

Understanding Decision Processes Related to Pathways of Community College Engineering Students

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Title: Understanding Decision Processes Related to Pathways of Community College Engineering Students

Keywords: Transfer, Socio-economic status, undergraduate, 2-year Institution

Abstract

Research highlights the importance of having strong and strategic partnerships between 2-year and 4-year institutions to increase the number of transfer students in engineering, which has been identified as a key national strategy for broadening participation in engineering and computer science. Currently, research tends to focus on the perspectives and experiences of engineering students who successfully transfer to their bachelor's-granting institutions. These students often are easier to locate and willing to share their experiences with the transfer process. It is often much harder to understand students who followed a different path, particularly those students who had originally planned on attending a particular transfer institution but then made a different decision. Our study is uniquely positioned because of a partnership between both a 2-year and 4-year institution—we have access to and relationships with students who had originally planned on transferring to a particular 4-year institution but made a different decision along the way. We interviewed 11 engineering students who engaged in the Virginia Tech Network for Engineering Transfer Students (VT-NETS), a pre-transfer program that was organized to promote transfer to the College of Engineering at Virginia Tech. Those students ultimately chose other pathways, and we focus this particular study on understanding the role that the VT-NETS program still played in their decision-making processes.

Our findings suggest that as engineering students navigate the community college-to-bachelor's degree pathway, the pre-transfer program influences them through three distinct activities of the grant that we have labeled: Recruitment, Program Involvement (scholarship, proactive advising, cohort building, and perceptions), and After Pre-transfer program. Additionally, our findings show the influences on the decision against remaining in the program for these students included life events, comparable pre-transfer programs, academic challenges, and career shifts. The findings provide insights for fine-tuning programs designed towards engineering students pursuing a community college-to-bachelor's pathway and to share unique perspectives and experiences of community college engineering students who typically have not been represented in the literature.

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Introduction

Over a decade ago, the President's Council of Advisors on Science and Technology prioritized the need for over one million additional science, technology, engineering, and mathematics (STEM) professionals in the United States (Olson & Riordan, 2012). This initiative aligned with repeated calls from the National Academy of Engineering to broaden participation in engineering among underrepresented, first-generation, and low-income students (National Academy of Engineering, 2004). Given that underrepresented groups in engineering also are included in the fastest-growing subpopulations within the United States, it is important for the field to better mirror the demographics it serves. Community colleges have emerged as potential starting points for a more accessible and cost-effective pathway to obtaining a bachelor's degree in engineering (e.g., Grote et al., 2019).

Community colleges are recognized as pivotal contributors to a stronger national workforce and in increasing opportunities in STEM fields (Bahr et al., 2022). According to the American Association of Community Colleges report (AACC, 2023), 1,038 community colleges in the United States serve 10.2 million students (IPEDS, 2021), constituting 38% of all U.S. undergraduates and 30% of all first-generation college students. From 2008 to 2017, 52% of the 14.8 million students who obtained a bachelor's degree attended a community college, with 41% of those graduates majoring in engineering at the community college level (NCSES, 2020). While community college enrollments have rebounded post-COVID-19, four-year institutions, except for suburban campuses, lag behind in enrollments (NSCRC, 2023). The continued growth and role of community colleges underscore the importance of understanding the diversity of students they serve, and the pre-transfer programs designed to support aspiring engineering students seeking a bachelor's degree.

Previous research on transfer students' experiences has primarily focused on students who have successfully made the transfer to a different institution (Grote et al., 2022; Chamely-Wiik et al., 2021). However, there exists a gap in understanding the experiences of engineering students engaged in pre-transfer programs at community colleges who did not ultimately transfer to the intended partner university.

Purpose

This paper, utilizing a qualitative research approach, aims to fill the existing void by focusing on the influence and role of a pre-transfer program within the community college-to-bachelor's degree pathway for engineering students who opted for a different direction during their time at a community college. We utilize a combination of semi-structured open-ended interviews to address the following research questions:

RQ1: How does participation in a pre-transfer program influence the pathways of community college students who did not persist to the program's partner 4-year institution?

RQ2: Why did these community college students not persist within the program as it was designed?

Addressing these questions enriches our understanding of how pre-transfer programs can influence engineering transfer students in various ways. Understanding the decision-making processes of students will be beneficial for practitioners, researchers, and program developers aiming to refine and support pathways from community college to an engineering bachelor's degree.

Positionality

The first author, a first-generation college student, did not personally pursue the transfer pathway from community college to a 4-year institution. However, they shared similar experiences with participants as a low-income, underrepresented engineering undergraduate student. These prior experiences motivated the first author to create accessible pathways in various forms and shapes.

This author team includes tenured faculty members, an administrator, and a post-doctoral student. They hold strong commitments to interdisciplinary collaboration and partnerships in engineering education between community colleges and 4-year institutions. Additionally, they are dedicated to advancing equity and inclusion in the field.

Our intended goal with this work is to assist others in finding success in their pursuits, ensuring that social, racial, or systemic barriers don't hinder their success. Through this study, we aim to share the voices and experiences of a group of students who navigate complex structures and still manage to thrive.

Literature Review

Community College Transfer Students

As of Spring 2023, according to the NSCRC report, community colleges have seen growth across all its sectors. Community colleges have a history of providing educational opportunities to historically marginalized groups and currently serve 38% of all undergraduate students in higher education (AACC, 2023), with a strong representation of its students originating from minoritized groups. Community college students currently represent 52% of all Native American students, 48% of all Hispanic students, 39% of all Black students, and 34% of all Asian Pacific Islander students in higher education. The AACC (2023) report highlights the diversity of transfer students who attend the 1,038-community colleges in the United States but stops short of describing the life situations and challenges experienced by these students and how those situations may influence the path to transfer.

Community college students are typically older than students at four-year institutions with many working full-time and assuming additional family responsibilities (Dougherty et. al, 2017;

Rosenbaum et. al, 2016). The AACC (2023) reports that 62% of full-time and 72% of part-time community college students work full or part time jobs during their time in school. Community college students have a variety of post-community college goals that can vary from completing high school dual enrollment credits, vocational training to enter the workforce after graduation, to the majority who have intentions to transfer to a four-year college and complete their bachelor's degree when they originally matriculate.

Unfortunately, many enrolled community college students do not complete their degree or credentials (Dougherty et. al, 2017; Rosenbaum et. al, 2016). According to the Community College Research Center (CCRC, n.d.), of those students who started their studies in Fall 2020, only 62% were still enrolled a year later; and, of those students, 69% of full-time students persisted, but only half of part-time were still enrolled. The CCRC continues to highlight that even graduates among those intending to transfer often fail to achieve their goal of transferring to a four-year institution. It notes that in 2015, 80% of community college students reported having plans to transfer to a four-year college, but that six years later only 32% of those students had successfully transferred.

There are varying reasons explaining why students choose to pursue a community college-to-bachelor's transfer pathway or make the choice to stop attending an institution of higher education. For many students, their decision to step away from community college revolves around the financing of their academic pursuits, which includes not being able to afford school and needing to take time off to make enough money to return to school, struggling with financial aid problems, or being averse to taking loans (Daugherty et. al, 2020; Becker et. al, 2021; Ortagus et. al, 2021; Skinner et. al, 2022). On the other hand, there are community college students who found it challenging to establish a balance between school and their life commitments and make the choice to stop attending (Becker et al., 2021; Levesque, 2018). Some of these students make the choice to stop attending school because of their physical and emotional well-being (Becker et. al, 2021; Ortagus et. al, 2021). For others, it is the limited college knowledge of a clear pathway from their enrollment to a postsecondary credential, or inadequate advising about how to navigate this pathway (Daugherty et. al, 2020; Becker et. al, 2021; Levesque E., 2018; Ortagus et. al, 2021; Skinner et. al, 2022).

STEM Community College Transfer Students

Shifting the focus from community college transfer students across all fields to STEM community college transfer students clarifies unique challenges and disparities within these fields. As research around community college engineering transfer students, specifically, is still limited, this literature review expands to include STEM transfer students. Wang's (2021) work provides valuable insights into these distinct obstacles with the broader context of the transfer experience reviewed above. While also highlighting the gap that exists between the aspirations and realized goals of students aspiring to transfer, it is particularly pronounced in the STEM disciplines.

Wang (2021) identifies four critical challenges that impede the progress of STEM transfer students: 1) financial barriers, 2) issues related to degree programming and course offerings, 3) challenges within the teaching and learning environment, and 4) deficiencies in academic

advising. Notably, financial constraints are found to persistently hinder transfer students, particularly those pursuing STEM degrees, which are associated with higher costs when programs have differential tuition or additional fees in place. STEM degree programs also often require students to take a series of sequentially ordered courses. This sequencing in degree programming and course offerings is crucial for transfer students to make the most of their time after transferring, and often students are not able to progress until pre-requisites are successfully completed (Thiry et. al, 2023; Queen, 2022). This scenario makes the role of advising that much more important in guiding students moves between institutions (Harper & Thiry, 2022; Queen, 2022; Wang, 2021).

Wang (2021) further raises the question about the divergent trajectories of students who have similar transfer aspirations and underscores the need to bridge the gap between their aspirations and attainments. In the context of community college engineering transfer students, current research focused on engineering students has highlighted how engineering students dealing with vertical transfer face challenges with the mobility of credits across institutions which can make the transfer pathway a challenging endeavor. Richardson (2023) found that credit loss is experienced by all engineering transfer students in some form. Her research further reveals that this credit loss affects transfer students through their entire engineering transfer pathway. Grote et al. (2022) highlights the emerging and growing practice of tailored proactive advising to assist community college students intending to transfer to a four-year institution in accessing information and streamlining their coursework. Their findings showed that students felt that they were taking the right classes and moving towards a successful transfer. Their research further highlighted how proactive advising provided the students with insider knowledge that their peers did not have in navigating the transfer process and feeling like their aspiration and goals were moving forward.

Pre-Transfer Programs

Research underscores the importance of having strong and strategic partnerships between 2-year and 4-year institutions to increase the number of transfer students in engineering and to be able to study the different perspectives and experiences of pre-transfer students (Laugerman et. al, 2019; Ogilvie, 2017, Wyner et al., 2019). Chamely-Wiik et al. (2021) highlights programing that focuses on different transfer student challenges around academic and social interventions like transfer shock, early student engagement in research, mentorship by faculty, and building on academic belonging. These kinds of programs focus on assisting community college students when they arrive at their four-year institution. For example, prior work by Grote et al. (2022) has highlighted the experiences of successful transfer students in navigating coursework transfer in engineering after they had participated in a pre-transfer program that provided students with scholarships, advising, cohort participation, and a study abroad opportunity. The research design compared these students to students who had also successfully transferred but who did not take part in a pre-transfer program. Our current study delves deeper into this same institutional context, exploring the experiences of students who engaged in the same pre-transfer program but followed an alternate pathway than that envisioned by the program's design.

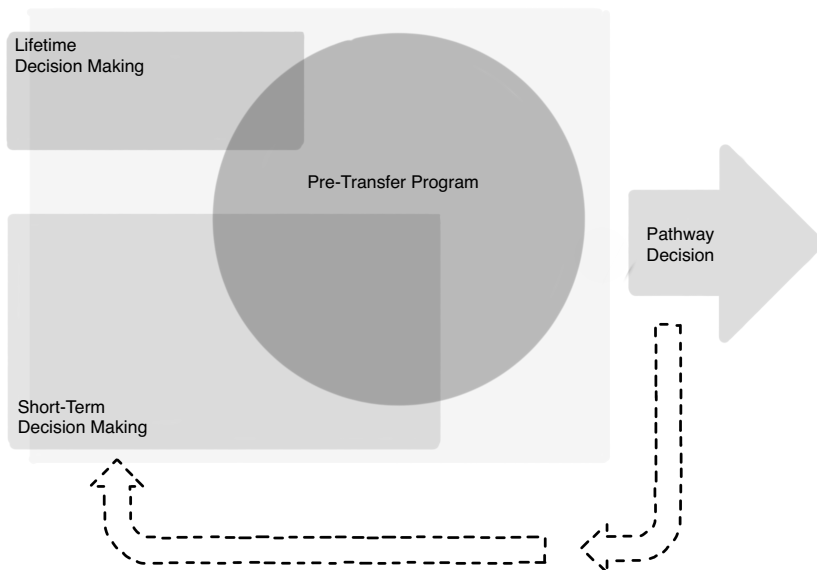
Theoretical Framework

This study is guided by Wickersham's (2020) College Pathway (Re)Selection Model Among Beginning 2-Year College Students (abbreviated as the Pathway (Re)selection Model hereafter). The framework focuses on 2-year college students starting in STEM programs or courses and looks at the subsequent decisions those students make as they navigate higher education (refer to Figure 1). The Pathway (Re)selection Model contains two main categories that define the purposes of the decisions students make as they navigate postsecondary education: 1) lifetime decision-making, and 2) short-term decision-making (Wickersham, 2020). Our study uses an adapted version of this model to frame the pre-transfer program and its influence. The model additionally describes the constructs of payoff, fit, transferability, place, flexibility, and mobility and their role in the decision-making process; this will not be included in this paper.

Although our research focuses on engineering students more specifically, we selected this model because of its focus on the related subpopulation of STEM students. The model provides a means to be able to observe the strategic and thoughtful process that 2-year college students engage in as they make progress in their programs and understand the adjustments that they make to their paths along the way. Because this study is looking at the influence that a pre-transfer program has on the pathways and experiences of community college transfer students, the framework provides a lens through which to analyze and speak to students' varying experiences.

Figure 1

College Pathway (Re)Selection Model Among Beginning 2-Year College Students



Note. Adapted from "Where to Go from Here? Toward a Model of 2-Year College Students' Postsecondary Pathway Selection," by K.R. Wickersham, 2020, *Community College Review*, 48(2), 107-132.

Methods

The current study forms part of a broader investigation into an S-STEM program designed to enhance the academic success of engineering transfer students transitioning from community colleges to bachelor's degree programs. This initiative aimed to establish stronger connections between two community colleges and a partnering 4-year institution. We employed a qualitative research approach to examine the influence of the pre-transfer program, referred to as Virginia Techs Network for Engineering Transfer Students (VT-NETS), on students from one of these community colleges. Utilizing Edmund Husserl's transcendental phenomenological approach, which seeks to delve into human experience and its essence, we aimed to describe the shared meaning-making processes among multiple individuals (Moustakas, 1994; Creswell & Poth, 2017; Yee, 2019).

Participants and Sampling

This study focuses on the VT-NETS program participants, who met the definition of low-income as required by the S-STEM grant. Participants in this target population were all students who attended one particular community college, engaged in the pre-transfer S-STEM program, but did not continue with the S-STEM program's partner four-year institution.

From the participants who took part in the pre-transfer program at this one community college, 30 students did not continue with the cohorts or program at the four-year institution. We emailed the possible participants at three different times during the 2023 Spring semester. Our sample includes 11 of these 30 students who agreed to take part in an interview (refer to Table 1).

Table 1

Study Participants

| | | Number of Participants | Percentage Total |
|--------------------------|------------------------------------|-------------------------------|-------------------------|
| Gender | | | |
| | Female | 2 | 18% |
| | Male | 9 | 82% |
| Ethnicity/Race | | | |
| | Black | 2 | 18% |
| | Latino/Hispanic | 4 | 36% |
| | Two or more races | 2 | 18% |
| | White | 3 | 27% |
| Degree Discipline | | | |
| | Accounting | 1 | 9% |
| | Aeronautical/Aerospace Engineering | 2 | 18% |
| | Civil Engineering | 1 | 9% |

| | | | |
|-----------------------|--|---|-----|
| | Computer Science | 2 | 18% |
| | Integrated Engineering | 1 | 9% |
| | Mechanical Engineering | 1 | 9% |
| | Psychology | 1 | 9% |
| | Software/Compute engineering | 1 | 9% |
| | Systems Engineering | 1 | 9% |
| Cohort Group | | | |
| | Fall 2017 | 2 | 18% |
| | Fall 2018 | 2 | 18% |
| | Fall 2019 | 4 | 36% |
| | Fall 2020 | 3 | 27% |
| Different Path | | | |
| | Did not transfer to partner institution | 6 | 55% |
| | Transferred to partner institution then to another institution | 1 | 9% |
| | Transferred to Partner Institution but not through program | 2 | 18% |
| | Other still at Community College | 2 | 18% |

Data Collection

Interview participants scheduled a time to interview with the first author over a 45–60-minute Zoom call. Following our IRB protocol, all students before interviewing were emailed a copy of the consent form and asked to read before arriving at the interview if possible. Any student who interviewed was compensated with a \$30 gift card from Amazon in recognition of their time.

We used a semi structured protocol (refer to Appendix A for the protocol) that was divided into four parts. The first part focused on getting to know the student and understanding their long-term goals. The second focused on short-term goals, and the third part focused on influences on decision-making within their college experiences. The last section of the interview protocol focused on their experiences with the pre-transfer program. During the interview, students had the option to keep their zoom camera on or off to help them feel as comfortable as they could. Interviews were all recorded and transcribed using a professional transcription service.

Data Analysis

For the analysis of these transcripts, we followed both open coding (Descriptive and In Vivo

Coding) and a priori coding to develop a codebook. The first step that the first author took in analyzing the data was to read each transcript to better understand the lived experiences of the students at a high level. By doing this step, we began to develop descriptive codes as described by Saldaña (2021), which captured the basic topic of the transcript, excerpt, or passage. After initial review and generating descriptive codes, the first author continued with open coding by using in vivo coding in the first cycle coding to capture the specific words and phrases used by the students in their interviews.

To conclude the analysis, we used the codebook that was generated to develop themes that spoke to the participants' experiences and aimed to respond to our research questions. To ensure that the quality of our research was reliable, the findings of the analysis were vetted by the project team.

Limitations

Although this qualitative inquiry provides valuable insights into pre-transfer programs, several limitations must be acknowledged. The study's findings might not be broadly generalizable because of the specific context and participants involved, which is consistent with the nature of qualitative research; however, emphasis was placed on knowledge transferability rather than universal applicability. The interviewer's affiliation with Virginia Tech might have influenced participants' responses despite efforts to minimize this bias by assigning interviews to a graduate student instead of the faculty members involved with the program. Furthermore, the self-selection of participants could have introduced a bias, potentially offering a skewed perspective of experiences within the program. Additionally, some participants, because of the passage of time since their involvement, may have had difficulty accurately recalling their experiences, possibly impacting the depth and accuracy of the gathered information.

Findings

Our findings suggest that, as engineering students navigate the community college-to-bachelor's degree pathway, the pre-transfer program exerts influence through three distinct grant activities. These activities, which we've categorized as Recruitment, Program Involvement (encompassing the scholarship, proactive advising, cohort building, and perceptions), and After Pre-transfer Program, strongly influence the students. Furthermore, our findings highlight that life events, comparable pre-transfer programs, academic challenges, and career shifts influenced these students' decisions against remaining in the program.

Recruitment

The findings highlight the influences that the pre-transfer program had on our participants' engineering paths when they were recruited for the program, which was an ongoing process as multiple cohorts were recruited for the study. For Dom, his plans to attend college in any form had been stalled as he was not sure how he would be able to afford school. The recruitment email that arrived in his inbox about the pre-transfer program opened a door for him he did not know existed and propelled him forward to pursue his degree:

When I was in high school, I got an email from a professor over here at [community college], telling me about this program that would help me transfer to Virginia Tech, and I reached out to her asking her that I was interested and she helped me get through the process of applying for the grant and everything, and I got accepted. So I told my family that I am going to go to college in the end, because initially I was planning on going to college, but I guess because of the cost and everything, I wasn't really too sure how I was going to be able to do it, if I was going to have to take out any loans. Because financial aid didn't really give me almost nothing for [community college], surprisingly.

In a similar way, the recruitment email that James, Link, and Leo received helped them financially; but for Link, it also redirected his academic trajectory by providing him another option of a career he could follow. He decided to change majors to engineering because of the opportunity's recruitment into the pre-transfer program provided:

I picked IT and I stayed in it for about a year, switched over to cybersecurity halfway through it. And then my friend showed me a scholarship opportunity for VT-NETS, and all I had to do was become an engineer, and I was like, "Okay, I'm down to become an engineer.

For Madison, she learned about the pre-transfer program in one of her classes, and upon realizing that she did not have enough credits to be considered full-time she signed up for more credits to be able to meet the requirements of the program. From her experience this had the positive effect that when she made the choice not to attend the partner institution, these extra credits were helpful in her new 4-year engineering institution.

In our findings, students' pathways were influenced by the recruitment email for the pre-transfer program in different ways: financial opportunities, credit transferability, and career plan shifts. The influence that the program had begun with an email and continues with its programming.

Program Involvement

In our findings, we noticed that the time and level of involvement in the pre-transfer program made a difference in the influence the program had on students. However, COVID-19 and the associated shutdowns was one of the biggest variables in these students' opportunities to be involved in the different elements of the pre-transfer program. Mia highlights how each component of the program, from a study abroad opportunity to the cohort experience, provided her with learning opportunities that provided her with support as she navigated the transfer experience:

I felt like VT-NETS was a great program. I would say I liked the Global Engineering class a lot. I really liked the opportunity to travel with that program as well. I also liked how it gave us a cohort, just giving us the opportunity to relate to one another as well. And I also liked the advisors, it gave us to have additional resources as well.

Participants noted the role of advising in helping them rewrite the course work that they original thought was needed to transfer. Additionally, they highlighted how advising strengthen their

decision around the program and attending Virginia Tech. Lastly, pre-transfer program advising also played an important role in assisting after they had left the program with navigating the more complex side of transferring credits to a non-partner institution. James highlights his advising experience:

... the advising. I think that was the best part because like I said, I came into college with it sounds cool... But [program advisors], I would always have my advising meetings and that's why having that path established for me of regardless of which school I want to transfer, they gave you the resources like, hey, here's the websites that you need to know and here's all the things and here's what colleges will accept what and all this stuff. That was the most valuable thing that I gained out of it.

For our participants, being able to have the scholarship provided them with financial support that they were able to leverage towards needed technology, financial needs, and, for students like Leo and Mia, reduced working hours. Leo shares how for him the scholarship was a miracle in his life and influenced him to take on less hours at work:

I joined VT-NETS because I saw that was, for me, it was a good opportunity financially that it could help me to alleviate some of that financial burden, I will call it. And it really, really helped me a lot because I didn't have to work that much, or I knew I had some aid that it could help me to alleviate that burden because I was working almost like 30 hours when I was being a full-time student back then. And receiving that aid was a miracle, honestly.

In our analysis of program involvement, our participants highlighted how certain planned events were cancelled and their experiences with the program were limited due to the online format that the program took for them. For Ricky this experience while not complete, ended up being a positive one as he was able to gain an international perspective through the preparation that was part of the program.

A lot of students, or at least a lot of the friends that I made had a very international perspective, and so being able to hear their stories and make friends like that was definitely an added benefit of that experience with VT-NETS ...I'll definitely say it helped my international perspective. Even though the trip was canceled, just learning about it, and discussing it with my friends, that perspective definitely helped.

On the other hand, Link found that while the opportunity to take a trip abroad helped him narrow his field of study, he found that he had missed out on other aspects of the program including university visits, cohort meetings and research opportunities.

After Pre-Transfer Program

This section highlights the resources that the pre-transfer program continues to provide to students beyond their involvement in the program. Madison had developed a relationship with her VT-NETS advisor, and when it came time to navigate her transfer to a different institution, she relied on this relationship to navigate the space. In her interview, Madison shares that

navigating the transfer to an institution she was not originally planning to attend brought with it many challenges that were exacerbated by the fact that she had been out of school for three years and had not maintained contact with her past professor who she now needed to contact to transfer:

The transfer process was honestly so, so complex. They require so much. If my professor [was also advisor] hadn't helped me with the transfer, I think I would've started at the school basically with a freshman level academics... the school required the syllabi [for courses] ... It was hard to reach out to, or remember, my professors...I had my professor at the time, who was also my advisor, message all of the professors. So that was very interesting. But yeah, the school required a lot and transferring was really messy. I didn't really like that process... She was at [community college]. I think she also participated with the VT-NETS ...She is amazing. I am eternally grateful for her.

For those participants who were able to take part in the study abroad aspect of the program, they highlight how their global perspective around engineering continued and has influenced the way they approach engineering. Link highlights that for him the experience of being part of the study abroad program helped him narrow down the career he is now pursuing beyond the program.

I went to Italy and Germany, and we visited a lot of companies, and it just helped me realize...Well, there was also a class attached to it where we had a bunch of speakers coming from high positions, and it's helped me hone down what I want to do engineering wise, so that had the most effect.

Our findings highlight how recruitment is pivotal for some students to begin to continue their pathways, how program involvement is not all just about focusing on giving out financial assistance, but also the co-curricular programming of proactive advising, cohort building, and broadening the students' perceptions of engineering. Concluding with the influence that takes place after they are no longer involved in the pre-transfer program but continue to use the resources that the program helped to build for them.

Influences on the Decision Against Remaining in the Program

In this section, our analysis focuses on reasons why students did not persist within the program as it was designed. While we focus and separate our four themes as to why our participants did not persist, it is important to note that multiple variables were also involved and intertwined in the decisions that each of the participants made. For many, finances and COVID-19 influenced their life events, some pointed to a comparable pre-transfer program was more appealing, and GPA requirements pushed decisions and actions that provided time away to reflect and make the choice to change careers.

Life Events

For students in the program, life events took varying forms. The first was that of a global pandemic and other health issues that took them away from school or led to them facing

academic challenges. Personal life events, such as moving, family deaths, and balancing family roles, with school responsibilities also played an important role. George shares his experience of how for him a decision to leave for another state was the reason he did not persist:

I just left for three months to go to [another state]. And I think ultimately that's where I fell out of the VT-NETS program because it was before that, that I got into the VT-NETS program while I was still trying to do the [Certified Nursing Assistant] (CNA) thing and in school and trying to juggle all of that. Yeah, it was about that time.

For George, like many of our students, they found themselves juggling many life events that for some did not only take them away from the pre-transfer program, but they also took them away from higher education. Some of those students later returned to finish either in engineering or in a different field of study.

Comparable Pre-transfer programs

In addition to life events, comparable pre-transfer programs also provided students with varying opportunities to pursue different institutions and to navigate the transfer process. Leo shares with us how he went about leveraging two programs to find success in his engineering path:

I was in two programs. One is VT-NETS and the other one is [different program], which is the agreement between [community college] and [different university]. I first joined [different program] because my first path was like to go into [different university], and that was the easiest path. I would say that when you join [different program], basically you are also a [different university] student, but you're taking class at [community college], like you are taking just your first two years at [community college] and then you transfer to [different university], but you're still a [different university] student. I joined also VT-NETS because I saw that was, for me, it was a good opportunity financially that it could help me to alleviate some of that financial burden.

For Leo, his original intentions where to attend George Mason but being part of two programs provided him the opportunity to receive support from both programs and take the strengths from each, giving himself more opportunities when it came time to make the decision to transfer.

Academic Challenges

Mia reflected in her interview how her academics began to struggle because of the many activities that she had to juggle and how even with her best effort it was just not enough, and she was dropped from the program:

And I remember even reaching out to [advisor] and letting her know I was struggling, and I was in danger of failing and falling behind the cohort. So, I reached out to as many resources, I got a tutor, I tried to pass, but I ended up not passing. So that set me back. And then they gave me the opportunity again within the VT-NETS Program to catch up. But at that point, it was too late for me to apply with the VT-NETS cohort. And then I

tried to apply to Virginia Tech by myself, and I didn't get in. And then my second choice was [different university].

Some of our participants, much like Mia, found that COVID-19 and the sense of isolation that they felt further affected their grades and ability to continue meeting the requirements of the program. These students expressed that after they were able to improve their grades, they wish there had been a way for them to return to the program and continue to take advantage of its opportunities.

Career Shifts

In our last notable theme of the study, Josh made the decision to change from engineering to accounting. He was in the middle of his transfer to Virginia Tech (VT) when he made the decision that he would change course and follow a new path:

...it was around the time I applied to VT and it was in engineering. I was in the engineering department. But the issue, I experienced some financial aid issues, and after, I just decided not to go to VT, I took a gap semester. And during that gap semester, I just reflected on what I liked and whatnot, and I was always just interested in business and understanding how business was run and whatnot. So, I figured, you know what, I could just get into accounting, I figured about accounting and that's why I changed it. But I didn't really know accounting had a lot of jobs initially when I transferred, I just thought it was just interesting, so I just transferred to that.

Each student had different circumstances that lead them to not persist with the program, but each found their own way to continue to pursue a bachelor's degree.

Discussion and Implications

This study emphasizes the crucial role of a pre-transfer program throughout the community college-to-bachelor's degree pathway. We identified three critical ways the pre-transfer program influenced engineering students: Recruitment, Program Involvement, and After Pre-Transfer Program. The program's influence began with recruitment and extended through various components. Recruitment emails and program benefits influenced students by offering financial opportunities, credit transferability, and the exploration of new career paths.

This study makes a significant contribution by showcasing students who participated in a multimillion-dollar S-STEM grant but did not persist to the program's intended partner institution. It allowed us to explore the program's limitations and potential improvements. It also demonstrates that even with ample resources to assist students in the transfer process, some opt for different paths. For some students, this involved leveraging multiple programs to find their best path forward and establish their strategy for success. Others found the program's most important influence in enabling college entry and financial stability.

Participants did highlight that one of the struggles they faced was that the constraints of the program did not give them the chance to redeem themselves and return to the program.

Additionally, this study highlights a very important notion around money and how it is used by students. Prior studies establish that transfer students often face financial challenges in their academic pursuits (Daugherty et. al, 2020; Becker et. al, 2021; Ortagus et. al, 2021; Skinner et. al, 2022). While most studies focus on the financing of tuition and fees, our study highlights how financial grants and scholarships can impact students beyond just covering tuition and fees. They can reduce the need to work long hours, purchase necessary technology, and provide students with flexibility and opening doors that they thought were close. The intentions of the program were to provide a scholarship for tuition and fees, but the students found additional uses for the funds by freeing up resources and time in other areas. These ideas are salient in this discussion because, while students had a scholarship, it meant they were no longer juggling multiple responsibilities; rather, they were able to reduce the hours they needed to work to find financial stability.

The study further explores how pre-transfer programs influence students at various stages of their journey. The flexibility of such programs and their influence on students' career decisions is highlighted. Some students faced challenges like personal life events and the impact of the pandemic. The cost of education and minimizing student debt are significant concerns for students, leading them to make strategic choices about their academic and career paths. Our study was framed by Wickersham's (2020) conceptual model College Pathway (Re)Selection Model Among Beginning 2-Year College Students. This framework was developed to look at the decision that 2-year college students starting a STEM program or course make as they navigate higher education. For the purposes of this study, we used the two main categories of Lifetime and short-term decision-making to guide our observations of the strategic and thoughtful process that these students engage in as they made progress and adjustments in their respective programs.

It allowed us to highlight the role of advising and the crucial role it plays in students' success and persistence. Advisors should be encouraged to help not just with academic planning but also serve as points of contact and support for students. Additionally, co-curricular activities, such as study abroad programs and cohort-building initiatives, have a positive impact on students' perspectives of engineering and can help them thrive in their academic journeys. Students may not always follow a linear path to their desired institution or career, and that's okay. Community colleges should acknowledge the diversity of students' journeys and be more flexible in their support. Lastly, pre-transfer partnership programs should actively communicate opportunities to incoming or current high school students, especially those from low-income and underrepresented backgrounds

These findings highlight the multifaceted nature of community college-to-bachelor's degree pathways and emphasize pre-transfer programs' significance in supporting students. Advising, financial support, and adaptability emerge as critical elements in helping students overcome challenges and make informed decisions. The experiences and choices of these students emphasize the need for flexible, personalized approaches in higher education.

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Appendix A: Interview Protocol

Protocol for Interviews with Transfer Student in the Virginia Tech Network for Engineering Transfer Students (VT-NETS) Grant Program

The primary area of exploration for these interviews with students is to better understand the experiences and impact of the VT-NETS program on the pathway decision(s) that students made while in the program and after.

Before we start,

- Do you have any questions for me?
- Did you have an opportunity to review the consent form? (If not, can you do that now?). Do you voluntarily agree to participate in this study?
- Is it okay to record this interview? (Only audio recording; video recording will not be used)

Repeat prompt after you start recording:

Today is _____ (date) at _____ (time). This is _____ (interviewer name) interviewing _____ (participant's name).

Part I - Life-time Decision Making

We want to get an idea of what your career goals and academic pathways are/where.

1. To begin, can you tell me a little about yourself?
 - a. How do you identify? (Class, race, gender identities, etc.)
 - b. What path did you take after graduating from high school?
 - c. Where are you now? Working, school, etc.?

2. In general, how have things been going [in terms of school or work]?
 - a. If still enrolled in Northern Virginia Community College (NVCC)?
 - i. How are your courses going?
 - ii. What are your plans for school?
 - iii. Where do you see yourself in 5 or 10 years, in terms of jobs?
 - b. If still enrolled in NVCC:
 - i. What support have you had for continuing your path?
 - ii. What barriers or problems have you encountered along the way?
 - c. If transfer from NVCC occurred:
 - i. How was the transfer process for you?
 - ii. How do you like(d) being a student at [name of new college]?
 - iii. What is/was the new environment like as opposed to where you were in the past?
 - d. If transfer has occurred:

- i. Overall, what is/was your new college like as opposed to [name of previous college]?
- e. If no longer enrolled:
 - i. Why did you stop going to school?
 - ii. Are you currently working? If so, could you tell me more about your job(s)
 - iii. What are you planning to do now (or in the future)? Any plans to re-enroll?

Part 2 - Short-Term Decision Making

We want to get an idea of what your college goals and experiences are/where.

- 3. How did you come to decide to attend NVCC?
- 4. What are/were some of your goals for attending college?
 - a. If still enrolled in community college:
 - i. Looking to the future, have you thought about attending or transferring to a different college? Why?
 - ii. What influences your decision to attend other colleges?
 - iii. Can you tell me about a time(s) when something or someone influenced your decision?
 - b. If student did not successfully transfer to Virginia Tech (VT) or other institution:
 - i. What knowledge did you have about the transfer process when you started in Community College?
 - ii. Tell me about how you went about gaining knowledge of the transfer process.
 - c. If student successfully transferred to other institution, (not VT):
 - i. What knowledge did you have about the transfer process when you started in Community College?
 - ii. Tell me about how you went about gaining knowledge of the transfer process.

Part III - Influences

We want to get an idea of the influence the following factors had on your decision making.

| Influence | Description |
|---------------|---|
| Payoff | Maximizing Financial and Post-Graduation Rewards: Looking for the best and most for the money you put in. |
| Fit | Finding a Path That Suits: A match for what you are looking for, whether it be institutional environment, size, program, academic preparation, etc. |

| | |
|------------------------|--|
| Transferability | Moving and Applying Credits or Programs: The ease or not of being able to move and apply your credits to another institution. |
| Place | Connection to a Location: where the institution was located was very important. |
| Flexibility | Making It Work Through Course and Program Options: permits you to take care of other responsibilities and attend college at the same time. |
| Mobility | Moving on and Moving Up: personal or professional growth, such as career advancement or lifelong learning |
| Other: | Any Influence that you can think of, that falls outside of these options |

5. Which of the following factors were most important for your decision to initially enroll at _____? [Decision of cc]
6. Which of the following factors were most important to your decision to pursue a degree in engineering? If you changed, why and what factors influenced that change?
7. Which of the following factors were most important to your decision to (go to/do) _____ after you left _____? [Decision of post-cc plans]

Part IV - VT-NETS

For this next part we want you to reflect on your time as a VT-NETS student. We are seeking to understand the transfer process more fully, specifically the role of programs like VT-NETS in helping students navigate the different pathways. The next set of questions will ask you to think about your experiences with VT-NETS.

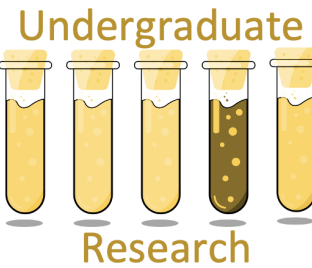
8. What do you remember about your experience with VT-NETS?
 - a. Why/how did you decide to take part in VT-NETS?
 - b. How did being part of VT-NETS influence your community college experience?
 - c. Do you feel that any of your social identities (e.g., class, race, gender, etc.) impacted your experience with VT-NETS or at your school?
 - d. How did the prospects of receiving a scholarship impact your decisions?
9. Thinking back to when you started in VT-NETS, what would you say has been the most helpful to you in terms of reaching your goals? (e.g. school, life overall, or for the future in general)
 - a. What created a barrier for you in realizing your goals, if any?
 - i. [more direct question, wondering how to ask about whether they would have changed major]

10. What of these specific experiences did you participate in and remember? Can you tell me how those experiences were either helpful or created barriers for you?

VT-NETS Pre-Transfer Programs



Advising & Monthly Meetings



University Visits



Study Abroad



11. How has/was your experience been impacted by COVID-19?

12. Is there anything else you would like to share or add that I may not have asked about?