# What Makes First-Time-Transfer Students Different from First-Time-in-College Students

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# What Makes First-Time-Transfer Students Different from First-Time-in-College Students in Engineering

## I. Introduction

A recent report by the National Research Council and National Academy of Engineering (2012)[1], titled *Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit*, has provided a renewed focus on the importance of community college pathways to four-year institutions and the state and national impact gained through the successful transition, retention, and graduation of these students. While there have been several attempts to explore transfer students' pathways to a Bachelor of Science (BS) degree in engineering at a four-year institution, current literature has been situated for student populations at the institutions located in a few geographical areas[2]. Particularly considering varied gender and ethnic populations across the United States and different academic support and policies for transfer students across four-year institutions, there is still a room to explore transfer students at different educational settings. In addition, as we focus on increasing engineering growth and diversity by paving these pathways, a greater understanding of these paths is needed. Therefore, increasing awareness of the factors that may or may not impact student success in engineering and how these factors differ between first-time-transfer (FTT) versus first-time-in-college (FTIC) students is important in increasing the success rates of both student populations.

### A. Background

In 2011-12, the U.S. education system consisted of a total of 1,738 two-year institutions: 967 public, 100 non-profit, and 671 private[3] (Table 306). This represents 37% of the total number of institutions with four-year institutions representing the remaining 63%. Figure 1 shows a comparison of four-year versus two-year institutions in the United States. During that year, there were over 20 million students enrolled in an academic institution across the United States with over 6 million being educated at a two-year public institution[3] (Table 223). These public two-year institutions also have a large population of underrepresented minorities with approximately 35% of the total number of African Americans and 46% of the total number of Hispanics students enrolled in academic institutions. In addition to expanding underrepresented minority participation through institutional partnerships with two-year public institutions, 33% of the total female population that was enrolled at an academic institution was enrolled in a two-year public institution[3] (Table 268).

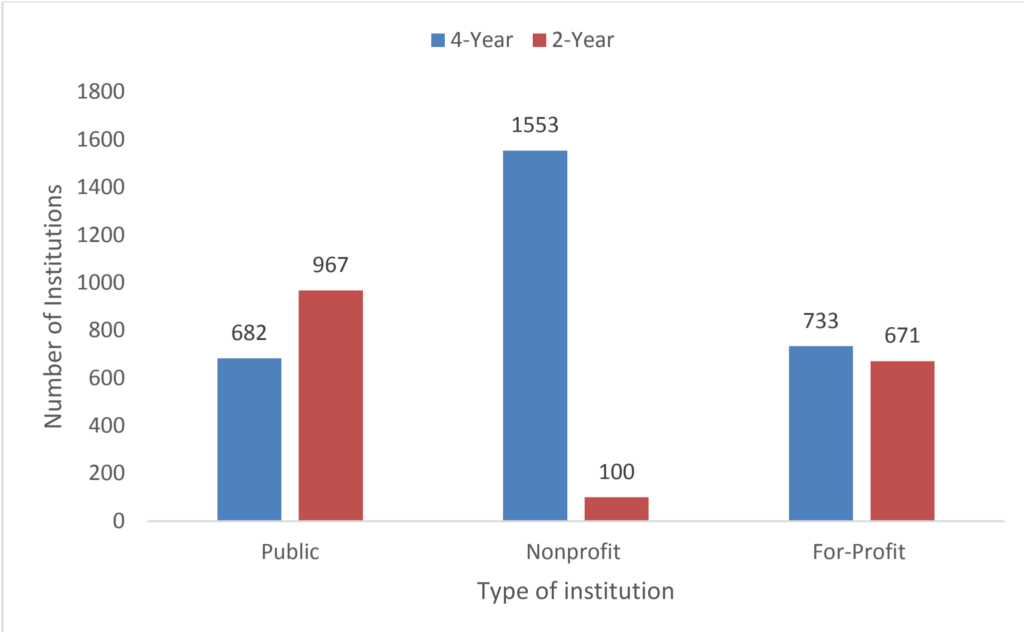

Figure 1. Number of public, nonprofit and for-profit two- and four-year institutions across the U.S.

However, a few studies to date identified some characteristics of transfer students in engineering at four-year institutions located in California[4] and Midwest[5, 6, 7, 8]. For example, Sullivan et al. (2012), who utilized the domestic student population of Multiple-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD), revealed that first-time-in-college (FTIC) students academically outperformed the first-time-transfer (FTT) counterparts on GPAs and female students were less likely to utilize engineering transfer pathways. Another study[4] utilized data from California Partnership for Achieving Student Success (Cal-PASS) reported demographic percentages of transfer students who graduated with an engineering degree by gender and ethnicity: 17 % female, 40% Asian, and 31% White transfer students. The authors also noted that on average, the time to completion for an engineering degree was 6.5 years from their post-secondary enrollment but 2.7 years after transferring. In addition, there was no correlation in the number of transfer credits to early graduation. For example, students transferring with 70 credits or more were no more likely to complete their engineering degree in less than two years than students who transferred in with fewer credit hours[4].

In a recent report by the National Research Council and National Academy of Engineering (2012)[1], it was noted that minority groups underrepresented in STEM fields will soon make up the majority of school age children in the Unites States and the proportion of underrepresented minorities in the natural sciences and engineering was less than a third of the overall population in 2006. The role of community colleges, which has the capacity to provide a diverse population of STEM students, can provide a compelling argument for strategic two- and four-year partnerships to work together to transform transfer pathways efficiently. Therefore, the rationale of this study is clear, which is to enhance our knowledge on the differences between FTT and FTIC students, help transform transfer pathways and educational programs, and dispute institutional myths regarding the quality of transfer students from two-year institutions.

## B. Purpose of the Study

This study explores characteristics of the FTIC students and FTT students and compares them in terms of their demographics, the first year engineering (FYE) common course credits, and graduation outcomes. In detail, we raised the following research questions: (a) how are the demographic characteristics of the FTT students different from the FTIC students?; (b) how are the FYE common course credits different for each population?; (c) how are the graduation outcomes (e.g., time to graduation, graduation rates, and cumulative GPAs) in engineering different for each population?; and (d) how are the graduation outcome (cumulative GPAs) of the FTT and FTIC students different by subgroups (e.g., gender, race/ethnicity, and residence)?

# II. Method

## A. Setting

At a large southwest public university, engineering was the largest program that provided 12 departments with 17 degree programs as of 2006. While there existed a total of 19 different curriculum tracks, 13 tracks from 11 departments had an almost identical FYE curriculum that included mathematics (engineering mathematics [Calculus] I and II), chemistry (fundamentals of chemistry I and II), physics (mechanics and electricity and optics), and engineering (foundations of engineering I and II) as shown in Table 1. Here, we defined two mathematics, one chemistry, and two physics courses as the FYE common courses. Among the courses, Calculus I was required for all curriculum tracks.

Table 1. First Year Engineering Common Curriculum

| Discipline | First Semester | | Second Semester | |
|---|---|---|---|---|
| | Subject | Cr | Subject | Cr |
| English | Composition and Rhetoric | 3 | – | |
| Mathematics | Engineering Mathematics I (Calculus I) | 4 | Engineering Mathematics II (Calculus II) | 4 |
| Chemistry | – | | Chemistry for Engineers | 4 |
| Physics | Mechanics | 4 | Electricity and Optics | 4 |
| Engineering | Foundations in Engineering I | 2 | Foundations in Engineering II | 2 |
| Elective | University Core Curriculum elective | 3 | University Core Curriculum elective | 3 |
| Health | Health and Fitness Activity | 1 | Required Physical Activity | 1 |
| Total Credit | | 17 | | 18 |

*Note.* Cr = Credits

For students to gain transfer admission, the applicants must have at least a 2.5 GPA on a minimum of 24 credit hours of graded, transferable coursework at the time the application was being reviewed. Transfer course credit policies were outlined for each academic year the student enters the university. Specific transfer credit policies had been established for both accredited and non-accredited institutions, as well as, credit from abroad, credit for military experience, and credit for extension and correspondence courses. Credit by examination (CBE) courses could be transferred if sequential course work with credit was also indicated. In addition, courses similar to ones offered by the College of Engineering at the junior or senior level could be transferred by title only.

## C. Samples

The sample of this study was 2,271 newly admitted students, who started their first semester in the summer or fall of 2006 in an engineering program at the university. We defined them as the 2006 cohort for the purpose of this study. Among the 2006 cohort, 1,989 students were first-time-in-college (FTIC) students (87.6%) and 282 students were first-time-transfer (FTT) students (12.4%).

## D. Procedure and Data Analyses

The 2006 cohort students' course credits and graduation status in engineering were tracked for 17 semesters (i.e., fall 2006 – fall 2014) through the data retrieved from the university archive. Therefore, fall 2014 was the semester that showed the 2006 cohort students' last academic activities if there were any. In this study, students' course credits were categorized into two groups: transfer course credits and credits from within the university. The transfer course credits were disaggregated into credits from Advance Placement (AP), College Level Exam Program (CLEP) exams, or International Baccalaureate (IB) course credits and credits from other institutions. Credits from the university was the first attempted course credits of the students who took the course at the institution and transfer course credits were the last credits that students achieved prior to the enrollment at the university. Students' graduation status was categorized into one of three groups: graduation in engineering, graduation in non-engineering, and no graduation.

As we involved the whole population enrolled in an engineering program at the university, descriptive statistics were used to identify trends in the FTIC versus FTT data and inferential statistics, such as independent *t*-tests, one-way and two-way analysis of variances (ANOVAs), were applied to check statistically significant differences between two populations and among subgroups. All assumptions for inferential statistics (e.g., independent observation, normality, and homogeneity of variance) were checked and when any of assumptions were violated, data were transformed.

# III. Results

## A. Demographic Characteristics

Table 2 shows demographic characteristics of the 2006 cohort broken down by the type of admission. As we expected, the average age of FTT students was 20.82 ($SD$ =3.23), which was about 2.8 years older than the average age of FTIC students ($M$ = 18.04, $SD$ = 0.43). Compared to the FTIC female students (21.3%), we could observe that the FTT group had a relatively small portion of female students (17.7%). Interestingly, the FTT group has a larger proportion of international students (14.5%) than the FTIC ones (2.2%). In terms of diversity, the distribution of racial/ethnic groups was quite similar between the two groups.

Table 2. Demographic Characteristics of the FTIC and FTT Engineering Students

| Category | FTIC | | FTT | |
|---|---|---|---|---|
| | *n* | *%* | *n* | *%* |
| Gender | | | | |
| Female | 424 | 21.3 | 50 | 17.7 |
| Male | 1,565 | 78.7 | 232 | 82.3 |
| Residence | | | | |
| Domestic | 1,945 | 97.8 | 241 | 85.5 |
| International | 44 | 2.2 | 41 | 14.5 |
| Race/Ethnicity[a] | | | | |
| Hispanic | 310 | 15.6 | 40 | 16.6 |
| American Indian or Alaska Native | 5 | 0.3 | 0 | 0.0 |
| Asian | 103 | 5.3 | 15 | 6.2 |
| Black | 70 | 3.6 | 6 | 2.5 |
| Native Hawaiian or other Pacific Islander | 1 | 0.1 | 0 | 0.0 |
| White | 1,426 | 73.3 | 178 | 73.9 |
| Multi-racial | 26 | 1.3 | 2 | 0.8 |
| Unspecified | 4 | 0.2 | 0 | 0.0 |
| Total | 1,989 | 100.0 | 282 | 100.0 |

*Note*. [a]Race/Ethnicity was categorized for domestic students only and percentages were calculated based on the total number of domestic students**.**

**B. First Year Engineering Common Course Credits**

In terms of academic preparation, there was an apparent distinction in types of course credits between FTIC and FTT students in the five first-year common courses in engineering: Calculus I, Calculus II, Chemistry, Mechanics, and Electricity and Optics (Table 3). As Calculus I was recommended to be taken in the first semester by academic advisors, majority of students achieved the course credits. However, as Calculus II was recommended in the second semester, fewer students achieved the course credits, which might be due to attrition after the first semester. This trend is similar to both student populations (FTIC and FTT). A similar pattern was found in Electricity and Optics because the course is recommended to be taken in the second semester after taking Mechanics. Particularly, as some departments (e.g., Biological and Agricultural Engineering and Engineering Technology) guided the course to be taken in the first or second semester of sophomore, relatively fewer number of students achieved the course credits. While on average, about 72% of FTIC students and about 28% of FTT students achieved credits on the courses by taking the courses at the institution. In contrast, about 7% of FTIC students and about 62% of FTT students achieved the transfer credits on the common courses.

Table 3. 2006 Cohort FTIC and FTT Students' Course Credits on FYE Common Courses

| Subject[a] | Types of Credits | FTIC | | FTT | |
|---|---|---|---|---|---|
| | | *n* | % | *n* | % |
| Calculus I | University Credits | 1536 | 77.2 | 39 | 13.8 |
| | Transfer Credits | 162 | 8.1 | 221 | 78.4 |
| | Credits from AP, CLEP, & IB | 213 | 10.7 | 18 | 6.3 |
| | No Credits | 78 | 3.9 | 4 | 1.4 |
| Calculus II | University Credits | 1217 | 61.2 | 58 | 20.6 |
| | Transfer Credits | 153 | 7.7 | 174 | 61.7 |
| | Credits from AP, CLEP, & IB | 81 | 4.1 | 6 | 2.1 |
| | No Credits | 538 | 27.0 | 44 | 15.6 |
| Chemistry[b] | University Credits | 1641 | 82.5 | 87 | 30.9 |
| | Transfer Credits | 64 | 3.2 | 182 | 64.5 |
| | Credits from AP, CLEP, & IB | 138 | 6.9 | 1 | 0.4 |
| | No Credits | 146 | 7.3 | 12 | 4.3 |
| Mechanics[b] | University Credits | 1654 | 83.2 | 93 | 33.0 |
| | Transfer Credits | 69 | 3.5 | 171 | 60.6 |
| | Credits from AP, CLEP, & IB | 68 | 3.4 | 5 | 1.8 |
| | No Credits | 198 | 10.0 | 13 | 4.6 |
| Electricity and Optics[b] | University Credits | 1150 | 57.8 | 111 | 39.4 |
| | Transfer Credits | 228 | 11.5 | 130 | 46.1 |
| | Credits from AP, CLEP, & IB | 63 | 3.2 | 4 | 1.4 |
| | No Credits | 548 | 27.6 | 37 | 13.1 |
| Average of Five Common Courses in Engineering | University Credits | 1439.6 | 72.4 | 77.6 | 27.5 |
| | Transfer Credits | 135.2 | 6.8 | 175.6 | 62.3 |
| | Credits from AP, CLEP, & IB | 112.6 | 5.7 | 6.8 | 2.4 |
| | No Credits | 301.6 | 15.16 | 22.0 | 7.8 |

*Note*. AP = Advance Placement (AP) exams; CLEP = College Level Exam Program (CLEP) exams; IB = International Baccalaureate (IB) course credits; FTIC= First-Time-in-College (FTIC) Students; FTT = First-Time-Transfer (FTT) Students

[a]According to the course catalog of the institution, Calculus I and Mechanics are recommended to be taken in the first semester and Calculus II, Chemistry, and Electricity and Optics are recommended to be taken in the second semester for most majors.

[b]In 2006, chemistry and both physics courses were not required for students enrolled in computer science engineering.

## C. Graduation Outcomes (Graduation Rates, Time, and GPAs)

**Graduation Rates.** Table 4 shows 2006 cohort students' graduation status at the university after 8.5 years (fall 2014). After 17 semesters (8.5 years), FTT students had a 71.6% graduation rate in engineering while FTIC students had only a 53.9% graduation rate. Figure 2 shows the 2006 cohort students' accumulated graduation rates in engineering across years by FTIC and FTT students. After 12 semesters (6 years) of their entrance to the university, FTT students had a 70.6% graduation rate in engineering while FTIC students had only a 51.7% graduation rate. Since then, the graduation rates look stable, but there was gradual increase in both populations.

Table 4. 2006 Cohort Students' Graduation Status by Admission Type after 8.5 Years (*N* = 2,271)

| Graduation Status | FTIC | | FTT | |
|---|---|---|---|---|
| | *n* | % | *n* | % |
| Graduation in engineering | 1072 | 53.9 | 202 | 71.6 |
| Graduation in non-engineering | 489 | 24.6 | 27 | 9.6 |
| No Graduation | 428 | 21.5 | 53 | 18.8 |
| Total | 1989 | 100.0 | 282 | 100.0 |

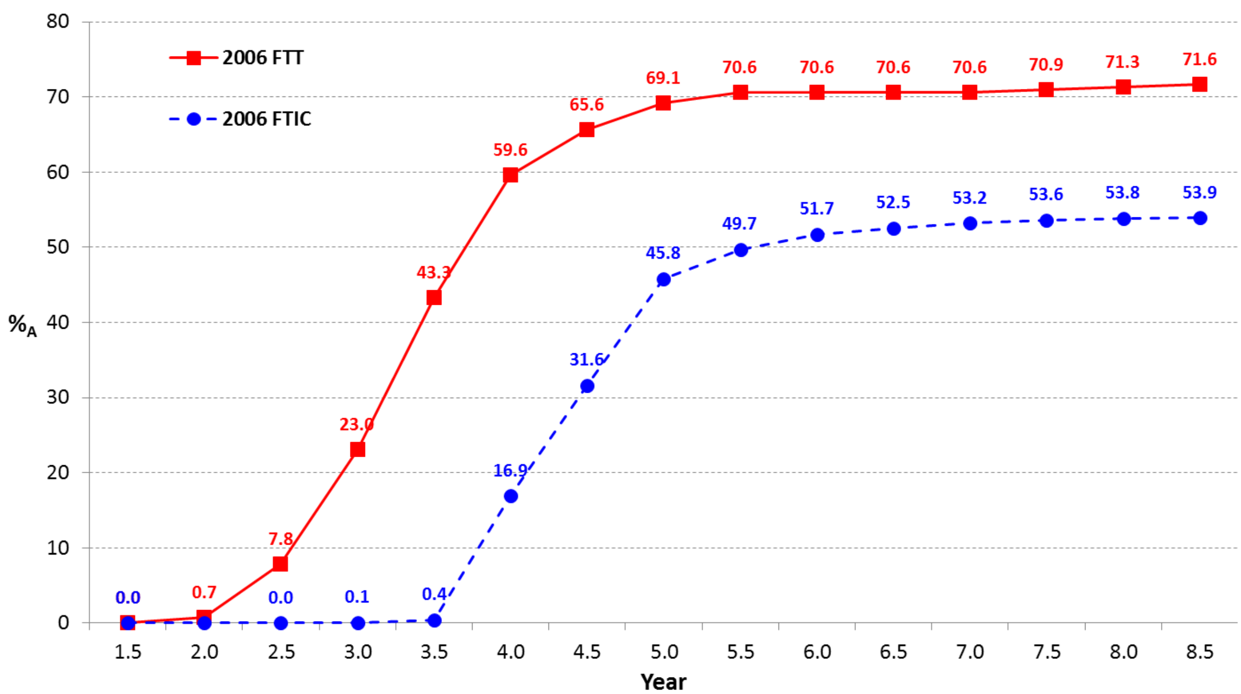


Figure 2. 2006 Cohort students' graduation rates in engineering by admission type (FTT vs. FTIC) across years

**Graduation Time.** In terms of years taken to achieve an engineering degree, on average, FTT students took 3.7 years (*SD* = 0.89) while FTIC students took 4.7 years (*SD* = 0.74) as of fall 2014 (after 8.5 years). Interestingly, both FTIC and FTT students who achieved a non-engineering degree at the institution took similar time for graduation, which was 4.7 years (*SD* = 0.87) and 3.9 years (*SD* = 1.00), respectively. Note that the time to graduation does not include the time of the FTT spent at other institutions prior to joining the institution.

**Cumlative GPAs.** Table 5 shows 2006 cohort students' cumulative GPA shown in their last academic semester segregated by their admission type and graduation status at the university. While there were no apparent differences in GPAs between FTIC and FTT students, there were distinct differences in GPAs by graduation status. Two-way ANOVA analyses revealed that while there was no significant main effect of admission type, $F$ (1, 2265) = 0.26, $p = 0.61$, *partial* $\eta^2 = 0.00$, there was a significant main effect of graduation status, $F$ (2, 2265) = 288.4, $p < 0.001$, *partial* $\eta^2 = 0.203$. The Bonferroni *post hoc* test showed that students GPA's were significantly different from each other by graduation status.

Table 5. 2006 Cohort Students' Cumulative GPA by Graduation Status

| Graduation Status | Total | | | FTIC | | | FTT | | |
|---|---|---|---|---|---|---|---|---|---|
| | $n$ | $M_{GPA}$ | $SD_{GPA}$ | $n$ | $M_{GPA}$ | $SD_{GPA}$ | $n$ | $M_{GPA}$ | $SD_{GPA}$ |
| Graduation in engineering | 1274 | 3.11 | 0.45 | 1072 | 3.12 | 0.45 | 202 | 3.06 | 0.44 |
| Graduation in non-engineering | 516 | 2.92 | 0.47 | 489 | 2.93 | 0.47 | 27 | 2.80 | 0.44 |
| No Graduation | 481 | 1.74 | 0.85 | 428 | 1.72 | 0.84 | 53 | 1.90 | 0.92 |
| Total | 2271 | 2.78 | 0.78 | 1989 | 2.77 | 0.79 | 282 | 2.82 | 0.72 |

**D. Subgroup Differences (by Gender, Race/Ethnicity, and Residency) on Cumulative GPAs**

Table 6 shows descriptive statistics of the cumulative GPAs by subgroups. On average, female students showed higher cumulative GPAs in total and in both admission types. Accordingly, an independent $t$-test showed a statistically significant mean difference in the cumulative GPAs by gender, $t(811.2) = 5.54$, $p < 0.001$. Two-way ANOVAs revealed that while there was no significant main effect of admission type, $F$ (1, 2267) = 1.09, $p = 0.297$, *partial* $\eta^2 < 0.001$, there was a significant main effect of gender, $F$ (1, 2267) = 15.90, $p < 0.001$, *partial* $\eta^2 = 0.007$.

As some racial groups (American Indian/Alaska Native, Native Hawaiian/other Pacific Islander, and multi-racial students) did not have enough students for inferential statistical analyses, mean comparisons of the cumulative GPAs were applied for only Hispanic, Asian, Black, and White student groups for the total population. One-way ANOVA revealed a significant differences by race and ethnicity, Welch's $F$ (3, 224.6) = 27.04, $p < 0.001$. Post-hoc analyses using Games-Howell tests for unequal variances showed significant mean differences between White students with other race/ethnic groups (Hispanic, Asian, and Black students).

Regarding residence, while, on average, international students seemed to have higher cumulative GPAs than domestic students in total and in both admission types. However, a two-way ANOVAs revealed no significant main effects of both admission type, $F$ (1, 2267) = 0.90, $p$ = 0.342, *partial* $\eta^2 < 0.001$, and residence, $F$ (1, 2267) = 3.34, $p = 0.068$, *partial* $\eta^2 < 0.001$.

Table 6. 2006 Cohort Students' Cumulative GPAs by Subgroups

| Category | Subgroup | Total | | | FTIC | | | FTT | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *N* | $M_{GPA}$ | $SD_{GPA}$ | *n* | $M_{GPA}$ | $SD_{GPA}$ | *n* | $M_{GPA}$ | $SD_{GPA}$ |
| Gender | Female | 474 | 2.94 | 0.71 | 424 | 2.93 | 0.71 | 50 | 3.03 | 0.70 |
| | Male | 1,797 | 2.73 | 0.79 | 1,565 | 2.73 | 0.80 | 232 | 2.77 | 0.71 |
| Residence | Domestic | 2,185 | 2.77 | 0.78 | 1,944 | 2.77 | 0.79 | 241 | 2.79 | 0.72 |
| | International | 86 | 2.91 | 0.76 | 45 | 2.82 | 0.85 | 41 | 3.01 | 0.65 |
| Race/ Ethnicity | Hispanic | 350 | 2.51 | 0.82 | 310 | 2.50 | 0.82 | 40 | 2.6 | 0.8 |
| | American Indian/ Alaska Native | 5 | 2.23 | 1.10 | 5 | 2.23 | 1.10 | 0 | N/A | N/A |
| | Asian | 118 | 2.62 | 0.91 | 103 | 2.59 | 0.94 | 15 | 2.8 | 0.7 |
| | Black | 76 | 2.39 | 0.69 | 70 | 2.34 | 0.69 | 6 | 3.0 | 0.4 |
| | Native Hawaiian/ other Pacific Islander | 1 | 2.91 | N/A | 1 | 2.91 | N/A | 0 | N/A | N/A |
| | White | 1,604 | 2.86 | 0.75 | 1,426 | 2.87 | 0.75 | 178 | 2.8 | 0.7 |
| | Multi-racial | 28 | 2.79 | 0.49 | 26 | 2.78 | 0.51 | 2 | 2.9 | 0.4 |
| | Unspecified | 3 | 2.46 | 0.76 | 3 | 2.46 | 0.76 | 0 | N/A | N/A |
| | Total | 2,271 | 2.78 | 0.78 | 1,989 | 2.77 | 0.79 | 282 | 2.82 | 0.72 |

**IV. Discussion**

To understand different pathways and trajectories of FTT students, this study made comparisons between FTT and FTIC students in terms of demographic characteristics, first year engineering common course credits, their success in engineering in terms of time to graduation and graduation rates in engineering, and academic performance in terms of cumulative GPAs. As shown in the results, the 2006 cohort students' data collected from a southwest public university showed apparent differences between FTIC and FTT students in their academic preparation, performance, and success. In addition, findings in this study showed conflicting results different from trends in the recent studies using large databases, such as Cal-PASS and MIDFIELD[4, 7]. For example, as Sullivan et al. (2012)' study only considered domestic students in MIDFIELD, demographic characteristics of FTT students were quite different from the population of this study: MIDFILED data had more White (77.9%) and Black (9.2%) and fewer Hispanic (3.0%) students compared to this study with White (73.9%) and Black (2.5) and more Hispanic (16.6%) students. In addition, while MIDFIELD data showed better graduation outcomes (six-year graduation rates in engineering and overall GPAs) of FTIC students, this study revealed better graduation outcomes (6-year graduation rates in engineering) by FTT students with similar cumulative GPAs of FTIC students.

As Belfield and Bailey (2011) reviewed the benefits of attending a community college, the data from the 2006 cohort students at the southwest public university showed similar advantages of the FTT students. For example, as community college tuition is lower than four-year college, FTT students may have lower costs for obtaining an engineering degree than FTIC students as FTT students' average time for graduation in engineering is about a year shorter than FTIC students. Considering the transfer credits on the engineering common courses, FTT students are more academically prepared and matured than FTIC students when entering on the same time, so their readiness for the upper course levels seem to result in a shortened time for graduation in engineering on average and higher graduation rates in engineering compared to FTIC students. As Laugerman et al. (2013)[7] pointed out, even if FTIC and FTT students start their engineering program at the same time at the same institution, they are quite different from each other from the onset, in terms of academic preparation, performance, and maturation.

### A. Limitation of the Study and Direction for Future Research

First, as the sample of this study is from a southwest public university, the findings of this study may limit the generalization of the results to the other institutions because of the different demographics and educational environment (e.g., support systems). Therefore, future studies situated in different educational settings would allow better understanding of the characteristics of FTT students different from FTIC students. Second, as we utilized the university archive data, there was a limitation in the scope of data. Therefore, future studies regarding student motivation systems or other psychological factors are in need to explore factors that facilitate or impede students to transfer to a four-year engineering institution and factors that facilitate or impede their subsequent success at the four-year institutions. Third, time to graduation was considered only at the final degree granting institution. Therefore, further exploration about the amount of time that transfer students have spent at their initial institution(s) is necessary in order to account for total time to graduation. Fourth, some factors that could be investigated here are the slope of how fast they graduate from the degree granting institution which is an indicator of transferability of courses that count toward graduation.

### B. Significance of the Study

This study is significant in several ways. First, with an increasing emphasis on incorporating community college as a pathway to a four-year degree, the results found in this study could be interesting to a wide audience who are at two- and four-year institutions with engineering related programs. Second, we utilized a large data set involving a whole population at a university and analyzed the data over a significant time span. This approach enabled us to rigorously explore characteristics of FTT students different from FTIC students in valid and reliable ways. Third, as there has been a lack of research on FTT students, the findings of this study will help educators and administrators in admission identify policies that may deter transfer students' success and develop policies or support programs to enhance their success in engineering.

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