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A Descriptive Study of Community College Transfers in Engineering and Computer Science in Texas

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Abstract

Community colleges are an increasingly popular route towards a baccalaureate degree, offering open enrollment policies, flexible schedules, and opportunities to address gaps in academic preparation. Unfortunately, research has found that few students successfully transfer to a four-year university to complete their degrees. There is also a lack of disaggregated data on students who begin their engineering or computer science (ECS) studies at a community college with the intention to transfer. This paper focuses on a descriptive study of the transfer success of students from 10 years of first-time-in-college cohorts who declared an ECS major in Texas. Researchers analyzed enrollments, transfers, persistence, and baccalaureate completion rates of students in public two-year and four-year colleges using data from the Texas Education Research Center. The data show that, despite efforts to improve transfer success and increase diversity in STEM, we have not seen significant gains in successful transfer and baccalaureate degree completion among students who begin their ECS studies at a two-year college.

Introduction

The Society of Women Engineers (SWE) is collaborating with the National Society of Black Engineers (NSBE), the American Indian Society of Engineers and Scientists (AISES), and the Society of Hispanic Professional Engineers (SHPE) as part of an NSF-funded initiative to increase the number of diverse engineering graduates from 30,000 to 50,000 per year by 2025. The 50K Coalition includes a number of member organizations that are working together to reach this goal through a comprehensive plan that includes a stronger focus on community college transfers in engineering. However, the availability of transfer data for disaggregated student populations is limited, making the development of a baseline to measure progress difficult.

Community college students are often excluded from conversations surrounding broadening participation in STEM – particularly in ECS fields, where they are significantly underrepresented. Community college is a particularly popular pathway for underrepresented minority students. In 2012, approximately 56 percent of Hispanic undergraduates, 53 percent of American Indian/Alaskan Native undergraduates, and 49 percent of Black undergraduates were enrolled in community colleges across the United States [1]. Among women, 44 percent of undergraduate students were enrolled in community colleges in 2012 [2].

Given that over 80 percent of first-time community college students indicate a desire to complete a baccalaureate degree or higher [3] and approximately 15 percent of community college students declare a major in ECS [4], the community college pathway toward an ECS

baccalaureate degree has the potential to significantly impact the diversity of the ECS fields. Unfortunately, only one in three community college students, regardless of major, successfully transfer to a four-year program [5].

SWE conducted an exploratory study to gain an understanding of the transfer and completion rates of women and other underrepresented students in ECS. Researchers analyzed available data from the Texas Education Research Center to help diversity organizations, higher education institutions, policy makers, and other interested parties highlight the progress of specific underrepresented groups in ECS in Texas – a large and diverse state that has included a STEM focus in its higher education strategic plan. Looking at the success rates of 10 years of first-time-in-college students in Texas, disaggregating by race and gender when available, the data show that there is great potential to significantly increase diversity in STEM if we can increase the success of transfer students in ECS programs.

Literature Review

With the rising costs of four-year colleges and universities, many students are now choosing to begin their degrees at community colleges. Among community college students, women and minorities are overrepresented [16] and often excluded from conversations surrounding broadening participation in engineering. Women and minorities are drastically underrepresented in engineering, suggesting that not enough resources are devoted to ensuring the success of engineering students originating in community colleges [7], [8].

In engineering, approximately 40 percent of 2008-09 engineering bachelor's degree recipients had attended community college at some point in time [9]. This percentage has increased slightly since 2001-02, when 38 percent of engineering graduates had community college credit [10]. A study by Van Noy and Zeidenberg [11] found that half of students that began studying at a community college in the 2003-04 academic year were enrolled in a STEM field at some point in time over the following six years.

Though interest in obtaining a bachelor's degree is high, successful transfer from community college to a four-year university and subsequent bachelor's degree completion can be challenging and slow. Research indicates that successful transfers may be as low as 20 percent, with the African American transfer rate even smaller at less than 10 percent [12], [13], [14], [15]. Of those students who began their studies at a community college in 2004, less than 12 percent had earned a bachelor's degree within six years [16].

A variety of individual factors can hinder a community college student's successful transfer to a four-year institution. Attendance patterns significantly influence a student's likelihood of transferring. There are clear negative outcomes on success for students who choose to attend part-time versus full-time [17], [18]. Approximately 10 percent of students who started at a

public community college and attended full-time completed their bachelor's degrees in six years, compared to less than one percent of part-time students [19]. Due to the high incidence of part-time attendance, community college students typically have lower levels of academic and social interaction on campus and are less engaged in campus activities than their university peers [20], [21]. A lack of engagement at the community college can lead to difficulties in integrating within the university community after transfer, particularly among students who attend part-time or transfer later in their academic program [22], [23], [24].

Another significant barrier to students is that a large percentage are in need of developmental education to become transfer-ready [25]. Nearly 60 percent of community college students are not academically prepared to take college-level work in at least one subject area [26]. Taking higher-level courses and completing required development coursework are associated with successful transfer [27]. Researchers note that academic preparation of community college students, as seen through large numbers of earned credit hours, increases the likelihood of transfer [28], [29].

In addition, external factors that a student cannot control, such as the existence and quality of articulation agreements between community colleges and four-year institutions, can heavily influence whether community college coursework is accepted toward a bachelor's degree. Many universities have established articulation agreements with their high-volume feeder community colleges, but these agreements do not always guarantee that accepted transfer credit will apply to the degree that the student desires.

Though there is an issue with the low transfer rates from community college to four-year universities, the community college engineering programs mirror their four-year counterparts in the low percentage of women and underrepresented minorities that choose to major in engineering. A study in California found that transfer students who completed an engineering degree were predominantly male and either Asian or Caucasian [30]. The researchers also noted that students transferring with 70 or more semester credit hours were just as likely as students who transferred in with fewer hours to take at least two years to complete their degree [31]. This indicates that transfer students, even those who have completed two years of study or more prior to transfer, will likely take longer to graduate than the traditionally-expected four years.

Data and Methodology

Public two-year colleges and four-year universities in Texas are required to report student-level data to the state's higher education agency. Enrollment data, major selection, and student demographic information are reported each semester, while graduation data are reported annually. The Texas Education Research Center allows access to the state's education data, but imposes strict requirements on the release of data and results from the Center to ensure the confidentiality of student data. Hence, the exploratory study could only analyze disaggregated

data by gender and race/ethnicity when sufficient numbers of students were available. Researchers accessed the student enrollment and graduation data for community colleges, public universities, and private universities in Texas, for the academic years between 2002/03 and Fall 2015. Researchers identified trends and gaps between student groups as well as transfer pathways that appeared to have relatively higher levels of success among ECS transfers and degree completions.

Findings

While it was no surprise to find out that few women who transfer from a two-year college to a four-year university choose to major in ECS, the low counts were still startling. Table 1 provides a breakdown of the percentage of students who chose to major in ECS, by gender and first academic year of enrollment in community college. Throughout the years covered by this study, approximately 55 percent of all transfers each year were women. However, there has been little change in the percentage of female transfers who declare an ECS major over the 10 years of this study – and possibly even a slight decrease since 2006/07. For any given academic year, fewer than 500 women who transferred chose to major in ECS. For example, out of over 35,000 students who started community college in 2010/11 and transferred from a two-year community college to a four-year university, only 1.6 percent (or fewer than 350) were women who chose an ECS major.

Table 1. Total Number of Transfer Students in Texas per Year by Gender, and Percentage of Transfers Who Declared an ECS Major

Academic Year	Total Student Transfers, by Gender		Total Transfers	% of Total Transfers Who Declared ECS Major, by Gender	
	Female	Male		Female	Male
2002/03	34,394	26,040	60,434	2.2%	11.7%
2003/04	28,472	21,757	50,229	1.7%	11.4%
2004/05	26,328	20,674	47,002	1.7%	11.2%
2005/06	25,697	20,401	46,098	1.6%	10.7%
2006/07	24,017	19,617	43,634	1.7%	11.5%
2007/08	22,919	18,516	41,435	*	11.3%
2008/09	22,414	17,930	40,344	1.5%	11.3%
2009/10	21,928	17,910	39,838	1.6%	11.2%
2010/11	20,981	16,796	37,777	1.6%	11.4%

* Data for female transfers in ECS for 2007/08 was unreliable, so it is not included.

Table 2 shows the percentage of ECS transfer students by gender who had earned an ECS degree by Fall 2015. It is important to note that transfer students from earlier years had more time to complete their degrees than those in later cohorts, which contributes to the lower student counts and percentages seen in 2009/10 and 2010/11. One observation is that female transfers in ECS saw higher ECS degree completion rates than male transfers in the later cohorts compared to prior years. This may be due to women requiring less time than men to complete their degrees, but it is also possible that women's completion rates are going up at a faster rate than men's. However, in any given year only about 15 percent of transfer students who declare an ECS major are women.

Table 2: Number of Students Who Transferred as ECS Majors and Earned an ECS Bachelor's Degree by 2015, by Gender

First Time in College Cohort	Female		Male	
	# of Declared ECS Majors	% Earned ECS Degree by 2015	# of Declared ECS Majors	% Earned ECS Degree by 2015
2002/03	763	33.2%	3044	56.9%
2003/04	482	39.6%	2471	59.3%
2004/05	439	46.2%	2310	60.1%
2005/06	423	50.6%	2186	63.2%
2006/07	408	45.8%	2261	59.2%
2007/08	*	N/A	2089	59.4%
2008/09	336	47.9%	2033	48.8%
2009/10	356	39.3%	2006	36.4%
2010/11	340	25.0%	1911	20.5%

* Data for female transfers in ECS for 2007/08 was unreliable, so it is not included.

Data suppression issues prevented access to major declaration data by gender and race for transfer students, so researchers were unable to determine who declared an ECS major by race, only by gender. Data for Asian transfer students were unavailable due to low student counts. However, researchers were able to analyze transfer data by race for ECS degree earners, as shown in Table 3. As with data shown earlier by gender, the number of degrees earned is lower in later years. These counts are expected to rise, as it appears that transfer students require more time to complete their degrees than students who begin at a four-year university.

What the data show is that there has been little change on the racial distribution of ECS degrees earned over the ten years of this study. Black students hover around 6 percent of total ECS degrees earned by transfer students, while Hispanic students have seen a slight increase in their representation among ECS degree earners to approximately 30 percent.

Table 3: Number and Percentage of ECS Degrees Earned by Transfer Students by 2015, by Race

First Time in College Cohort	Black		Hispanic		White	
	# Earned ECS Degree by 2015	% of Total ECS Degrees Earned by Transfers	# Earned ECS Degree by 2015	% of Total ECS Degrees Earned by Transfers	# Earned ECS Degree by 2015	% of Total ECS Degrees Earned by Transfers
2002/03	92	5.2%	362	20.7%	1299	74.1%
2003/04	82	5.8%	338	23.7%	1004	70.5%
2004/05	78	5.6%	411	29.5%	903	64.9%
2005/06	82	6.0%	357	26.0%	932	68.0%
2006/07	75	5.7%	375	28.5%	864	65.8%
2007/08	71	5.7%	360	28.8%	820	65.5%
2008/09	49	5.0%	298	30.4%	633	64.6%
2009/10	47	6.3%	212	28.5%	485	65.2%

Researchers also studied the data available across race and gender. From the 10 years of cohorts included in this study, fewer than 1,300 women transferred and graduated with an ECS baccalaureate degree. Of these, less than 10 percent were Black women, and 35 percent were Hispanic women. For men, among the almost 9,000 ECS transfer graduates in the study, only 5 percent were Black, and 25 percent were Hispanic. Across all 10 years, only 0.7 percent of White and Hispanic women who transferred (regardless of major) earned an ECS degree by 2015 compared to 7 percent of White men and 5.2 percent of Hispanic men. Among Black students, only 0.5 percent of Black women who transferred (regardless of major) and 2.8 percent of Black men earned an ECS degree by 2015.

Low rates of ECS major declarations among women and underrepresented minorities is a major concern, but of equal concern are the large numbers of students switching out of ECS at both two-year and four-year colleges. Of particular concern are the large gaps identified at individual institutions between the percentage of men and women switching out of ECS into a non-ECS major. Many institutions are seeing over half of women switching out of ECS, and most are seeing 10-20 percent more women switching than men.

Conclusion

The Society of Women Engineers conducted this study to find out how successful women and underrepresented minority students in Texas are on the transfer pathway to ECS baccalaureate degree completion. Unfortunately, the researchers discovered that only high-level trend analysis was possible because so few women and underrepresented minority students transfer and graduate in ECS. However, we were able to confirm that women are less likely than men to declare an ECS major, and we discovered that their rates of ECS major declaration may actually be decreasing. Also surprising is how few Black and Hispanic transfer students choose to major in ECS – particularly among female transfers – and how this has not improved over the 10 years of this study.

As more attention is paid to increasing the diversity of ECS fields, more research is needed to understand what helps and hinders students who choose to pursue an ECS degree starting at a community college. As this research into the success of students on the transfer pathway in Texas shows, there is great potential to address the need for more ECS graduates while improving both the gender and racial diversity of the ECS professions if we can retain more community college students in ECS and support them through transfer. National data show that over 65 percent of students who successfully transfer in engineering are graduating with engineering baccalaureate degrees. Our investigation into the success of ECS transfer students in Texas found very similar success rates, but getting students to that transfer point is the challenge. More research is needed to determine what supports are necessary to increase the number of students staying in ECS majors at a community college and transferring to a four-year university – particularly among women and underrepresented minorities.

SWE intends to conduct further study to understand the specific challenges that women on the transfer pathway towards an ECS baccalaureate degree face. What we learn will inform our efforts and those of other diversity-serving organizations toward better supporting women and other underrepresented groups. The next phase of research planned will include a qualitative study of women on the community college pathway, as well as a pilot program aimed at developing inclusive programming to introduce community college women to the collegiate, professional, and corporate networks that SWE offers.

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