



## **Women on the Community College Pathway toward a Baccalaureate Degree in Engineering or Computer Science in Texas**

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## **Introduction**

The community college pathway towards an engineering or computer science (ECS) baccalaureate degree has the potential to increase the diversity of the ECS fields. Approximately 15% of two-year college students declare a major in ECS, and the majority of those who transfer are successful at completing their ECS degrees [1]. However, while more women than men transfer from two-year to four-year colleges, male transfers are five times more likely than females to declare an ECS major. This paper focuses on a descriptive study of the transfer success of women from 10 years of first-time-in-college cohorts who declared an ECS major in Texas, analyzing enrollments, transfers, persistence, and baccalaureate completion rates of women in public two-year and four-year colleges.

## **Background**

Gender diversity in engineering and computer science (ECS) has been a continuous struggle. Women have been enrolling and graduating from college at higher rates than men for three decades, but disciplines like ECS continue to strive to raise their female enrollments. Today, women earn only 20% of bachelor's degrees in engineering and 18% in computer science [2]. While degree attainment for women in engineering has remained relatively stagnant, women's share of computer science degrees is actually declining. Women of color are particularly underrepresented in ECS, receiving less than 5% of bachelor's degrees in these disciplines in 2014 [3].

Those interested in addressing the lack of diversity in ECS are starting to look at students on various pathways into ECS professions, including students who begin their studies at a two-year college. Community colleges offer flexible enrollment policies and schedules, and the cost is significantly lower than most four-year universities. About 40% of undergraduates in the United States are enrolled at a public two-year college, and more than 80% of first-time community college students intend to transfer and complete their baccalaureate degrees [4,5]. More than half of all undergraduate students of color and 44% of female undergraduates are enrolled in two-year colleges [6,7]. Considering that over 65% of transfer students who declare an engineering major eventually complete a bachelor's degree in engineering, there is great potential to increase diversity in ECS fields if transfers in ECS increases [8]. Unfortunately, only about 33% of community college students successfully transfer and only 12% of students of color transfer, regardless of major [9,10].

Data is scarce on students who are on the ECS transfer pathway towards a baccalaureate degree. Many higher education institutions are exploring programs at a local level to try to encourage and support transfer students, using their own data to measure progress, but data at a regional or national level is difficult to obtain. To help address this lack of data, this study was undertaken to gain a better understanding of the transfer success of women, particularly women of color, on the transfer path towards an ECS bachelor's degree.

## **Data and Methodology**

Texas education agencies collect student-level data from public two-year colleges and public and private four-year universities in Texas, including enrollment data, major selection, graduation data, and student demographic information. Researchers obtained longitudinal datasets beginning with the 2002/03 school year from the Texas Education Research Center housed at The University of Texas at Austin for this study. While this study was intended to analyze the transfer success of women and students of color in ECS in Texas, extremely low student counts in female subpopulations limited the analysis of disaggregated data. All analyses are disaggregated where possible and are collapsed across cohorts when required to avoid data suppression.

For the purposes of this analysis, degree-seeking students were assigned to first-time-in-college (FTIC) cohorts based on the year they first entered college. Ten FTIC cohorts were included in this study (2002/03 through 2011/12). High school students enrolled in dual credit courses are not included in an FTIC cohort until after high school graduation. Completion rates were determined by whether or not a student had obtained a bachelor's degree by Fall 2015, regardless of how long it took to complete their studies.

## **Findings**

As stated earlier, while more women than men are transferring from a two-year college to a four-year university to complete their degrees, there are far less female transfers choosing to major in ECS than their male counterparts. Table 1 lists the total student transfers in Texas, by gender, and the percentage of each who declared an ECS major. Data show that on average less than 2% of female transfer students over the ten years of cohorts included in this study had selected an ECS major compared to 11% of male students, as shown in Table 1. These rates of ECS major selection are far lower than those of first-time freshmen entering four-year institutions, as surveys indicate that up to 7% of female freshmen intend to major in engineering [11].

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.

Regarding successful completion of ECS baccalaureate programs, transfer students exceeded 60% for men and 50% for women from the 2005/06 FTIC cohort, the highest in this study. Table 2 lists the number of transfer students who declared an ECS major after transfer, by gender, and the percentage of those students who earned a degree by Fall 2015. The 2005/06 FTIC cohort had 10 years to complete their baccalaureate degrees, so later cohorts are expected to see higher completion rates over time.

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.

Given the low number of female students transferring and graduating from each cohort, it is difficult to analyze the transfer success of female students by race/ethnicity within a given cohort. Data across all female transfer ECS graduates from all FTIC cohorts, 9% were Black females and 36% were Hispanic females. However, of the over 227,000 women who transferred from a two-year to four-year college (all majors) in the 10 years of FTIC cohorts in this study, less than 1% had earned an ECS baccalaureate degree by Fall 2015.

One interesting trend discovered is that among transfer students earning degrees in ECS, women are making up a larger percentage within an individual FTIC cohort. Table 3 shows that the percentage of ECS degrees earned by female transfer students from each cohort is on the rise. Analysis of earlier FTIC cohorts, which allow time for students to transfer and complete their degrees, shows that less women appear to be declaring an ECS major, but a higher percentage are staying in ECS and earning ECS bachelor's degrees.

Table 3. Number of Transfer Students Who Earned an ECS Baccalaureate Degree by 2015, by Gender and FTIC Cohort

<b>First Time in College Cohort</b>	<b>Female</b>	<b>Male</b>	<b>% Female of Total</b>
2002/03	253	1,733	12.7%
2003/04	191	1,466	11.5%
2004/05	203	1,388	12.8%
2005/06	214	1,382	13.4%
2006/07	187	1,338	12.3%
2007/08	195	1,241	13.6%
2008/09	161	992	14.0%
2009/10	140	731	16.1%
2010/11	85	391	17.9%

Researchers also looked at ECS degree completion rates by sending institution, or by community college where a student transferred from. Though it was not surprising to see low female counts, what was surprising was how many community colleges are sending hundreds of male transfer students in ECS, but very few female transfers, to four-year universities. Over 60% of the 63 two-year colleges included in this analysis had more than 100 male transfer graduates in ECS by Fall 2015. This compares to only two institutions that had more than 100 female transfer graduates in ECS.

Regardless of whether a student began at a two-year college or four-year university, the major switch rate out of ECS into a non-ECS major for both men and women was high. Institutions with high major switching among women also tend to have high major switching among men. For students who declared an ECS major in a four-year university across all FTIC cohorts, an average of 46% of women and 37% of men switched to a non-ECS major by 2015. For students who declared an ECS major in a two-year college across all FTIC cohorts, an average of 40% of women and 27% of men switched to a non-ECS major by 2015. Though high, what was most surprising was that seven community colleges and six four-year universities had over half of their female ECS students switch out of ECS at some point while pursuing their degrees, while only one four-year institution saw such rates among male ECS students.

## **Discussion**

This study was conducted to find out how successful women are on the transfer pathway to ECS baccalaureate degree completion in Texas. Though some findings were expected, such as the significantly lower numbers of women than men transferring in ECS, what was surprising was how few women in Texas were transferring. Due to these low counts, disaggregating the data by gender and race proved difficult. Researchers were able to confirm that women are less likely than men to declare an ECS major, and extremely few Black and Hispanic female transfer students choose to major in ECS across the ten years of data analyzed.

The most promising finding was the increasing success of female transfers in ECS, as their degree attainment rates are on the rise. Given this success, more should be done to encourage and support women who begin their ECS studies at a two-year college. More research is needed to understand what helps and hinders students who choose to pursue an ECS degree starting at a community college. This study indicates that there is potential to increase ECS graduates and improve the diversity of the ECS professions if we can retain more community college students in ECS and support them through transfer. The findings from this study support prior research of ECS transfer students' successful degree completion, but the challenge is how to increase the number of transfers in ECS. More research is needed to determine what supports are needed to increase the number of students staying in ECS majors at a community college and transferring to a four-year university, particularly among underrepresented groups in these fields.

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