Building College Capital for Community College Students: The Perspectives of Students Participating in an Engineering Momentum Program

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Abstract

Community colleges have a critical role in providing education and training for students who pursue careers in the science, technology, engineering, and mathematics (STEM) fields. Yet, many community college students, particularly underserved students in STEM, face challenges in achieving their educational aspirations due to a lack of what we define as "college capital"—that is, the access to academic, co-curricular, social, financial, and professional support that students need to be successful within institutions of higher education. As an academic and professional initiative aiming to bolster students' college capital and promote students' engineering achievement, the Engineering Momentum Program provides: 1) academic support to ensure program participants are prepared to succeed in calculus, which is a gateway course for engineering majors; 2) paid research internships to guide students toward engineering careers; and 3) transfer advising to help students navigate the pathways from community college to four-year engineering programs. Using a survey instrument for data collection and our college capital framework to guide our analysis and interpretations, this study investigates how students who participated in the Engineering Momentum Program in their first year in community college perceive their experiences and how they value the program's impact on their academic and career decisions. The findings suggest that about 95% of student participants intended to pursue an engineering or computer science career. Students perceived that the Engineering Momentum Program's components, workshops, and support from program-trained, embedded staff were valuable for their academic and professional journey. They highly rated their participation in the program and its wrap-around support as beneficial in their preparation for math and engineering courses, as well as the help with internship applications. However, participants also reported that a lack of emotional well-being, work obligations, and financial pressure were the three main barriers to their success in the Engineering Momentum Program, which could provide insight into ways to further improve the program and its offerings. This study further discusses practical implications for institutions interested in developing interventions to improve community college engineering students' academic and career-related outcomes.

Introduction

Community colleges offer students affordable education programs, including many choices for associate degrees, transfer pathways options, and career training. Many students attend community college to prepare for the science, technology, engineering, and mathematics (STEM) workforce or to transition to four-year STEM degree programs. Nationally, approximately 29.8 million U.S. workers have a community college education. Of those, about 6.6 million (22%) are entering the STEM workforce [1]. Community colleges play an important role in expanding STEM education and, ultimately, our nation's workforce. They also provide a bridge to financial stability that can improve the economic outlook of students and their families. It is important, therefore, to understand community college students' experiences to help community colleges fulfill their objectives and to help students achieve their aspirations. Among those enrolled in community colleges, a large portion of students come from underserved

backgrounds—32% are first-generation to attend college; 55% are from low-income families; 28% identify as Hispanic; and 12% identify as Black [2].

Prior studies suggest that community college engineering students—particularly those from underserved groups—experience academic struggles, financial hardship, multiple obligations outside of school, and inadequate support in the learning environment that discourage them from pursuing their education goals [3], [4], [5], [6]. Many of the challenges facing community college engineering students result from a lack of education, financial, and/or professional resources. In this study, we define the resources students must have to navigate their education as "college capital" — that is, the access to academic, co-curricular, social, financial, and professional support that students need to be successful within institutions of higher education [7].

Focusing on the concept of "college capital," [7] we introduced the Engineering Momentum (EM) Program that is an academic and professional initiative aiming to bolster students' college capital, promote their engineering and computer science pathways in community colleges, and subsequently aid them in transferring to engineering and computer science bachelor's degree programs. The purpose of this study is to explore community college students' experiences in EM and develop strategies to refine how we support their education and career pursuits. We used a survey instrument for data collection and our college capital framework to guide our analysis and interpretations. The research questions informing the study are as follows:

1. How do students who participated in the Engineering Momentum Program in community college perceive their experiences?
2. How do students value the program's impact on their academic and career decisions?

Engineering Momentum Program Description

For engineering specifically, as well as many other STEM programs, math is central to students' academic success. For community colleges, math preparation can be a challenge because there may be few, if any, mathematics entrance requirements for incoming students. One goal of EM is to help alleviate this purported math challenge by providing year-round access and resources for community college students, especially those from underserved groups or those who—without a program like ours—may not otherwise consider engineering as an accessible career or to improve their math preparation and foundational engineering skills. The end goal of EM is to provide students with the academic prowess and confidence to transfer to a university to attain their bachelor's degree and ultimately enter the engineering enterprise.

The program comprises several critical elements: 1) a community college summer bridge program and academic-year support to ensure that students are prepared to succeed in the math courses that lead to calculus readiness—a gateway course for engineering majors; 2) transfer advising to help students navigate the pathways from community college to four-year engineering programs; 3) paid research internships to further solidify students' interest in engineering and to provide them pre-professional experience and mentorship; and 4) professional staff at each campus to provide personalized advising and wrap-around support to EM students

[7]. These elements are interrelated to building students' college capital to further support their academic and engineering career pursuits (Figure 1).

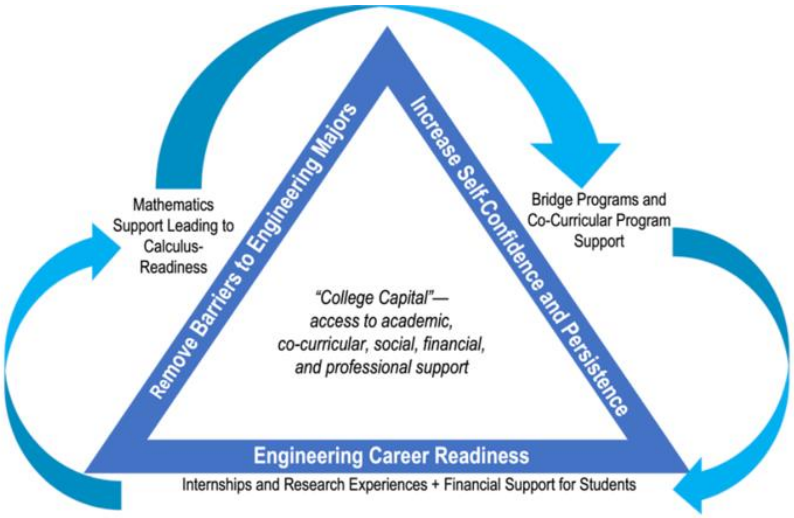

Figure 1. The Engineering Momentum Program's critical elements to building "college capital."

Students in EM join an academic-year, cohort-based learning community which provides academic and professional development opportunities for engineering-focused community college students. Students are enrolled in block-scheduled math courses and, as much as possible, an introductory engineering or computer science course (or both). While participating in EM, all students have wrap-around academic and social support for enhancing their learning experiences. At each EM college, an engineering staff member—a dedicated, full-time individual who works for and at the college—provides this with wrap-around support and year-round programming of socializing activities, STEM workshops, resume preparation, and guest speakers. The engineering staff person—who is often called a Student Support Specialist—assists EM students in navigating the transition into higher education, adjusting to the expectations of the EM program, aligning course schedules with academic goals, and coping with the challenges of balancing school, work, family, and personal life. A second, part-time person skilled in the nuances of transfer, assists students with the requirements for transfer to four-year universities to pursue STEM bachelor's degrees.

In this study, students participated in EM at one of two Colorado community colleges during the project's second year—academic year (2023-2024). Each community college had a cohort of 25 students.

Methods

The research team worked in partnership with the lead institution to facilitate this study. The research team developed an online survey (via Qualtrics) to seek students' perspectives on their experiences in EM and to assess their overall academic and career goals and factors that led to specific decisions during the academic year (2023-2024) of the program. The online survey was chosen for its ability to efficiently reach a geographically dispersed cohort and provide a standardized data collection method. The survey comprised a total of 32 questions addressing

five main components: 1) student demographics and background; 2) types and quality of support that students reported receiving from EM; 3) students' reported academic and internship outcomes; 4) questions that prompted student participants about their mindset, career and educational goals, and decision-making factors during the program; and 5) participants' overall impressions of the program, including open-ended questions about their program experience. Also included was the consent form clearly describing the survey's purpose, procedures, privacy, and confidentiality. No identifying information was collected.

In the spring of 2023, the research team submitted the survey to the research team's university Institutional Review Board (IRB) to review and approve the study. The EM staff person at the colleges assisted us with survey administration by sending the survey link to their student cohort email listserv in mid-April of 2024; the survey remained open for the month of May. We received 34 participant responses, of which 21 were fully completed—a 42% response rate, based on the total number of participating students who received the email invite (n = 50). After reviewing all responses, we analyzed the survey data and presented the results to the EM leadership team at the lead institution, along with college-based staff associated with EM. Based on the survey responses, student demographics revealed a high percentage of students who identified as Black (38%), first-generation (81%), low-income (62%), and having a disability (43%), which underscores the program' success in reaching underserved populations.

Results

Academic backgrounds

We asked students about their academic background—i.e., questions about their academic plans, how they learned about the program, and why they chose to join the program. The background information gives us the story behind students' program participation. Among the 21 survey responses, 48% of students were engineering majors, while 28% of students were computer sciences majors. In addition, 14% of students' majors were undecided, 5% of students were math majors, and 5% of students were chemistry majors. For the students in non-engineering (yet still STEM) majors, we were hopeful that they would change to engineering after experiencing EM and becoming more aware of the benefits of an engineering career.

Most students (96%) intended to transfer from their community college to a four-year institution. Students reported that faculty (35%) and advising staff (35%) were the primary sources from which they learned about EM. With respect to the reasons for participating in EM, 36% of students indicated that they wanted to have better access to internships, 33% of students hoped EM would help them achieve their career goals, and 29% of students hoped to have a supportive community through EM.

The types and quality of support received

Students were asked to reflect on their academic and professional experience as a participant in EM during the academic year. They reported how they valued the program's components: accelerated math courses (note the term "accelerated" was used with students to refer to the strategy of EP students enrolling as cohorts in math classes that were supplemented by tutoring

and other wrap-around support as needed), Student Support Specialist, and summer internships. Figure 2 shows students' responses to each component. About 57% (n = 12) of students rated the Student Support Specialist as *extremely valuable*. About 66% (n =14) of students rated summer internship as *extremely valuable* components. Regarding the accelerated math course, about one-third of students (n = 7) perceived it as a *very valuable* component.

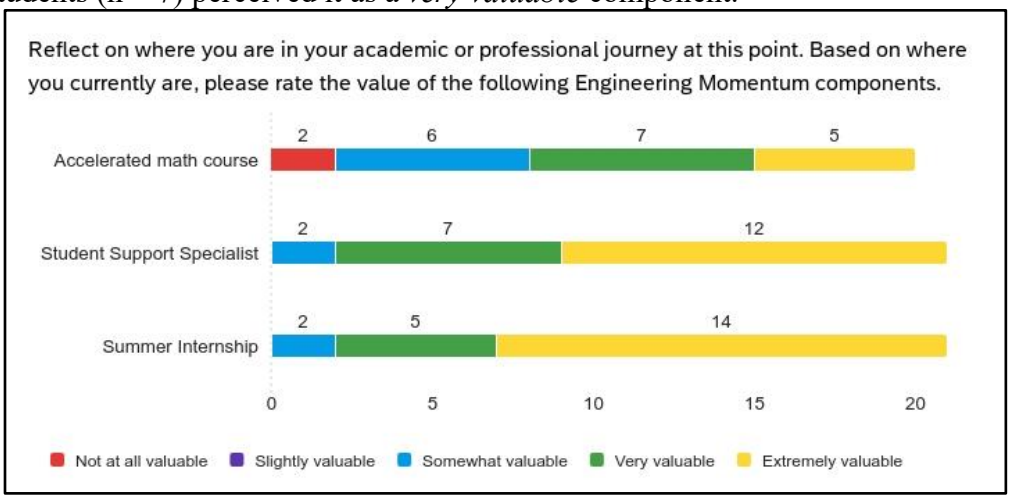

Figure 2. Students' reported value of EM components (n = 21).

EM offers workshops to improve students' academic, professional, and career knowledge about engineering fields. Students reported how they valued the workshops. Figure 3 shows that over 71% of students (n > = 15) found the career-development workshops (preparing resumes, preparing for interviews/professional communications, and employer series/panel discussions) *very valuable*.

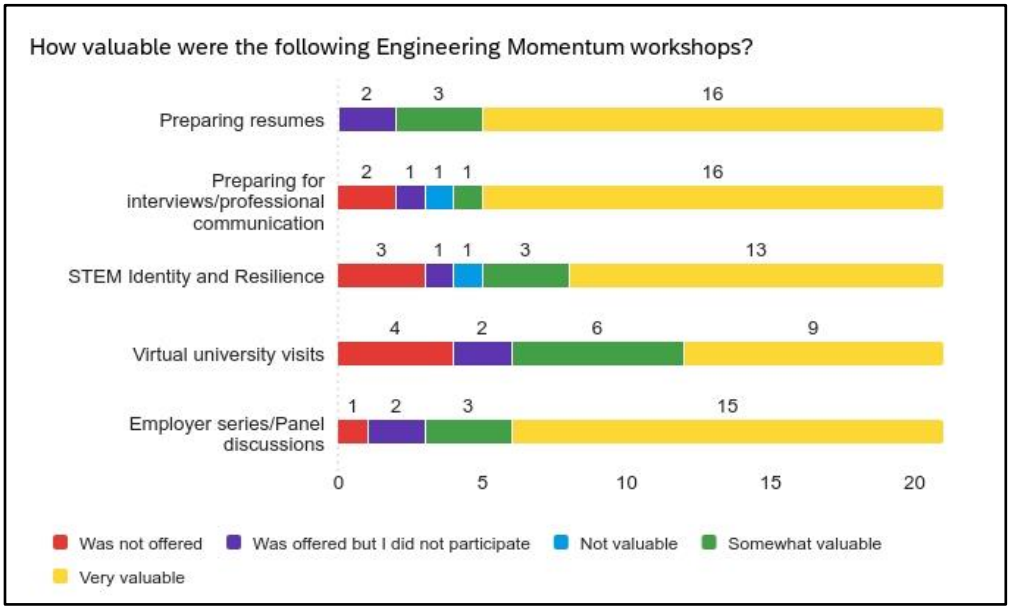

Figure 3. Students' reported impressions of the EM workshops (n = 21).

The Student Support Specialist plays an important role in EM, serving as the first point of contact to interact with students and address their needs. Over 80% (n > = 17) of students highly valued the support that the Student Support Specialist provided in their resume and interview

preparation, connecting them to internships, and exposing them to STEM opportunities (Figure 4).

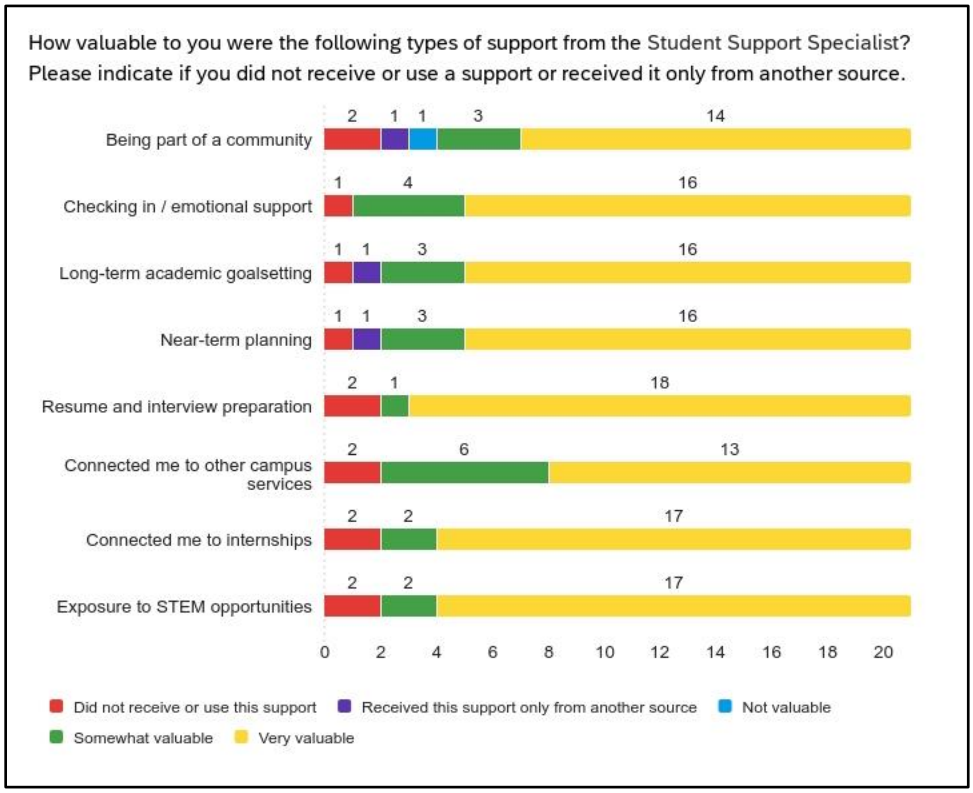

Figure 4. Students' reported types of support from the Student Support Specialist (n = 21).

Barriers to their engineering program success

In addition, we asked students to provide information about the barriers to their EM success. Emotional hardship (43%), financial hardship (33%), and work obligations (33%) are the top three major barriers that students indicated. Other major barriers that need to be noted are the quality of instruction (24%), caregiving obligations (19%), lack of motivation (19%), and lack of confidence in their STEM ability (19%). Figure 5 shows the major barriers and students' response numbers.

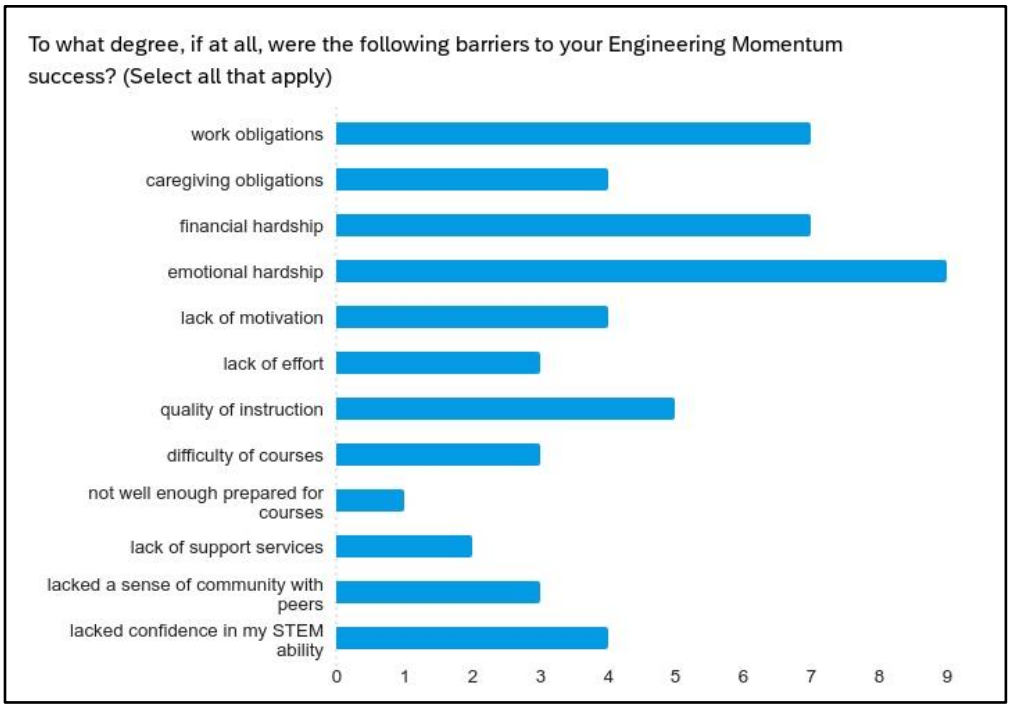

Figure 5. Students' major barriers to success in EM (n = 21).

Academic and internship outcomes

Students highly rated EM regarding the support for their math learning and internship application (Figure 6). Twenty nine percent (29%) of students indicated that the program prepared them for success in math *very well*, while 38% of students viewed their math preparation *somewhat well*. Compared to math preparation, students gave a higher rating for the program's help in preparing them for the internship application. Over 60% (n = 13) of students reported that they felt the preparation that they received for the internship application went *very well*. By May 2024 when students completed the survey, more than half of student participants reported that they had applied for the 2024 summer internship.

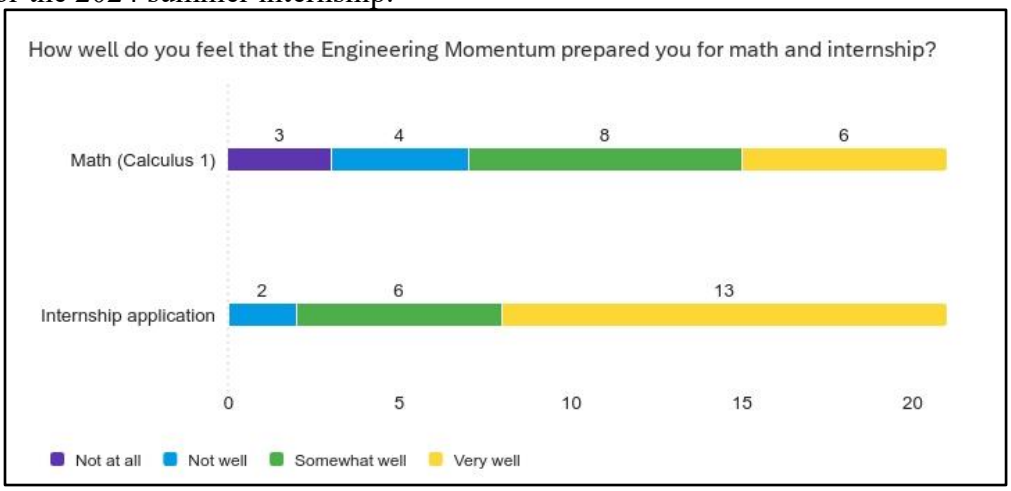

Figure 6. Students' reported math preparation and internship application (n = 21).

Mindset, career and educational goals, and decision-making factors

In this part of the survey, students were asked about their intent to pursue engineering/STEM careers and the factors affecting their plans during the program. About 95% (n = 20) of student participants planned and expected a career in engineering/STEM (Figure 7).

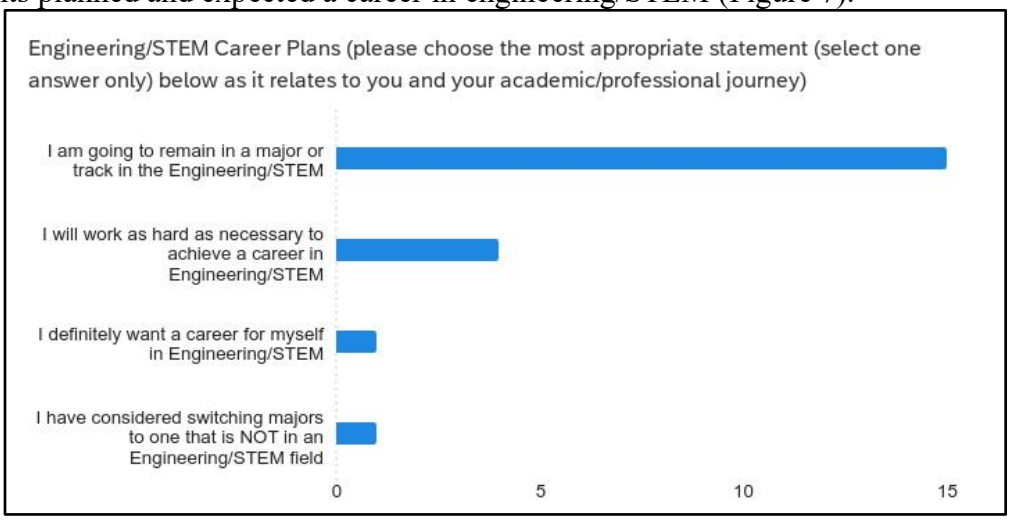

Figure 7. Students' reported intent to pursue engineering/STEM careers (n = 21).

Regarding decision-making factors, students stated that their academic plans were significantly impacted by their financial responsibilities (33%) and family responsibilities (33%). Moreover, students' financial responsibilities significantly impacted their professional plans (24%). Figure 8 demonstrates the factors and students' response numbers.

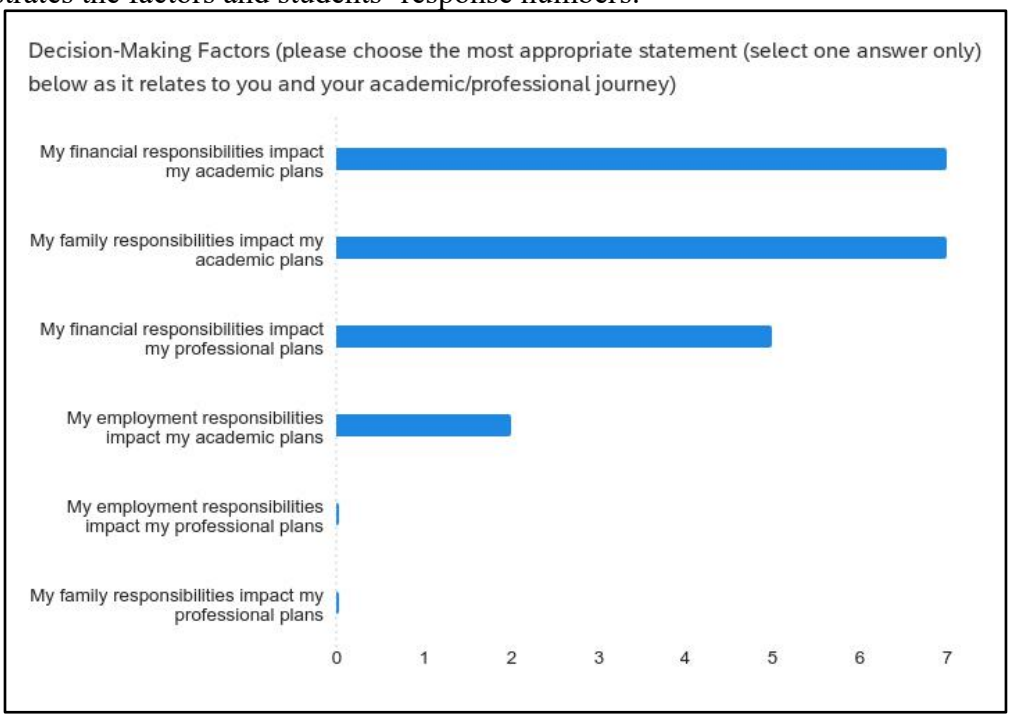

Figure 8. Decision-making factors' impact on academic/professional journey (n = 21).

Impressions on their program experience

We also included open-ended questions in the survey to encourage students to provide additional information about their EM experience. Students responded to the question asking how participating in EM made them think differently about their future career plans. One student participant noted:

> *"The program has definitely influenced my thinking about my future career plans. It has provided me with a deeper understanding of the various fields within STEM and the opportunities available. Through the program, I have also gained valuable skills and knowledge that I believe will be beneficial in my future career, particularly in software engineering with a focus on machine learning and AI. Overall, the program has reinforced my passion for STEM and has motivated me to continue pursuing my goals in this field."*

The student's comment echoes the goal of EM, which is to improve students' engineering knowledge and skills as well as increase their confidence in entering engineering careers. The experience of EM also helped students have a supportive network that motivated them to learn and cope with struggles, as indicated by the following comment from another participant:

> *"The program has opened my eyes to so many opportunities, careers, and connections. When I felt stuck and didn't know what I wanted to do, I was given so much support by my advisor and my teachers around me. I developed friendships and amazing relationships with those around me."*

Furthermore, students shared how EM could be improved. They expected to have "more in-person events," "bigger engineering projects," "more events and workshops," and "more meetings as a cohort." These keywords highlight that student participants enjoyed their EM experiences and wanted to engage themselves in more interactive activities of the program.

Discussion

This study explored community college students' experiences in an engineering program aiming to build their college capital for their academic and career pursuits in engineering-related fields. The first research question inquired about students' perceptions of their experience in the program. The findings show that student participants highly rated their participation in the program and its wrap-around support as beneficial to their preparation for math and engineering courses, as well as assistance with internship applications. Students' positive experiences suggest that the EM Program helps build students' college capital by offering them accessible instructions, guidance, and resources and equipping them with the knowledge to navigate challenges.

Our second research question asked about how students valued EM's impact on their academic and career decisions. Student participants indicated that the program components, workshops, and support from program-trained, embedded staff were valuable for their academic and professional journey at the point when they were in the program. Notably, about 95% of student

participants intended to pursue an engineering or computer science career. This suggests that the program plays an important role in strengthening students' momentum to reach their educational goals and retaining them in the engineering fields. Other findings of this study show that emotional wellness, work obligations, and financial pressure were the three main barriers to students' success in the program; this in turn provides insight into ways to further improve the program and its offerings by creating a more supportive learning space, encouraging more open communication, and educating students with coping skills in balancing multiple commitments.

One way to provide this support might be by implementing a transfer student ambassador program, in which engineering students who have already transferred and navigated this type of journey provide support and mentorship. Engineering ambassador programs have been quite successful for first-time in college students [8], so creating an ambassador program focused on the unique needs of prospective engineering transfers could be impactful. Additionally, we note that students preferred more in-person meetings as opposed to online options. While the program did not envision offering as many in-person options, we will consider restructuring these types of activities in the future. This shift to more in-person modalities suggests a shift in preference from some of the online preferences described in community college literature [9, 10].

Overall, this study showcases that the EM Program as an intervention can benefit community college students by building their college capital for success in engineering learning and career preparation, which further contributes to engineering education and the STEM workforce. In future articles, this study will also build on prior work to further explore the impact of research-based internships on students who are part of EM [7]. Their participation in summer internships can be—and our team believes, IS—life-changing for them and their current or future families. Through grant funding, we are able to offer these paid internship opportunities for students who may not otherwise learn about the career pathways available to them.

Acknowledgements

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