



Tapping into the Talent: Exploring the Barriers of the Engineering Transfer Pathway

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Abstract

In order to remain globally competitive, the United States must maximize our nation's capacity for innovation. Although the United States has long been a world leader in innovation, global competition in the production and retention of Science, Technology, Engineering and Mathematics (STEM) talent is currently a major threat to the country². In fact, to address heightened concern regarding the United States' global position, several national efforts have been implemented to increase the number and diversity of students pursuing degrees and entering STEM careers. In 2012, the President's Council of Advisors on Science and Technology announced that by 2022, the country would need 1 million more STEM professionals than projected to be produced¹⁸. One critical asset to reaching this capacity lies in the cultivation of competent, adaptable engineers prepared to lead in a global economy. As many engineering careers begin at community colleges, maximal engagement of students from community colleges at the university level is of paramount importance^{3,4,22}. The Center for Diversity in Engineering at the University of Virginia (U.Va.) is interested in and committed to enhancing pathways to engineering for all students. However, in efforts to achieve this, university specific barriers to the transfer process must first be identified and understood. The purpose of this qualitative (work in progress) study is to understand the barriers from the students' perspective in transitioning from engineering in the community college environment to that of the School of Engineering and Applied Sciences (SEAS) at the U.Va.

Introduction

The National Center for Education Statistics reports that in the year 2013, 3,871 Engineering, 37,475 Engineering Technology and 38,897 Computer Science associate's degrees were awarded²⁴. This is a very vital set of statistics when one considers that more than 50% of undergraduates from underrepresented groups attend community college^{9,17,22}. It is projected that the majority of jobs will continue to be in computing, accounting for approximately 71% through the year 2018 with traditional engineering (16%) and physical science (7%) as the closest runner ups^{17,23}.

Of the 50 states, Virginia ranks 5th for the number of projected STEM jobs with an anticipated 404,000 by 2018¹⁰. In addition, Governor Terry McAuliffe recently announced that 1.4 million jobs would need to be filled in Virginia by 2022 with more than half of those positions being in STEM and health care fields and requiring postsecondary education¹⁰. It is the charge of the United States' educational system to develop the talent to supply the workforce of tomorrow and Virginia, specifically, has an ambitious undertaking ahead^{7,10,17}.

As a public university, the opportunity to maximize 2-year to 4-year pathways to engineering as viable incubators of talent is apparent. There is a national demand for engineering talent and particularly from women and underrepresented minorities^{1,13}. In 2012 in Virginia, women, Blacks and Hispanics were each underrepresented in the number of degrees/certificates conferred in STEM fields compared to the college-age population for their demographic groups⁷. To demonstrate increasing trends for underrepresented students to initially matriculate two-year colleges rather than four-year institutions, Figure 1 shows Hispanic students increasingly enrolling in the Virginia Community College System compared to Virginia public 4-year institutions over a span of five years. In a time where population demographics are shifting and less people from underrepresented groups are choosing to enter STEM related fields of study,

there is an urgent need to capitalize on the talent pool of community college students for four-year institution engineering programs^{1,6,8,13,17,21}.

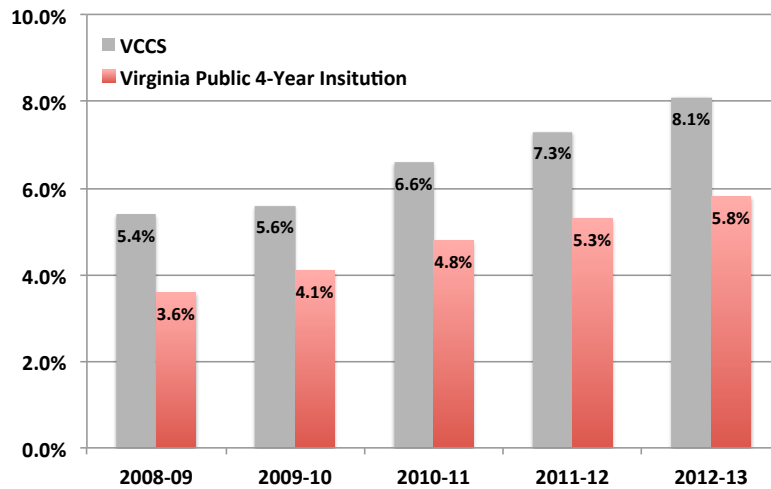


Figure 1. Percent of Hispanic students enrolled in Virginia’s public institutions. Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics.

Community college enables students to learn of the opportunities available to them by various careers in STEM. Students of the Virginia Community College System (VCCS) earned 31,000 degrees, diplomas and certificates in 2014¹⁰. Currently, more than 25 public and private schools have Guaranteed Admissions Agreements with the VCCS where approximately 56% of graduating students are in transfer programs planning to pursue a bachelor’s degree¹⁰. Figure 2 shows that more than 40% of Virginia Community College System students enrolled in the 2010-11 Academic Year transferred to a 4-year institution by 2014.

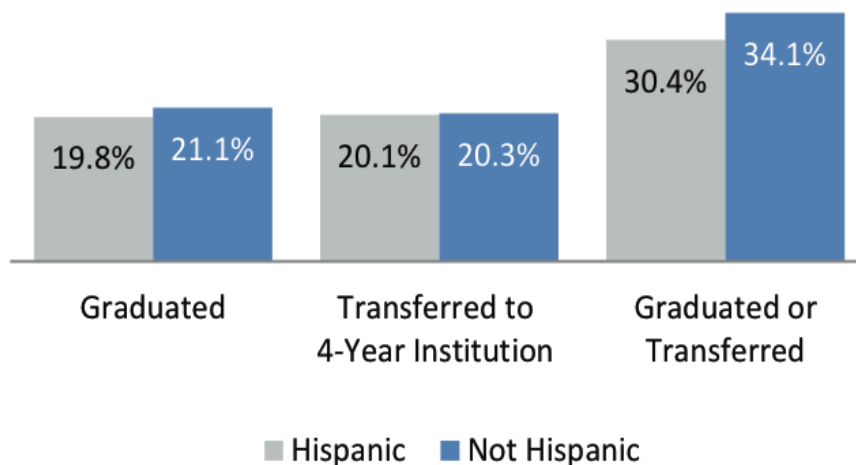
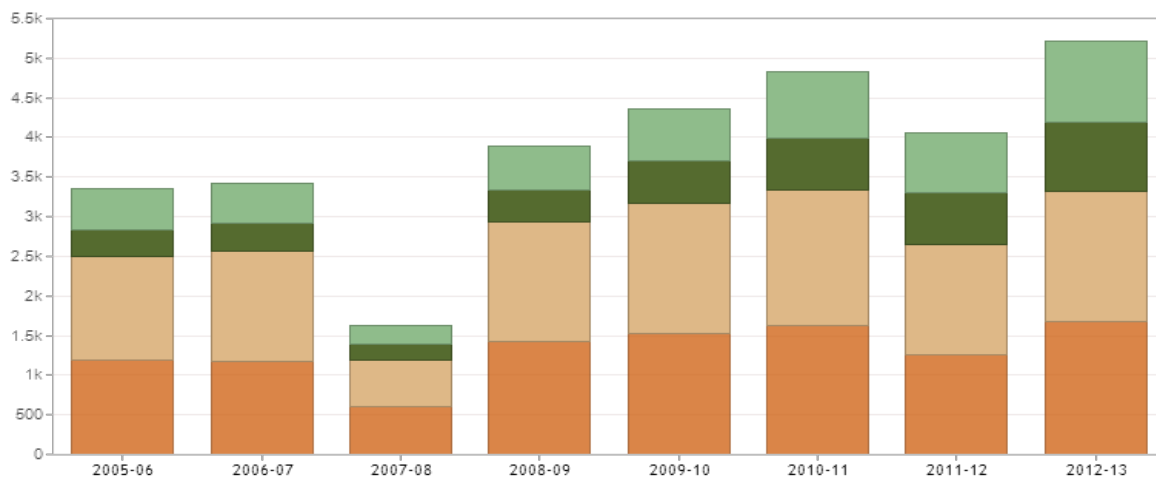
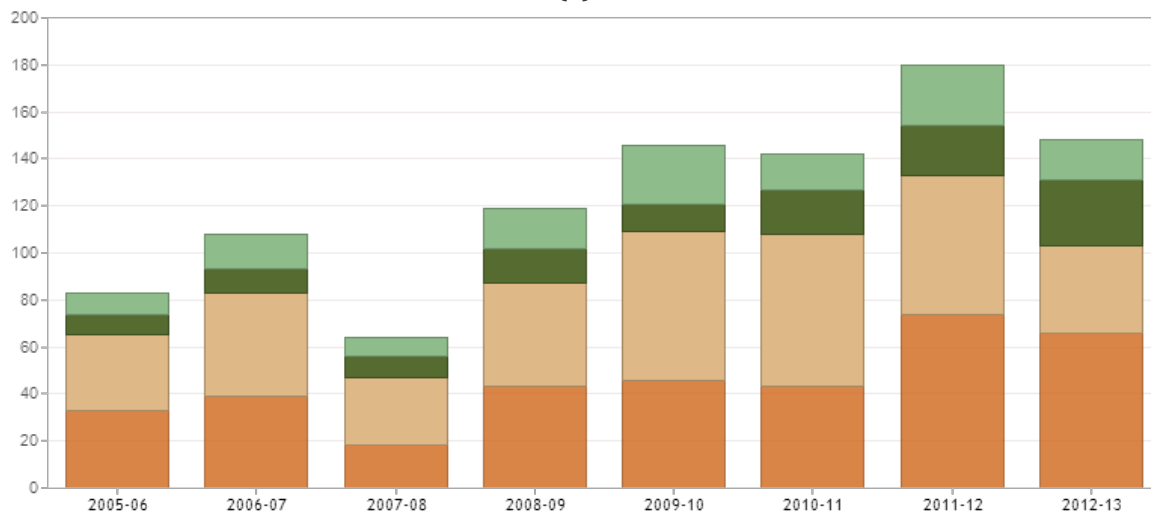


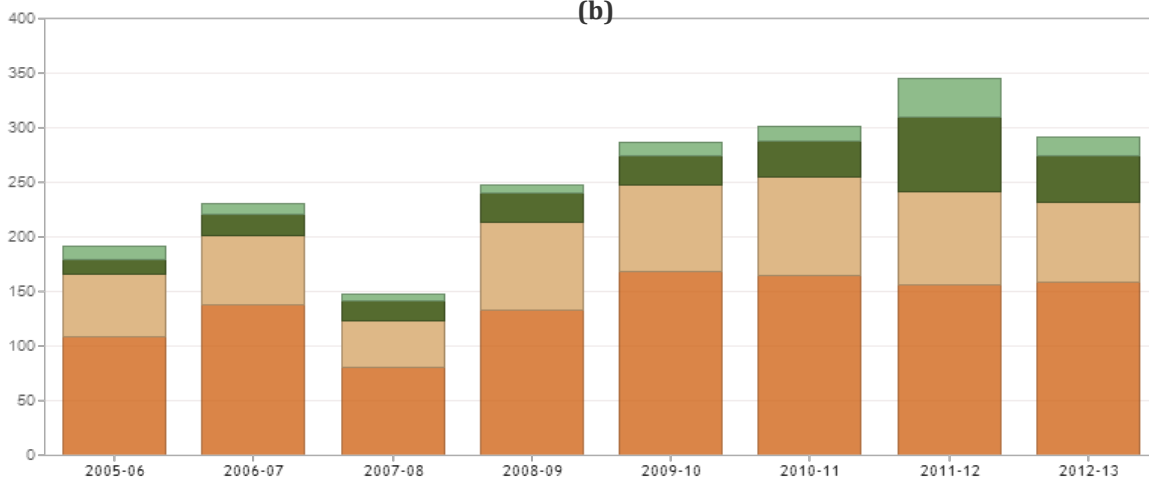
Figure 2. Percent of students enrolled in 2010-11 Academic Year graduating by Summer 2013 or transferring to a 4-year institution by Spring 2014. Adapted from VCCS Snapshot data.



(a)



(b)



Number of Transfers to Four-Year Institutions.



(c)

Figure 3. Community college students with between 16-30 credits transferring into (a) total public 4-year institutions, (b) the University of Virginia and (c) Virginia Tech in the Fall and Spring of the designated years. Adapted from *Source: State Council of Higher Education.*

The State Council on Higher Education for Virginia (SCHEV) collects data on Community College transfer trends. Figure 3 shows data for Virginia Community College System students with between 16-30 credits transferring to a public, 4-year Virginia institution, U.Va. or Virginia Tech. With the exception of the academic years 2007-08 and 2011-12, there has been a steady increase in the students transferring to public institutions. However, for both U.Va. and Virginia Tech, transfers decreased in 2013. In the year 2012-13, 5,209 students transferred to a public, 4-year Virginia institution. This included approximately 148 students transferring to the U.Va. and 292 students transferring to Virginia Tech, which nearly doubled the transfer enrollment of U.Va. With regard to diversity, 1,885 (36%) of those transferring to public, 4-year institutions were students of color. At U.Va., 45 (30%) were students of color compared to 60 (21%) at Virginia Tech²³. Although these numbers include transfer students from all disciplines and not solely engineering, it clearly demonstrates the pool of underrepresented students in the community college population as a viable source for cultivating engineers to meet the demand of the future. As the #2 Best Public University, it is important to discern the critical factors students are considering in the selection of their transfer institution. As the transfer experience can be very daunting for community college students, a greater understanding of the barriers to entrance, retention and academic excellence will be invaluable in creating sustainable pathways to engineering programs at the University of Virginia.

Table 1: Annual VCCS graduates and credential awards by college.

Community College	Number of Students Earning a Graduation Central	Total Number of Credentials Awarded
Blue Ridge	701	961
Central Virginia	693	928
Dabney S. Lancaster	179	232
Danville	669	833
Eastern Shore	148	182
Germanna	1,012	1,712
J. Sargeant Reynolds	1,635	1,800
John Tyler	916	1,389
Lord Fairfax	1,062	1,280
Mountain Empire	599	731
New River	599	673
Northern Virginia	6,680	7,719
Patrick Henry	559	683
Paul D. Camp	194	277
Piedmont Virginia	678	824
Rappahannock	506	662
Southside Virginia	1,388	1,447
Southwest Virginia	465	584
Thomas Nelson	1,275	1,629
Tidewater	3,992	4,359
Virginia Highlands	428	662
Virginia Western	985	1,150
Wytheville	716	1,059
VCCS	26,079	31,776

As a part of the Virginia Community College System’s strategic plan, *Achieve 2015*, student transfer and graduation data is being tracked as a measure of student success. There is an explicit goal to increase the number of students graduating, transferring or earning a workforce credential by more than 90,000⁹. The accomplishment of such goals will result in greater applicant pools and students interested in transferring to the university, which will ultimately need to be accommodated at the university level. According to a 2005-06 VCCS report, 38% of students who graduated from VCCS in a STEM field continued in a STEM field at a 4-year institution. Additionally, of students earning an associate’s degree from VCCS and transferring to a 4-year institution, 75% completed a bachelor’s degree⁹. Although these numbers represent students from all STEM disciplines, an increase in overall numbers will directly increase the influx of engineering specific transfers. Table 1 shows the 4-year institutions most commonly attended by 2005-06 VCCS graduates.

Table 2. Four-year institutions most commonly attended by 2005-2006 VCCS graduates adapted from SCHEV Transfer Cohort Lifecycle Data http://research.schev.edu/feedback/transfer/xfr_lifecycle.asp.

Transfer Institutions	VCCS Graduates Transferring	
	N	%
Old Dominion University	1175	19
George Mason University	1004	16
Virginia Commonwealth University	463	7
James Madison University	292	5
Radford University	280	5
Strayer University	212	3
Virginia Tech	174	3
University of Phoenix	155	3
University of Mary Washington	151	2
Liberty University	144	2
Norfolk State University	119	2
University of Virginia	110	2
Other Institutions	1896	31
Total	6175	100

As evident from Table 2, the University of Virginia has trailed other state institutions in the admission of transfer students. The University of Virginia is one of the public universities with an operating admission agreement in place with the Virginia Community College System and this document has guided the transition of students having received an associate’s degree in engineering to the U.Va. SEAS since 2012. Despite the existence of this pathway, VCCS transfer applicant pools to the University are low. It is our belief that having a better idea of how students select their transfer institutions and the experiences they have post-matriculation could potentially help identify areas of opportunity and intervention to improve the overall process and hence student success. However, to our knowledge, a student-focused investigation of the perceived barriers in transferring to the U.Va., and specifically the SEAS, has not yet been conducted.

This work is an attempt to learn firsthand about transfer student experiences, which will facilitate awareness of student-perceived barriers to the transfer process. It is anticipated that this study will shed light on areas of intervention where strategies can be developed and implemented to eliminate and/or improve existing barriers. Such efforts will enhance existing transfer pathways to the University of Virginia and support the continuation of learning for students that have demonstrated mastery of technical subjects at community colleges. Such enhancements could potentially benefit the students in their professional pursuits and be transformative to the development of the engineering workforce in the South Atlantic region and beyond.

Background

The University of Virginia School of Engineering & Applied Science is a leading public university with a focus on undergraduate education. There are 2,688 undergraduates where 31% are women and 29% are from other underrepresented populations. The 2014 first-year applicant pool consisted of 5,748 applications. 1,694 offers were made. 632 students accepted the offer and matriculated the university. Of this accepted pool, 95% were in the top 10% of their high school class, 31% were women, and 69% were in-state students.

Transfer Admission Process

At the University of Virginia, transfer applicants are students who have earned twenty-four or more semester hours (the equivalent of one full year) of college credit after graduating high school. Students are ordinarily admitted for the fall semester. Applicants are required to apply online via the Common App Website and also provide the high school transcript, college transcript(s), and SAT (or ACT) scores. There is a March 1 deadline for August admission and October 1 for January admission. Additionally, there are specific transfer requirements according to the school and program an applicant wishes to enter.

Transfer admission to the School of Engineering and Applied Science is accepted only for admission to the Fall term. Students are expected to be in both good academic and social standing. Applicants from the VCCS are encouraged to enroll in the Associate in Science degree program with a specialization in engineering (when applicable). When the Associate in Science degree program in engineering is not offered, it is recommended that students enroll in a comparable first year course load with the intention to transfer into the second year. Transfer students are admitted into the School of Engineering and Applied Science and not directly into an academic major during the admission phase. Student placement into a SEAS major takes place at a later date after review of transfer credit and other forms of advanced standing. Admission to a specific degree program is not guaranteed and is impacted by space availability and departmental entrance requirements.

Course requirements for transfer in the SEAS are as followed:

- Calculus (8 credits)
- Chemistry (4 credits with at least one calculus-based chemistry course)
- Physics (4 credits with at least one calculus-based physics course)
- Computer Science (3 credits including a course in introductory computer programming with a preference for JAVA)
- English Composition (transferring university's full course sequence)

**Specific attention of the Admissions Committee is given to transfer candidates' academic performance in math and science courses.*

Guaranteed Admission Agreement

In January 2012, the University of Virginia entered into agreement with the VCCS granting admission to students meeting the criteria outlined in the Guaranteed Admission Agreement. In order to fulfill the criteria, a student seeking admission to the SEAS must:

- Complete an Associate of Science degree, Associate of Arts and Sciences degree in Engineering or Science, or an approved transfer degree by the State Council of Higher Education for Virginia (SCHEV) Associate Degree in General Studies program in the VCCS within two years of matriculating the university.
- Earn a minimum of 54 transferable credit hours with at least 45 being from the VCCS.
- Satisfy all SEAS specified competency and requirements.
- Achieve a VCCS cumulative grade point average of 3.4 or better on a 4.0 scale.
- Earn a grade of C or better in every VCCS course and B or better in English, all Mathematics, Physics and Chemistry courses.
- Submit completed application and all supplemental materials by March 1 deadline.

Students that satisfy all of the above criteria and coursework requirements are admitted into the SEAS as a third-year student. To earn a Bachelor's degree from the SEAS, a student must earn a total of 128 credits with at least 64 being earned at the University.

Enrollment Data

A critical inspection of the transfer student process begins with a look at the data. Recent data for the University of Virginia demonstrates that there has been an indirect relationship between applicants and enrollment. Total applications have increased over the last four years. However, the matriculations of transfer students, and in particular VCCS transfers, have declined.

Table 3: Undergraduate Admissions Transfer Student Data.

Year	Total Applicants	VCCS Applicants	Total Admits	VCCS Admits	Total Matrics	VCCS Matrics
2014	299	123	86	53	57	40
2013	246	123	89	60	61	48
2012	258	113	79	43	59	36
2011	230	101	71	49	57	44

VCCS – Virginia Community College System, *Admits* – Individuals admitted into the university, *Matrics* – Individuals matriculating into the university

Table 3 demonstrates how applications from external transfers to the University of Virginia's SEAS has increased 30% over the last few years. Despite this growth in applicants, the total number of students matriculating into the program has remained largely unchanged. These numbers reflect transfer applicants and enrollments across the university and not exclusively engineering.

Table 4. Undergraduate admissions demographic data for transfer students in Engineering, Fall 2014.

	Total Applications	Completed Applications	Offered Admission	Accepted Offer
African American	12	12	2	2
Asian	37	37	8	7
Hispanic	30	29	10	9
Multi-Race	18	18	7	5
Non-Resident Alien	37	37	4	3
Race and Ethnicity Unknown	26	26	9	5
White	141	140	46	26
Total	301	299	86	57

Engineering specific data is represented in Tables 4 and 5. In Table 4, 2014 applications to the SEAS are disaggregated by race and ethnicity. Underrepresented minorities (African Americans and Hispanics) constituted 13% of the applicant pool and 14% of those offered admission. 92% of underrepresented students offered admission accepted the offer. This number is elevated in comparison to 57% of White students accepting the offer of admission. For many students, particularly those from underrepresented groups, the community college pathway may be the only practical way for them to access an engineering education³.

Table 5. Engineering Transfer Student Demographics.

	Fall 2013 (n=58)	Fall 2014 (n=53)
Asian	6	7
Black or African American	4	2
Hispanic	4	8
Multi-Race	0	5
Non-Resident Alien	1	3
Race and Ethnicity Unknown	9	4
White	34	24

Table 5 compares SEAS transfer student demographics from year 2013 to 2014. In just one year, the number of Hispanic transfer students enrolling in the SEAS increased 100%. Despite such an increase in the number of Hispanic transfer students, the number of African American students decreased by 50%. It is also worth noting that two of the four African American students of the Fall 2013 class were listed in the academic records as African American permanent aliens. However, the students themselves do not self-identify as African American.

Table 6. Undergraduate admissions gender data for Virginia Community College System transfer students, in Engineering, Fall 2014.

	Total Applications	Completed Applications	Offered Admission	Accepted Offer
Female	24	22	9	6
Male	101	101	44	34
Total	125	123	53	40

Table 7. Undergraduate admissions socioeconomic data for Virginia Community College System transfer students, in Engineering, Fall 2014.

	Total Applications	Completed Applications	Offered Admission	Accepted Offer
Low Income	8	8	8	6
Not Low Income	117	115	45	34
Total	125	123	53	40

Two additional demographics that have been shown to impact representation and persistence in engineering are gender and socioeconomic status. Table 6 demonstrates that 44% of men with completed applications were offered admission compared to 41% of women. 78% of men offered admission accepted the offer compared to 67% of women. Although the offer and acceptance rates of men and women are comparable, it is key to highlight that the initial application pool of women is substantially smaller (22%) than that of men.

There are also observable differences between the socioeconomic data for the applicant pool (Table 7). Transfer rates from community colleges to four-year institutions are not as high as they could be, especially for low-income students of color²⁰. Just 6%, $n=8$, of the total completed applications were from low-income students. 115 completed applications were received from not low-income students and nearly 40% of these students were offered admission. This is a critical statistic as it serves as evidence of the changing demographics of community college students. This data was important to include since conversations to redefine what constitutes diversity in engineering continue to grow¹⁴. The impact of social class, which includes socioeconomic status, on students' experiences in engineering is a developing body of work. For many reasons, more students from all backgrounds are attending community college and not primarily those from traditionally underrepresented groups, students from low socioeconomic backgrounds or students with average merit.

Although enrollment, retention and graduation data are often used as metrics of success, it is imperative to gain an understanding beyond the numbers. Such investigation will lay the foundation to develop studies that measure correlations between student experiences and outcomes. Understanding the transfer process and experiences unique to the U.Va. SEAS from the students' perspective is the first step in developing sustainable pathways to baccalaureate engineering degree programs for transfer students from community colleges.

Research Questions

To meet this goal, this study addressed three research questions:

- 1) What factors influence a community college student's decision to continue studies at a 4-year university?
- 2) For students that pursue transferring to the University of Virginia's School of Engineering and Applied Science, what are some of the barriers encountered in the process and post-matriculation?
- 3) How can the Center for Diversity in Engineering support enhancement of the existing pathways to promote transfer student success at the university and beyond?

Research Design

Participants & Data Collection

This qualitative study will include interviews of 5 current University of Virginia School of Engineering and Applied Science transfer students. Using a current roster of transfer students, email requests for participation were initially sent out to 8 students. As of January 2015, 5 responded affirmatively (response rate of 50%) and three are presented in this preliminary study. The participant demographics are presented in Table 8. Students were interviewed to capture intricate details of their experiences. Students were asked open-ended questions regarding their community college and university experiences (advising, courses, preparation and the transfer process). The participants were encouraged to be candid and thorough to best represent the successes and challenges to their overall process and identity as a transfer student to engineering. All interviews were conducted and transcribed. The semi-structured interviews were designed to last the amount of time it took for participants to answer the questions. The length of the interview ranged from 35 – 65 minutes. The interview protocol is shown in Table 9. The data and results presented here are preliminary.

Table 8: Participant Demographics

Name	Gender	Race/ethnicity	Age	Transfer University	Current Major	Academic Year
Eddie	M	African	26	Piedmont Valley Community College	Aerospace Engineering	Fourth-year
Lucy	F	Hispanic	22	John Tyler Community College	Chemical Engineering	Second-year
Ronald	M	African	27	Piedmont Valley Community College	Electrical Engineering	Fourth-year

Data Analysis

Data analysis required hand coding the data to identify common themes and issues. Several themes emerged in the process of analyzing the interviews, however, the focus remained on identifying barriers. This method of study was chosen due to the critical need to understand the perspectives and experiences from the vantage point of the transfer student. Personal narratives have increasingly been used in engineering education as a reliable qualitative research tool and rich source of data to capture the human experience²¹.

Table 9: Interview Protocol: Core questions of session.

1. Introduction and explanation of reason for conducting the interview.
 2. What was your ideal plan upon graduating from high school?
 3. Was applying to community college your direct initial move?
 4. Did you complete your Associate's Degree prior to coming to the University of Virginia?
 5. What made you decide to continue pursuit of your studies at a 4-year university?
 6. How did you make your decision to apply to the University of Virginia?
 7. Were there any hours you completed at the community college for which you did not receive transfer credit? If so, did this pose an issue for you?
 8. Were you provided information about the admission process and admission requirements for your chosen major?
 9. Did you matriculate into the University of Virginia through the Guaranteed Admission Agreement?
 10. Were there any special programs designed to orient you to campus, campus life and campus activities?
 11. Were there special programs to orient you to the academics of your discipline and academic expectations?
 12. Was there any assistance provided in finding housing?
 13. What is the primary reason you chose the University of Virginia as opposed to another 4-year college or university to further your engineering study?
 14. Have you felt academically prepared for the engineering courses at the University of Virginia?
 15. Do you feel a part of the University of Virginia's School of Engineering and Applied Science community?
 16. If there was one thing you could change about the transfer process you experienced, what would that be?
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Findings

Students interviewed represented John Tyler and Piedmont Valley, both community colleges of the Virginia Community College System. Each community college has a Guaranteed Admission Agreement in place with the U.Va. SEAS. However, students had very differing perspectives on the benefit of needing to attain the associate's before applying to transfer. 66% of the students interviewed did not utilize the Guaranteed Admission Agreement for their transfer into the SEAS.

It is critical that we understand the experiences of these students in all components of their transfer experience. This includes, but is not limited to, the application process, advising and academic support received, course credit and preparation, on-campus interactions and ability to excel academically. The preliminary data analysis yielded four key assertions, all of which are presented below and illustrated by quotes from the interviewees.

Assertion 1 – A Plan to Transfer

For the majority of student's, their decision to transfer to a 4-year institution had been a plan in the making when they entered their respective community college. In addition, unanimously in this sample, the decision to transfer to a 4-year university was influenced by a family member or role model that had previously executed a similar transition. For example, Eddie described the example he had of his older sister:

I already knew what I had to do. My sister did the same thing and transferred to James Madison, but her studies were in psychology. For us, it was about saving money for the family. The cost savings in those two years' tuition made it a no brainer.

Lucy described that her family was veteran to the transfer process. Her father and two siblings were also enrolled in community college and used their associate's degree to transfer to a 4-year institution. It was actually the advisement of her family that enabled her to navigate that process rather than an academic support entity at the community college. Her thoughts described the process as a very individual journey:

Getting the information you need shouldn't be dependent on your personality. Everyone should be able to find everything.

For Ronald, it was a professor that he serendipitously met at the grocery store while enrolled in the community college that redirected his path:

I am from Congo and my first language is French. I encountered a PVCC professor who learned in French and he was very helpful to me in focusing on pursuit of a 4-year degree.

Prior to his encounter with the professor of common background, his original plan had been to finish his studies with the associate's degree. In pursuit of mastery of a technical field, he initially enrolled in technology. Ronald's barrier was language. Upon confiding in the professor he was not experiencing the level of engagement he had anticipated, the professor informed him that technology and engineering were not synonymous. Although it may have been intuitive to another student, for Ronald as a new community college student relocated from Congo, it was far from. As a result of his interaction with the professor, he was redirected and enrolled into the engineering program.

The other shared consideration of all participants was the affordability of an undergraduate education. Their plan had always included community college as a way to minimize the cost of university tuition:

By going to the community college, that's 2 years tuition my family doesn't have to be burdened with.

The critical observation in this assertion is that students were able to navigate their way to the 4-year institution in engineering. However, each of these students had an example, role model or cultivated a personal relationship that afforded them the guidance from those who had similar experiences. The barrier identified in this assertion is the plausibility that having a Guaranteed Admission Agreement posted on a website may not be sufficient marketing and messaging to inform and attract students to the option of transferring into a 4-year university as well as the potential benefits it creates.

Assertion 2 – Access to My Professors Please

Students felt the difference in the student-professor interaction typical of the community college setting compared to that in the 4-year university setting was a major challenge. In the community college setting, classes are usually smaller which enables more direct interaction and one-on-one instruction with the professor. The class size alone seemed to create, at least initially, an intimidation factor. Eddie recounted:

The classes at PVCC were much smaller. It just makes you have to adjust knowing it is not going to be easy.

There was a common negative perception regarding the professors' availability that seemed to be conveyed. Ronald discussed how university professors are always so busy:

At PVCC, you definitely had more access to professors - professors have more time for students. Here, you have to deal with the TA and that is a very different experience.

The community college environment sets the foundation for rich interactions with the faculty. However, when students transfer to the university setting, the level of access and support they have come accustomed to is instantly removed. That type of interaction at the university is more typical of the interaction a student conducting research with a professor receives. This proved to be a very daunting adjustment for Lucy:

You really have to go back and forth to meet professors. At the community college it was easier because it was more one-on-one. But here, they have random office hours, usually while another class is happening. It's just difficult.

Students felt that professors should play a more integral role in promoting transfer student success. Professors should be informed when a transfer student is in their course so that they can be aware that that particular student may initially require more assistance. Roland articulated the stress of the transition process as it relates to needing additional professor support:

You need help from professors, not to be handheld, but because your first semester is actually the third year. You've got crazy schedules because you MUST take all of the courses to finish in two years WHILE adjusting to the changes and you're not having the accessibility to

professors you're used to. I just think they should do something to make professors more aware. They have a huge role to play in our transition.

Similar to other studies, students associated a sense of community and belonging with a supportive faculty^{1,12}. Unfortunately, transfer students perceived the faculty as not having time for them. When university faculty-student interactions were compared to that of the community college environment, students felt like they were being short-changed by their professors. The time available with community college faculty may not be possible in the university environment. However, although the demands of the university professor are already high, persistence and success of engineering students has been correlated with the quality of their interactions with faculty¹². If transfer students are unable to make critical connections with their professors early on in their transition, it could be a factor that leads to academic difficulty, or worse, attrition.

It is critical that an intermediate dynamic be established so that transfer students can have a suitable adaptation period in transitioning to university academic dynamics and culture. Without feeling connected, students may not attain the academic integration needed to be successful. It is also critical to consider that underrepresented students face additional challenges in their undergraduate programs that can influence feelings of isolation and serve as compounding factors when students find themselves at the intersection of several identities^{12,13,21}.

Assertion 3 - Lacking Infrastructure for Sustained Advisement and Support

Students did not feel like there was a sustained infrastructure of academic guidance and support after the initial orientation-related activities. Students consistently described experiences of having to find their own way.

They give you an orientation at the beginning and a mentor. The timing is not really effective because it's so crowded and there are just so many people. It all was very fast. And then, once my real questions came, the help was gone.

Students acknowledged the Student Transfer Day. However, one student did not perceive the value in the activity and consequently did not attend. For those that did attend, they noted this activity was important for transfer students as an opportunity to identify students in their major and create peer networks.

In terms of academic support, students reported that nothing memorable was executed to ensure that academics and academic expectations were clearly articulated and supported. Lucy recalled the Student Orientation Day:

This event was shared with all 1st-year entering students and proved to be a frustrating experience. The primary focus was on 1st-year students and these students receive an informed choice on class schedules. Consequently, no information on registering for classes was provided to transfer students at that event. Because of this, I did not get to register for classes until the day before classes. There was no communication from my advisor. He simply put a hold on my account and I had to go and research all of the courses only for him to

keep rejecting the courses I selected. After submitting it to him four times, I ended up on the waiting list for all except one class.

This focus on first-year students did not prove to be beneficial for the transfer students. In what should be an event designed to be informative and helpful in the process of positioning oneself for academic success, the transfer students left feeling neglected and disconnected.

Assertion 4 – Sense of Belonging in SEAS Community

When asked whether students felt a part of the U.Va. SEAS community, the responses were very mixed. The types of experiences that impacted a student’s sense of belonging varied greatly. Ronald described a situation where a professor made a reference to an activity that the majority of the class had experienced together the previous semester, prior to his matriculation:

In one class a professor shared an experience from last year and all of the students started moving. Everyone knew exactly what this meant and exactly how to move because they had been there. For me, it was very intimidating. It highlighted just how much I’d missed and showed me how disconnected I actually was. It made me feel so far behind everyone.

Students described how the timing of their transfer was critical to the impact it had on their sense of belonging. They shared how the tendency is for students to connect during their first and second year, so in a sense:

...you come in as an alien. In the third year, everyone is already connected. You always feel a little behind.

For Lucy, it was just more important for her to rely on her outgoing personality. She admitted that networking and making friends was something at which she naturally excelled. However, she recognized how it could be a tremendous challenge for someone more introverted or just overwhelmed by other factors of the transition.

For academic and social support and a sense of belonging, many transfer students found other transfer students through classes and naturally formed affinity groups of their own:

We tend to be together most of the time. It’s always 6 or 7 of us plus or minus, especially when we have the same course.

Lucy captured the sentiment of all of the students in saying:

More transition programs for people coming from community college would definitely make it easier. I just had to wing it.

The fact that there is room for improved infrastructure to support transfer students on all levels presents a great opportunity. By enhancing the visibility of such pathways and the process itself, there is great potential to influence the increase in interest of students to transfer and pursue the 4-year engineering degree.

Another area of concern that emerged in one interview, but was not mentioned by all interviewees was the fact that transfer student grade point averages (GPA) have no bearing once enrolled at the university. The student stated how starting from scratch with a 0.00 GPA as a third-year at a time when the classes are most difficult for all students creates a greater pressure for transfer students while preparing for marketability in a competitive job market. The sentiment of this student also demonstrates how the applicant status (how students transfer to the SEAS program) and their classification (2nd year, 3rd year, etc.) have a strong impact on perceptions of barriers.

In determination of these four critical assertions, only themes shared unanimously across participants were included. There were other barriers identified in the interviews. However, as with the aforementioned barrier, all participants did not share them.

Discussion and Implications

In order to create an ideal environment where students from all backgrounds and experience can thrive, we must first gain a better understanding of the experiences of transfer students. This preliminary work is still under way. However, as we begin to elucidate the barriers that currently make the transfer process less than optimal for students, we can begin to improve existing policies, practices and strategies. This study has shown that community college students are finding successful pathways to engineering through the University of Virginia. However, as demonstrated through the enrollment data compared to the pool of VCCS students, there remains a great opportunity to attract more community college students to the 4-year engineering degree pathway. Additionally, the accounts of the students present core areas where improvements can be made to the transfer process for students and positively impact their experiences as a university, engineering student.

The main barriers identified through this set of interviews were:

- Limited information describing the transfer process to those who are unfamiliar
- Limited awareness of the benefits of transferring to a 4-year university
- Drastically different style of professor-student interaction and professor availability
- Insufficient programs and services in place to offer continued academic, personal and professional development support for transfer students once matriculated
- Promoting a sense of belonging for transfer students in the engineering community

There are a few limitations to this study. For one, there is a limited sample size. This study originated as merely as an inquiry to identify ways to improve support for transfer students. However, from the interviews, it became evident that there was wealth in the information and so the idea to expand the information collection emerged retrospectively. Also, all participants are current U.Va. SEAS students that have been accepted into specific engineering majors and continue to persist. U.Va. SEAS transfer students that did not persist in engineering and either transferred into another major or failed to complete the degree in engineering would add a valuable perspective regarding challenges to the transfer process but were not included in this preliminary investigation. On that same token, to include students from the VCCS that chose not to apply to U.Va. and instead transferred to another Virginia institution of higher learning to pursue the 4-year engineering degree would be equally informative. Again, those individuals were not included in this preliminary investigation.

As we continue to interview students, we will continue to identify additional barriers. By identifying such barriers, we identify opportunities for intervention to enhance the transfer students' experience and success. We want the community college pathway to become an increasingly viable source of engineering talent. To achieve this, higher education must focus on being inclusive, cost-efficient and increasingly efficient in a way that makes potential transfer students regard this process as a strategic and necessary endeavor³.

Future Work

We will continue interviewing students in hopes to identify additional barriers from the student perspective. We seek to have a diverse representation of transfer students spanning different engineering majors and enrollment periods. It is our goal to eventually integrate comparative analyses that investigate the unique experiences transfer students that are also members of underrepresented groups have.

Over the summer, the Center for Diversity in Engineering will also set the foundation to create a Transfer Student Hub out of our office. By identifying transfer students after they have accepted admission, we will form a cohort and provide them with services, resources and support to promote academic success in engineering. A few preliminary objectives of the programmatic structure include:

- Develop a theoretical framework for a transfer student support program designed to promote engineering identity, sense of belonging, academic excellence and professional development that increase overall transfer student success.
- Develop an increased visibility with U.Va. faculty, students and staff on the campuses of surrounding VCCS institutions.
- Work to identify engineering faculty mentors that have interest and/or first-hand experience with community college transfer experiences. These faculties could potentially serve as departmental advocates to help students connect with professors in their majors.
- Develop the Mentoring Engineering Transfers (MET) Program as a sub-group of our U.Va. Center for Diversity in Engineering Peer Mentoring Program where engineering upperclassmen (who were themselves transfer students) mentor incoming engineering transfer students with pairings starting prior to student arrival on campus Fall semester.
- Identify early, incentivized research opportunities for community college students on the U.Va. campus.

Documentation and data collection will be executed throughout this process for future evaluation and assessment purposes. We are confident that as we work to develop these goals and find opportunities to leverage existing support for transfer students and opportunities for collaboration, we will be able to enhance the experience of current transfer students and, in time, have a direct influence on the increased application, admission, acceptance, enrollment, retention and graduation of engineering transfer students.

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