NSF S-STEM: Iron Range Engineering Academic Scholarships for Co-Op Based Engineering Education

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Introduction

This paper presents a description of the fourth year of implementation of the Iron Range Engineering STEM Scholars, funded by the NSF S-STEM award (Award #2221441). The scholarship program includes financial support as well as additional mentorship support for scholarship recipients within the Iron Range Engineering (IRE) program. The paper outlines the format of the scholarship program and a subset of results related to job search goals and co-op placements. As a primarily co-op based program, these insights are crucial for designing activities and resources to promote student success specifically for job search goals while working towards their degree in this learning environment.

Iron Range Engineering

IRE students complete lower-division coursework at community colleges around the nation [1]. Students then join IRE for one semester, named Bell Academy, on campus; this semester is focused on developing students' professional, design, and technical skills. After this first semester, students earn their degree while working in a co-op and earning an engineering salary (average $21.5k per semester). Students remain full-time students through the co-op based learning format by taking 1-credit hour technical competencies and design, seminar, and professionalism coursework. They earn course credit for coursework related to their valuable co-op experience by applying and further developing their professional, design, and technical skills. Approximately 97% of students obtain a co-op in the first semester after Bell Academy; however, students who do not obtain a co-op complete industry projects to develop skills and earn credits through this experience.

After five semesters at IRE, and in as little as four and half years of academic and professional engineering work combined, students graduate with a Bachelor of Science in Engineering degree, with a focus area if desired (e.g. Chemical, Electrical, Mechanical Engineering). IRE is in the Department of Integrated Engineering at Minnesota State University, Mankato (MSU, Mankato). This model is intended to be a financially sustainable option for students, as community colleges typically have more affordable tuition costs, and the income they earn on co-op while earning their degree can offset the tuition costs at MSU, Mankato. The cost for five semesters at IRE is $67k, and on average, students earn $68k while attending school.

IRE STEM Scholars

The first semester in IRE is often a barrier for low-income students, particularly nontraditional students who may have other financial responsibilities. The IRE STEM Scholars is a scholarship and mentorship award for incoming IRE students that is meant to help overcome this barrier. It supports students financially in completing the first semester of IRE, the only semester in which students are not earning an engineering income, to help with the costs of tuition. IRE STEM Scholars are also supported in obtaining their first co-op and completing their educational requirements in a timely manner. The program is intended for low-income, high achieving

students who otherwise would not have access to a financially sustainable engineering degree. In addition, cohort bonding across all students at IRE is crucial to help students develop their sense of belonging and engineering identity.

Methods

As part of a larger concurrent mixed-methods study exploring how undergraduate students' overall wellbeing in a co-op based engineering program [2,3], this paper presents a current description of students' co-op experiences. Specifically, we present data identifying students' job search goals and locations of companies where IRE students have worked.

Data Collection

The survey consisted of items on engineering belonging [4], engineering identity [5], co-op information, and demographics. The items on engineering belonging and identity are scored on an anchored scale of 0 to 6 and have previously been tested on a similar population [4]. The survey has been administered annually since 2021, and scholars had the option to respond multiple times; this generated a total of 343 responses. For this paper, we used qualitative data from participant responses to a specific open-ended prompt in the 2025 survey to explore students' job search goals (n=92). Responses regarding the work locations and employer companies from 2022 to 2025, which capture co-op data from 2021 to 2025, provided data for an overview of the locations of companies where IRE students have worked.

Data Analysis

The 2025 responses to the open ended prompt "Please tell us a little about any job search goals you've had and if you feel that you've met those (i.e. location, discipline, or specific company)" were coded, and we kept a count of those codes to show what types of goals students were setting related to their job search. Additionally we coded if the students indicated whether they felt that their goals were met.

Additionally, all company names and locations were pulled from each distribution of the survey, to create a list of companies students have worked at from 2021 to 2025. Duplicates were removed, and latitude and longitude for the remaining companies were gathered. Finally, a map was generated using OpenStreetMap [6] and html coding, where the circle size shows the number of companies within 1 latitude or longitude or about a 69 mile radius. Metropolitan areas in separate states were separated, which is most noticeable in the DC area and in the Minneapolis-St. Paul area.

Results and Discussion

Identifying the types of goals being set by students in their job search can further help us mentor and support students in achieving their job search goals. We identified six different types of goals, as shown in Table 1. Students most frequently are looking for specific locations or specific disciplines (such as automotive engineering or biomedical engineering). There were 17 students who set very open-ended goals for any engineering position. We also saw students looking for

positions at specific, desired companies, or looking for positions with good pay. The "other" category primarily included responses with vague answers or responses on how they approached getting a job (e.g., building a strong resume, networking) rather than describing a specific goal. Below are quotes from students sharing their location specific goals and if those have been met:

> "[The] Goal of finding engineering in a specific field and specific location [is] very difficult."
>
> "My job search goals have been to find a co-op in California and specifically [the] Santa Barbara area, but I haven't found anything yet."
>
> "I have been looking for jobs in Colorado, and I have had followups but no acceptances."

Of the students who indicated if they felt they had met their goals, half (n=29) indicated they had met their goals and half indicated that they had not. In mentorship, we focus on supporting students in their goals with targeted job search advice. Weekly job listings are shared with students listed by disciplines. In looking to address the most common goal– finding a job in a specific location– the companies with which prior students had worked provide a strong starting list for students looking for places to apply.

Table 1: Type of job search goals set by students and number or responses for that job search goal. Some students responded with multiple goals.

Goal	Number of responses
Specific Location	34
Specific Discipline	20
Any Engineering Position	17
Specific Company	5
Good Pay	4
Other	5

Figure 1 shows a map of co-op placements, where the size of the circles show the number of unique companies in approximately a 70 mile radius. An interactive version of this map was generated and shared with IRE STEM scholars, so that a student may scroll over the circles and see a list of the company names in that area. Based on survey feedback and feedback from mentors, students tend to either have discipline specific goals or location-specific goals when searching for co-ops. This interactive map helps address the location-specific goals.

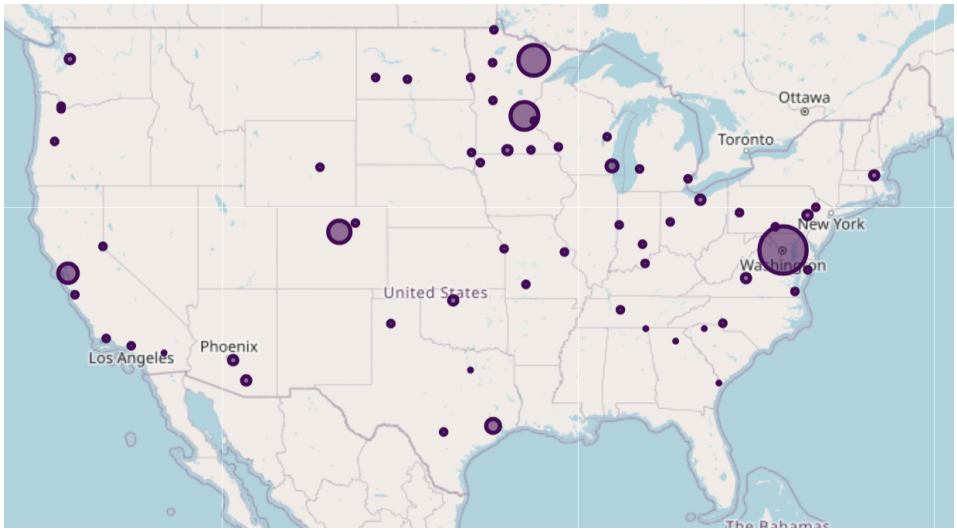

Figure 1: Radius map showing the number of companies in approximately a 69 mile radius that IRE students have worked between 2021 and 2025

Summary

Identifying students' job search goals in a co-op based program allows mentors to better support those job search goals and provide information to support those goals. Co-op experiences have been financially beneficial, and most of the IRE STEM Scholars are reaching their co-op goals and gaining experience in areas of engineering that will be beneficial to their future careers.

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