

## Comparing Success for Transfers Students and First-Time Freshmen Using Data from Institutional Archives – Early Results

**Dr. Fred W. Depiero, California Polytechnic State University, San Luis Obispo**

Dr. Fred DePiero earned his BS and MS degrees in Electrical Engineering at Michigan State University. After which he worked at Oak Ridge National Lab in the areas of robotics and machine vision. He then earned his PhD, also in EE, from the University of Tennessee. In 1996 he moved to San Luis Obispo, CA and joined the faculty of Cal Poly in EE. After 10 years of service as an Associate Dean, Fred rejoined the faculty and has since moved into the Computer Engineering Department. His areas of interest have branched out to include web applications for teaching and learning, as well as new approaches to digital-to-analog converters with first and second order holds.

**Prof. Dominic J. Dal Bello, Allan Hancock College**

Dom Dal Bello is Professor of Engineering at Allan Hancock College (AHC), a California community college between UC Santa Barbara and Cal Poly San Luis Obispo. At AHC, he is Department Chair of Mathematical Sciences, Faculty Advisor of MESA (the Mathematics, Engineering, Science Achievement Program), and Principal/Co-Principal Investigator of several National Science Foundation projects (S-STEM, LSAMP, IUSE). In ASEE, he is chair of the Two-Year College Division, and Vice-Chair/Community Colleges of the Pacific Southwest Section. He received the Outstanding Teaching Award for the ASEE/PSW Section in 2022.

**Dr. Lizabeth L. Thompson, California Polytechnic State University, San Luis Obispo**

Lizabeth is a professor at Cal Poly, SLO in Industrial and Manufacturing Engineering. She has been teaching for 22 years and has continued to develop innovative pedagogy such as project based, flipped classroom and competency grading. Through the SUSTAIN

**Stephen Robert Beard**

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### **Background**

This study is associated with a National Science Foundation grant that provides scholarships for students in STEM disciplines, “Engineering Neighbors: Gaining Access, Growing Engineers,” (ENGAGE). The focus of ENGAGE is to improve recruitment, persistence and graduation of students originating at two Hispanic-Serving California Community Colleges, and transferring to Cal Poly, a highly selective, predominantly white, 4-year public institution. Partnering institutions are Hancock and Cuesta colleges.

Results include comparisons of transfer student success versus first time-first year (FTFY) students at Cal Poly, in the College of Engineering. Disciplines include Computer Science and Software Engineering. The authors believe that transfers can succeed as well as FTFY students and are not alone in this belief [1]. However, success is not without challenges. Many published studies suggest that transfers may perform poorer when they are in Engineering [2], at a public institution [3], and due to first-generation status [4] [5] [6]. Cal Poly transfers also face challenges that are specific to campus. Students declare their major as they enter the university and discipline-specific coursework typically begins in the first year for FTFY. Early declaration of majors at Cal Poly has resulted in curricula that evolved to suit FTFY students well. Transfer students, on the other hand, face lengthy prerequisite chains, particularly in some Engineering majors.

Acknowledging these many challenges, the authors seek to understand the associated root causes some of which are specific to Cal Poly (such as the prerequisite chain issue). Which of the root causes are systemic and thus have the potential to be addressed via university changes? Also, based on the results of this study, the authors question whether transfer student performance is defined equitably in some internal metrics.

The timing of this study coincides with a semester conversion effort at Cal Poly. As part of the curricular redesign, programs are being strongly encouraged to establish more effective pathways to graduate transfer students in a timely manner (2 years, post transfer). One of the goals of this effort is to inform Cal Poly faculty regarding apparent root cause issues associated with transfer student performance. Another goal is to provide feedback to community college faculty regarding the outcomes of their transferring students.

A discussion of transfer students in California would not be complete without mentioning some nuances associated with matriculation from 2-year to 4-year institutions in the State. Engineering programs, including those at Cal Poly, do not guarantee admission to community college transfers. With over 110 community colleges, 23 Cal State Universities and 9 University of California undergraduate campuses, transfers must strategically select their community college coursework to prepare for a favorite 4-year destination as well as alternative options. This additional burden can impact students’ time to transfer at the community college, and time-to-degree at their 4-year university.

## Research Questions and Goals

For this study, student success is defined in terms of graduation rate (expressed as a percentage) as well as time to degree (expressed as a number of terms). Although these metrics are not all-encompassing, the graduation rates for transfers suggest this may be a good starting point to explore root causes. The student population investigated in this study includes transfers and FTFY students in the Cal Poly College of Engineering. The College has 13 undergraduate programs, including Computer Science and Software Engineering. The focus was on the 2015-2018 cohorts, with a total of 5607 students.

The following research questions are posed.

1. How do transfers and FTFY students compare historically, in terms of graduation rates, and other attributes?
2. What variables are significant when predicting time-to-degree for transfers?

## Data Sources

Where feasible, university data from the Offices of Institutional Research are employed on the ENGAGE project. However, more information was needed to investigate the research questions. To support this study a custom-built database system was constructed and loaded with campus archival data. Student identifiers were encrypted.

Important ongoing efforts include the integration of data from the three ENGAGE institutions. Individual and course data from Hancock and Cuesta partner institutions, together with the Cal Poly archive will provide a robust database for analysis. Data privacy and security for the data integration process are a concern for all three institutions. A secure approach is being employed that involves the Cal Poly Admissions Office to facilitate the matching process of student records. Admissions has access to more sensitive student data such as SSN and date of birth and can use the National Clearing House to support an imprecise or “fuzzy” matching process of student identifiers. Imprecise matches may be due to name changes or less formal versions of names, for example. The result of the fuzzy matching will be a table that associates student identifiers from all three partner institutions. This will facilitate joining course, term, and individual data from the community colleges, together with data from the Cal Poly archives.

### ***Results - How do transfers and FTFY students compare, in terms of graduation rates?***

This first set of results address graduation rates. University data is summarized in Tables 1 and 2 for recent cohorts of transfers and FTFY. Rates for the nominal time to degree appear in Table 1 (2 yr. and 4 yr.) and rates for 50% beyond nominal are in Table 2 (6 yr. and 3 yr.)

Table 1. Graduation rates for transfers (after 2 years) and for FTFY (after 4 years). University source. Includes part-time students.

Fall Cohort	2015	2016	2017	2018	2019	2020
Transfers	3.7%	4.1%	5.1%	8.9%	11.8%	11.7%
FTFY	40.2%	49.0%	49.0%	50.0%	-	-

Table 2. Graduation rates for transfers (after 4 years) and for FTFY (after 6 years). University source. Transfer rates rebound with the 4-year rates. Includes part-time students.

Fall Cohort	2013	2014	2015	2016	2017	2018
Transfers	80.3%	89.5%	84.8%	85.2%	81.5%	82.6%
FTFY	81.7%	84.8%	87.3%	86.9%	-	-

A recovery by transfers can be seen in Table 2 which describes the longer timeline. This reinforces the authors' belief that transfers can succeed as well as FTFY. These data also beg the question why gaps exist. The next results compare these student groups across a broader suite of attributes.

### **Results - *How do transfers and FTFY students compare, in broader terms?***

Published studies have suggested many factors impacting students' academic performance. For example, [4] [5] [6] report an increased attrition and lower rates of degree attainment can be attributed to first-generation status, gender, prior academic achievement, and other demographics. Other results [7] describe increased time to degree, due to fewer credit hours. A lack of continuous enrollment has been shown to have a significant impact on time-to-degree [8].

These prior findings provided many suggestions for variables incorporated into this study. Note that these other efforts typically involved student populations across multiple institutions. Some used nationwide data sets. Results here are for the Cal Poly College of Engineering only. The narrower scope of this study provides an opportunity to identify root cause issues specific to Cal Poly. In some cases, the mixed results from other studies appear explainable by systemic issues at Cal Poly.

Tables 3a-3f summarize results for several variables. Data included the 2015-2018 cohorts in the College of Engineering. Welch t-tests were used to examine significance [9]. Results include several comparisons with both significant differences and large effect sizes. Levels of significance are given by the following range: 0 '\*\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 '(Not)' 1.

**Table 3a. Junior-Level GPA.** Historical comparisons for transfers and FTFY students.

Cohort	Transfers	FTFY	Significance	Effect Size
2015	2.8, N=2206	3.1, N=15682	*** p < 0.001	Small, d = 0.27
2016	2.8, N=2208	3.2, N=13622	*** p < 0.001	Moderate, d = 0.35
2017	2.9, N=2638	3.3, N=14633	*** p < 0.001	Moderate, d = 0.35
2018	3.0, N=2570	3.3, N=11534	*** p < 0.001	Moderate, d = 0.34

**Table 3b. Senior-Level GPA.** Historical comparisons of course GPA between transfers and FTFY students.

Cohort	Transfers	FTFY	Significance	Effect Size
2015	3.3, N=1492	3.4, N=10762	*** p < 0.001	Small, d = 0.14
2016	3.2, N=1529	3.5, N=9449	*** p < 0.001	Small, d = 0.33
2017	3.3, N=1794	3.5, N=10144	*** p < 0.001	Small, d = 0.30
2018	3.4, N=1647	3.6, N=7917	*** p < 0.001	Small, d = 0.17

**Table 3c. Full-Time Status.** Historical comparisons for transfers and FTFY students. Results show the percentage of terms that a student maintained full-time status.

Cohort	Transfers	FTFY	Significance	Effect Size
2015	87%, N=167	92%, N=1260	*** p < 0.001	Moderate, d = 0.36
2016	84%, N=180	91%, N=1164	*** p < 0.001	Moderate, d = 0.51
2017	84%, N=222	89%, N=1332	*** p < 0.001	Moderate, d = 0.35
2018	84%, N=213	88%, N=1069	*** p < 0.0035	Small, d = 0.25

**Table 3d. Parental Education Level.** Historical comparisons for transfers and FTFY students. Education level is the maximum achieved by either parent. Levels range from 1-7, 1) No High School, 2) Some High School, 3) High School Graduate, 4) Some College, 5) Community College Graduate, 6) 4 Year College Graduate, 7) Postgraduate. The parental education level is categorical data but has been treated as numeric in this analysis. These data are self-reported on a student's Cal Poly application.

Cohort	Transfers	FTFY	Significance	Effect Size
2015	4.4, N=155	5.8, N=1217	*** p < 0.001	Large, d = 0.79
2016	4.6, N=172	6.0, N=1128	*** p < 0.001	Large, d = 0.84
2017	4.3, N=216	6.0, N=1296	*** p < 0.001	Large, d = 0.94
2018	4.5, N=213	6.2, N=1069	*** p < 0.001	Large, d = 0.85

**Table 3e. Student work level.** Historical comparisons for transfers and FTFY students. Work levels are self-reported on students' applications, reflecting work prior to Cal Poly attendance. Work hours levels are self-reported on students' Cal Poly applications. Hours were higher for transfers than for FTFY. The difference is significant, and the effect size is large. These data are categorical with levels ranging from 0-6: 1 (0 hours) 2 (1-5 hr.) 3 (6-10 hr.) 4 (11-15 hr.) 5 (16-20 hr.) 6 (21+).

Cohort	Transfers	FTFY	Significance	Effect Size
2015	3.9, N=167	2.5, N=1260	*** p < 0.001	Large, d = 0.75
2016	3.9, N=180	2.5, N=1164	*** p < 0.001	Large, d = 0.84
2017	4.2, N=222	2.5, N=1332	*** p < 0.001	Large, d = 1.06
2018	4.1, N=213	2.6, N=1069	*** p < 0.001	Large, d = 0.92

**Table 3f. Poor Grades.** Historical comparisons for transfers and FTFY students. The number of D, F, NC or WU grades is shown for each cohort. A grade of WU is referred to as an unauthorized withdrawal. NC means no credit.

Cohort	Transfers	FTFY	Significance	Effect Size
2015	2.3, N=167	2.1, N=1260	(Not) p = 0.45	Small, d = 0.06
2016	2.2, N=180	1.9, N=1164	(Not) p = 0.20	Small, d = 0.10
2017	1.8, N=222	2.0, N=1332	(Not) p = 0.37	Small, d = 0.06
2018	2.0, N=213	1.8, N=1069	(Not) p = 0.28	Small, d = 0.08

**Table 3g. GPA of undergraduate degrees.** Historical comparisons for transfers and FTFY students. Note the reduction in N for the 2018 FTFY cohort, likely due to COVID.

Cohort	Transfers	FTFY	Significance	Effect Size
2015	3.1, N=153	3.2, N=1115	*** p = 0.011	Small, d = 0.23
2016	3.1, N=160	3.3, N=1013	*** p < 0.001	Moderate, d = 0.46
2017	3.1, N=192	3.3, N=1332	*** p < 0.001	Moderate, d = 0.52
2018	3.2, N=178	3.4, N=632	*** p < 0.001	Moderate, d = 0.58

**Table 3h. Dropped Courses.** Historical comparison of the number of dropped or withdrawn courses for transfers and FTFY students, while at Cal Poly. Transfer students appear to have a surprisingly high number of dropped/withdrawn courses, compared to FTFY given that they first enroll as juniors. Further investigation is appropriate.

Cohort	Transfers	FTFY
2015	22.0, N=167	26.5, N=1260
2016	21.3, N=180	26.3, N=1164
2017	20.6, N=222	30.1, N=1332
2018	20.1, N=213	30.3, N=1069

**Table 3i. Graduate Enrollment.** Historical comparison of the percentage of transfers and FTFY students who enroll in a graduate program at Cal Poly.

Cohort	Transfers	FTFY	Significance	Effect Size
2015	9%, N=167	11%, N=1260	(Not) p = 0.22	Small, d = 0.07
2016	8%, N=180	15%, N=1164	*** p < 0.001	Small, d = 0.20
2017	16%, N=222	13%, N=1332	(Not) p < 0.11	Small, d = 0.07
2018	11%, N=213	13%, N=1069	(Not) p = 0.36	Small, d = 0.05

### Discussion of historical comparisons

Tables 3a and 3b indicate a drop in GPA for transfers, compared to FTFY. The gap narrows for the senior year. Differences are significant but the effect size is small to moderate. These results are consistent with other studies. In [10] GPAs for both FTFY and transfer students increased by class level, however, transfer students earned lower GPAs than FTFY students. While many transfer students experience a drop in GPA in their first semester [10], the majority recover in one year. In a summary of several studies, [11] describes mixed results that examined grades for first-generation students, compared to their peers. Some results demonstrated no differences, and some indicate lower grades. Results here are not inconsistent, as many transfers are first-generation students – see Table 3d.

Table 3c shows a reduced number of terms that transfer students maintained full-time status. This is consistent with other reported results [12] [2] citing number of units taken each semester and the importance of continuous enrollment. It is also concerning as [13] described transfers less socially and academically engaged than FTFY and that part-time transfers were even less likely to engage [14].

The authors' working assumption is that there is an underlying relationship between part-time status and increased financial need. However, a correlation has not yet been established. Formal determination of this correlation is the subject of future work. Table 3e suggests the correlation is likely, as transfers describe their work pre-transfer level significantly higher than FTFY, with a large

effect size. If a correlation exists then this could be a useful consideration in many studies, as financial status is closely guarded information. However part-time status has a lesser data security level. Hence the correlation would allow archival data with a lower sensitivity to provide an indication of the more sensitive financial status.

The comparisons of low grades in Table 3f and undergraduate GPA of Table 3g do not raise concerns specific to transfers. The number of poor grades was like that of FTFY. And while the undergraduate GPA was significantly lower for transfers, the means were above a 3.0.

The number of dropped or withdrawn courses in Table 3h is difficult to compare due to the shortened enrollment of transfers compared to FTFY. Hence, significance testing was omitted as this is somewhat of an apples-to-oranges comparison. Also, FTFY freshmen are automatically enrolled into required courses which should reduce drop / add activity in the first year. Note – in an ideal situation, transfers should have approximately half of the drops as FTFY. Transfers are far above this level. Further investigation is warranted.

Table 3i presents encouraging results on graduate school enrollment for undergraduate transfer students. Percentages vary. Sometimes transfers and above FTFY, and sometimes below. There are no significant differences. The effect sizes are small, but Cal Poly graduate programs have much lower enrollment than undergraduate programs, so this is not inconsistent. These results suggest an opportunity for the campus to further promote graduate programs for transfers.

**Table 4. Change of Major.** Comparing transfers and FTFY for various cohorts. University data source. Percentages for transfers are less than half the rates for FTFY.

Fall Cohort	2013	2014	2105	2016	2017	2018
Transfers	9.6%	12.4%	9.4%	12.0%	16.1%	8.0%
FTFY	24.2%	27.0%	27.4%	28.5%	-	-

Another potentially important factor impacting degree progress is change of major. Fortunately for transfers, their rates are less than half those of FTFY. See Table 4. While these lower rates are generally good, they speak to yet another challenge for transfer students, who have less flexibility when changing majors, due to a compressed time frame on campus.

### **Results - What variables predict time-to-degree for transfers?**

Clearly there are differences between transfers and FTFY in the College of Engineering. Which of these or other variables might be impactful regarding time-to-degree? A regression analysis helped identify significant factors [15][16]. The regression model predicted the number of terms to graduation using variables shown in Tables 5a-5d. Several variables from Tables 3 were included, as well as the academic ranking used on the Cal Poly application. This ranking system incorporates numerous criteria and is known as the “MCA” (Multi-Criteria Admissions) [17]. As suggested by [18] college-level GPA variable was also included, as this can be more revealing than a pre-college GPA. Multiple studies have demonstrated that excessive course withdrawal reduces the likelihood of completing a degree [19]. So, the total number of dropped and withdrawn courses was also included.

**Table 5a. Time-to-Degree 2015.** Regression analysis of time-to-degree for transfer students.  
N=123, adjusted  $R^2 = 0.67$ ,  $p < 0.001$ ,  $F = 27.96$ , 113 DF

Variable	Coefficient	Significance
Academic ranking of applicants (“MCA”)	0.000	(Not) $p = 0.54$
Percentage of terms with full time enrollment	-0.026	** $p = 0.002$
Parental level of education	0.047	(Not) $p = 0.46$
Work hour level	0.031	(Not) $p = 0.62$
Number of D, F, NC, or WU grades	0.291	*** $p < 0.001$
GPA of undergraduate degree	0.156	(Not) $p = 0.71$
Number of Dropped or Withdrawn Courses	-0.053	*** $p < 0.001$
Number of Lower Division Courses	0.149	*** $p < 0.001$
Number of Upper Division Courses	0.118	*** $p < 0.001$

**Table 5b. Time-to-Degree 2016.** Regression analysis of time-to-degree for transfer students.  
N=131, adjusted  $R^2 = 0.49$ ,  $p < 0.001$ ,  $F = 14.88$ , 121 DF

Variable	Coefficient	Significance
Academic ranking of applicants (“MCA”)	0.000	(Not) $p = 0.47$
Percentage of terms with full time enrollment	-0.061	*** $p < 0.001$
Parental level of education	-0.093	(Not) $p = 0.15$
Work hour level	-0.002	(Not) $p = 0.96$
Number of D, F, NC, or WU grades	0.186	* $p = 0.024$
GPA of undergraduate degree	0.711	(Not) $p = 0.12$
Number of Dropped or Withdrawn Courses	-0.041	** $p = 0.004$
Number of Lower Division Courses	0.108	*** $p < 0.001$
Number of Upper Division Courses	0.094	*** $p < 0.001$

**Table 5c. Time-to-Degree 2017.** Regression analysis of time-to-degree for transfer students.  
 N=148, adjusted  $R^2 = 0.57$ ,  $p < 0.001$ ,  $F = 23.07$ , 138 DF

Variable	Coefficient	Significance
Academic ranking of applicants (“MCA”)	0.000	(Not) $p = 0.70$
Percentage of terms with full time enrollment	-0.044	*** $p < 0.001$
Parental level of education	-0.067	(Not) $p = 0.29$
Work hour level	-0.041	(Not) $p = 0.57$
Number of D, F, NC, or WU grades	0.170	* $p = 0.019$
GPA of undergraduate degree	-0.461	(Not) $p = 0.26$
Number of Dropped or Withdrawn Courses	-0.006	(Not) $p = 0.66$
Number of Lower Division Courses	0.106	*** $p < 0.001$
Number of Upper Division Courses	0.068	** $p = 0.003$

**Table 5d. Time-to-Degree 2018.** Regression analysis of time-to-degree for transfer students.  
 N=153, adjusted  $R^2 = 0.54$ ,  $p < 0.001$ ,  $F = 20.63$ , 143 DF

Variable	Coefficient	Significance
Academic ranking of applicants (“MCA”)	0.000	(Not) $p = 0.40$
Percentage of terms with full time enrollment	-0.033	*** $p < 0.001$
Parental level of education	-0.095	* $p = 0.039$
Work hour level	0.037	(Not) $p = 0.55$
Number of D, F, NC, or WU grades	0.027	(Not) $p = 0.71$
GPA of undergraduate degree	0.179	(Not) $p = 0.62$
Number of Dropped or Withdrawn Courses	-0.060	*** $p < 0.001$
Number of Lower Division Courses	0.137	*** $p < 0.001$
Number of Upper Division Courses	0.129	*** $p < 0.001$

Samples included undergraduates in the College of Engineering, for the 2015-2018 cohorts. The population of students was restricted for the regression, to exclude students who entered a blended master's program. Blended programs delay awarding of a bachelor's degree until both the BS and MS are completed. This skews the prediction of time to degree for the BS.

All p-values for the regressions were highly significant, as seen in Tables 5a-5d. The  $R^2$  values ranged from 0.49 to 0.67. This indicates a relatively good fit, with the model accounting for these fractions of the variance. Note that  $R^2$  values are typically under 0.5 when dealing with human behavior.

### **Result Summary – Critical factors for transfers**

As shown in Table 5a-5d, several variables appear to have a significant impact on time to degree for transfer students, as opposed to FTFY.

- Full-time enrollment
  - Significant or highly significant in all 4 cohorts
  - Transfers had a lower percentage of full-time terms, and the difference was highly significant compared to FTFY, with a moderate effect size in 3 of 4 cohorts.
  - Consistent with [7][8][2].
- Number of lower division courses
  - Highly significant predictor in 4 of 4 cohorts
  - With an ideal transfer environment, students would not take any lower division coursework at their 4-year institution.
  - Appears to be a systemic issue due to curricular that are FTFY-oriented. Curriculum redesign is underway as part of the semester conversion.
- Number of upper division courses
  - Highly significant predictor in 3 of 4 cohorts, or significant
  - An unusual result. Transfers take 3-4 more upper division courses, typically, compared to FTFY. The difference is significant, although with a small to moderate effect size. Issue deserves more study. Possible explanation is that more transfers have financial aid and thus need to maintain a higher course load to meet the minimum required units for aid.
- Number of dropped or withdrawn courses.
  - Highly significant predictor in 3 of 4 cohorts
  - Transfers had significantly more, despite not enrolling at Cal Poly until juniors.
  - A concerning result. More streamlined curricula for transfers may help.
  - Consistent with results from [2] [7].

### **Result Summary – Less critical factors for transfers**

Variables that lacked a significant impact in most cohorts or were not challenges particular to transfers.

- Number of D, F, NC WU grades
  - Some level of significance in 3 of 4 cohorts.
  - Consistent with [2], citing failed courses.
  - Rates for FTFY students were similar, with significant differences and small effect size. Hence this issue is not particular to transfers.

- Parental level of education
  - Mildly significant in only 1 of 4 cohorts
  - While transfers include significantly more 1<sup>st</sup> generation students, this does not appear to impact their mean time-to-graduation. A good result to see for transfers.
- Work hour level
  - Not a strong predictor of time-to-degree
  - Work hours for transfers were significantly higher than for FTFY, with large effect size.
  - Another good result to see for transfers.
- GPA of undergraduate degree
  - Not a strong predictor.
  - Transfers have a lower GPA for their degree, compared to FTFY. However, the differences are around 0.1 to 0.2 and their mean GPAs are 3.1 and above. Hence, not impacting their good standing. GPA differences may be associated with the drop at the junior level, shown in Table 3a. Transfers bounce back as seniors. This trend has been reported across a wide number of institutions [10][11]
- Academic ranking of applicants “MCA”
  - Not a strong predictor. Note that other variables are post-transfer, which is an advantage for a predictor [18].

## Conclusions and Surprises

This study involved a single institution; hence, results may not generalize widely. However, it is possible that transfer students at other California State Universities may be experiencing similar challenges, in terms of their part-time status. In any case, this effort provided confirmation of other studies in a local context. It also revealed some surprises and demonstrated the need for a custom database tool to explore student progress.

Major challenges faced by transfer students appear to be systemic in origin, and not due to academic shortfall on the part of the student. For example, the impact of lower division coursework on time-to-degree is clearly related to the long prerequisite chains. These results show that the impact is significant. The benefits of revised curricula with the semester conversion are welcome. Part-time status is another systemic versus academic issue (presumably associated with financial aid or family commitments).

Results indicate that the impact of upper division coursework had an unexpected level of significance. Reasons for this are unclear and may include the need to pad units up to the minimum required for financial aid. This may result in part due to transfers being far off the flowchart and needing to wait to take courses that aren't offered in a particular term. The degree to which transfers are off the standard sequence of courses could be quantified in future studies. Course availability may be an exacerbating problem, as transfers have fewer chances to take required courses. The number of dropped and withdrawn courses was also a surprise and deserves more review.

It was also surprising to learn that Cal Poly's internal data sets differ from public data [20][21] associated with college rankings. An improved approach might be to include the graduation rates

for all students and for just the full-time students. Having data for full-time only students would allow faculty to appreciate curricular barriers, which would be helpful during the semester conversion process. Having data that includes all students would also be helpful as an indicator of the level of financial hardship and other circumstances that result in part-time attendance. Presenting both the full-time-only and all-student data would provide a more accurate depiction of transfer students. The need for clear definitions of campus data became quite evident through the efforts on this project.

Results of the statistical analyses strengthen the authors' belief that transfers can succeed at Cal Poly, and they look forward to transfer-friendly curricula soon. Changes are still in process but will likely include shortened prerequisite chains, and alignment with courses that are available at community colleges.

## References

- [1] T. Melguizo, G. S. Kienzl, & M. Alfonso, "Comparing the Educational Attainment of Community College Transfer Students and Four-Year College Rising Juniors Using Propensity Score Matching Methods," *The Journal of Higher Education*, 82(3), 265–291, 2011.
- [2] Predictors of Time-to-Degree for Recent UW-Madison Undergraduates, Academic Planning and Institutional Research, Office of the Provost, Nov 2018.
- [3] C. Bradford, & E. Farris, "Survey on retention at higher education institutions: Higher education survey report," Rockville, MD, 1995.
- [4] T. T. Ishitani, "Studying Attrition and Degree Completion Behavior among First-Generation College Students in the United States," *The Journal of Higher Education*, Vol. 77, No. 5, 2006.
- [5] L. Horn, "Stopouts or stayouts? Undergraduates who leave college in their first year," (NCES 1999-087). Washington, DC: U.S. Dept. of Ed., 1988.
- [6] R. J. Riehl, "The academic preparation, aspirations, and first-year performance of first-generation students," *College and University*, v70 n1 p14-19, 1994.
- [7] W. E. Knight, & W. Arnold, "Towards a comprehensive predictive model of time to bachelor's degree attainment," Association for Institutional Research, Cincinnati, OH, 2000.
- [8] M. J. Belcheir, "Predicting the probability of graduating after four, six, and ten years: Research report," Boise, ID: Boise State University, 2000.
- [9] M. Delacre, D. Lakens, & C. Leys, "Why Psychologists Should by Default Use Welch's *t*-test Instead of Student's *t*-test," *International Review of Social Psychology*, 30(1), 2017.
- [10] J. C. Glass Jr & A. R. Harrington, "Academic performance of community college transfer student and "native" students at a large state university," *Community College Journal of Research and Practice*, 26, 415-430, 2002.

[11] T. T. Ishitani, “A longitudinal approach to assessing attrition behavior among first-generation students: Time-varying effects of pre-college characteristics” *Research in Higher Education*, 44(4), 433-449, 2003.

[12] D. M. O’Toole, L. S. Stratton & J. N. Wetzel, “A Longitudinal Analysis of the Frequency of Part-Time Enrollment and the Persistence of Students Who Enroll Part Time,” *Research in Higher Education*, 44(5), 519–537, 2003.

[13] T. T. Ishitani, & S. A. McKittrick, “After transfer: The engagement of community college students at a four-year collegiate institution,” *Community College Journal of Research and Practice*, 2010.

[14] D. Flynn, “Baccalaureate Attainment of College Students at 4-Year Institutions as a Function of Student Engagement Behaviors: Social and Academic Student Engagement Behaviors Matter,” *Research in Higher Education*, 55(5), 467–493, 2014.

[15] J. Cohen, *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillside, NJ, Lawrence Erlbaum Associates, 1988.

[16] S. Chatterjee, A. S. Hadi, & B. Price, “Regression Analysis by Example,” 3rd ed, John Wiley & Sons, New York, 2000.

[17] MCA, <https://www.calpoly.edu/admissions/transfer-student/selection-criteria>.

[18] C. Moore & N. Shulock, “Student Progress Toward Degree Completion: Lessons from the Research Literature,” Institute for Higher Education Leadership & Policy, Sacramento, CA, Sept 2009.

[19] C. Moore & N. Shulock, “Beyond the open door: Increasing student success in the California community colleges,” Sacramento, CA: Institute for Higher Education Leadership & Policy, 2007.

[20] <https://CollegeFactual.com>

[21] <https://AdmissionsSight.com>