocumented students to higher education and inform them about the available resources.	Completed
I	Development of Engineering Curriculum for local K-8 STEAM School	N. Lawndale (Chicago West side)	Develop engineering components of a curriculum for primary school students.	Completed
I	Improve Engr 100	UIC engineering students	Improve the ENGR100 course curriculum to familiarize students with available resources and general engineering ideas.	Completed
I	Solar-powered fridges for community gardens	Little Village Community	Enable the community to store and have access to fresh produce.	Completed
II	Adopt Our Classroom	Chicago Public Schools	Implement a Web-based app to facilitate the connection between public school teachers and industry professionals.	Completed
II	Air Quality in Little Village	Little Village Community	Develop an open-source device to determine the air quality and empower community youth to advocate for their community's health.	Completed
II	University Park Water Crisis	University Park	Design a system to improve and track the water quality in University Park.	Completed
II	VRESSE: Virtual Reality to Excel Student STEM Engagement	Chicagoland area high schools	Create civil and computer science lesson plans through Minecraft education to help educate children on those engineering fields in a fun and interactive way.	Completed
III	Food4Homeless	Local homeless communities in Chicago	Create a system that will help eliminate food waste and benefit the homeless community by distributing food that	In-progress

			restaurants throw away at the end of the night to the local homeless communities in Chicago.	
III	Solar Panel Fridge Project	Little Village / Amor de Dios United Methodist Church / ENLACE	Create a solar panel fridge in Little Village near the local community church to allow community members to access food given to the church by food donations at any time of the week, not just during food donation days.	In-progress
III	Women in Community Connections	Isolated women	Create an app that connects women within the same community.	In-progress
III	CBCM Project	Chicago Bird Collision Monitors (CBCM)	Create a program for CBCM volunteers to input and view data on the number of birds killed by collision injuries in Chicago.	In-progress
III	Community Fridge Project	The Love Fridge/ Lower income communities of Chicago	Convert fridges that the love fridge has operating in the Chicago area to work on solar panels; the fridges are meant to support those who suffer from food scarcity in Chicago.	In-progress
III	Engineering Majors Introduction for High School Students	High school student with limited resources.	Create engineering-related activities/projects to teach high school students about engineering majors.	In-progress

Scholars from cohorts I and II have completed their SLP projects, and they were successful. Cohort III scholars are working on their projects and are expected to complete their SLP projects by the Summer of 2023.

Recruiting Industry Mentors. The College of Engineering Industrial Advisory Board has guaranteed to provide all S-STEM Scholars with industry mentors. The industry mentorship program aims to improve mentees' technical and professional skills and competencies, develop their engineering identity, and create a community that supports career growth. Scholars develop their engineering identity through industry mentors who are racially and ethnically diverse. All Cohorts of scholars were assigned to industry mentors and had multiple mentor-mentee meetings.

The Award Committee members also created an industry mentorship subgroup to work on the industry mentorship module specifically. The industry mentorship subgroup established four stages of mentorship to create an influential mentoring culture: matching participants, preparing participants, interacting with participants, and evaluating results. Also, in the participant matching stage of the module, the subgroup implemented different surveys, including "Surface and Deep Level Similarities Questionnaires" (for mentors and mentees) and "Short Myers-Briggs

Type Indicator." We asked mentors and mentees to complete these questionnaires and used them to match cohort II scholars with their mentors.

COVID-19 Modifications to the Project

Some of the project activities were affected by the COVID-19 pandemic. The following modifications were made to the project in response to input from faculty and students:

- **Educational Activities:** In Fall 2020 and Spring 2021, almost all UIC classes were offered virtually (synchronous or asynchronous mode). Moreover, in the same semesters, a Credit/No Credit grading policy modification and course withdrawals for all undergraduate students were offered by the University. This policy applied to our scholars as well. Also, the course interventions, such as SLP courses, were provided in a synchronous mode (using UIC-licensed Zoom, Blackboard Collaborate, or WebEx) until the COVID-19 pandemic was under control.
- **Advising and Mentoring:** Mentoring and advising sessions, such as mentor-mentee meetings, were conducted virtually in the Fall of 2020 and Spring of 2021.
- **Research Data Collection:** Three methods are used for research data collection: interviews, surveys, and educational record reviews. Virtual environment such as Zoom has been used for all the targeted interviews.
- **Project Investigators Meeting:** The level of student monitoring has been increased by faculty mentors since the Spring of 2020. Frequent virtual meetings were held to help them regarding the negative impacts of COVID-19 on their lives, including financial, medical, and psychological effects. Appropriate experts/resources are also offered to the students in the crisis. In addition, students whose unmet financial needs are increased due to COVID-19 receive financial support through additional scholarship awards from the S-STEM project.

Generation of Knowledge

The progress of the project has been disseminated through four poster presentations [3] [5] [6] [7]. In addition, engineering identity-focused interviews with cohort I scholars have been conducted, and the results have been published [8]. The execution details and assessment results of the Summer Bridge Program were published at an educational conference [9]. The implementation of an introductory course and its impact on students' academic success and

retention was also published at an educational conference [4]. Also, the structure of the industry mentorship program for undergraduate students was published by an engineering education journal [10].

Conclusions

Fifty scholars have been recruited in three cohorts (cohort I, 18 students, cohort II, 13 students, and cohort III, 19 students). Diversity on campus is reflected in all cohorts of scholars. Two scholars from cohort I and three from cohort III left the program because of personal issues. All cohort I scholars have graduated, and started a job; One of the scholars from cohort II has already graduated and joined a graduate program at UIC. The remaining 12 scholars from cohort II are expected to graduate in Spring 2023. Cohort II students are currently continuing their engineering degree programs and are expected to graduate in Spring or Fall 2023. The Summer Bridge Program, mentorship programs, an introductory engineering course (ENGR 194), and a Service Learning Project course were offered to scholars during their studies at UIC as part of the project. In addition, some modifications were made to the project tasks and resources to decrease the impacts of COVID-19 on students' lives. Since all the continuing students have been passed three semesters of their studies, the project has a 94 percent first-year retention rate.

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