Analysis of Transfer Credits in Mechanical Engineering

Randall Manteufel and Amir Karimi
Mechanical Engineering Department
University of Texas at San Antonio

Abstract

An analysis of transfer credits shows that a significant percentage of mechanical engineering students at The University of Texas at San Antonio (UTSA), earned transfer credit for many freshmen- and sophomore-level courses. Nearly two-thirds of the students transferred credit for Calculus I and half for Physics I. Foundational engineering courses like Statics and Dynamics both had around one-fifth earned by transfer. Students earning Calculus I and Physics I credit in high school is correlated with high student satisfaction with the quality of instruction, yet no statistically significant differences are observed for student evaluation of the quality of instruction in Graphics, Statics or Dynamics courses when comparing community college with University.

Introduction

It is common for a public 4-year University to accept many transfer credits for courses taken by dual enrollment while in high school or for courses taken at a community college.[1] The percentage of transfer credits has steadily increased in recent years, especially from courses earned while student is in high school.[2,3,4] After transferring to a 4-year public University, the subsequent academic success of each student is of interest. Academic success is related to the student evaluation of instructor received. This paper reports student evaluation of instruction received in 5 courses which are often transferred and are linked to student's academic success and progression toward graduation.

The success in junior-/senior-level courses in mechanical engineering often depends on the mastery of prerequisite topics in freshmen-/sophomore-level foundational courses. It has been observed that some students may have earned credit for foundational courses, like Calculus I and Physics I, but in some cases they have little mastery of those concepts. When taking a rigorous engineering class, a student can struggle with the new course material as well as need to review foundational math/sci concepts. Tracking the success of students through the mechanical engineering program helps identify patterns and/or groups linked to timely progression and eventual graduation.

This paper looks at student satisfaction with instruction in 5 courses. These courses are often transferred automatically with the State of Texas by their TCCN number[4], which are included in parathesis: Calculus I (MATH 2413), Physics I (PHYS 2325), Graphics (EGR 1304), Statics (ENGR 2301) and Dynamics (ENGR 2302).

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Student Survey Student

A group of 127 students enrolled in mechanical engineering thermodynamics and heat transfer courses in the Fall 2022 semester voluntarily participated in a survey about five courses frequently earned by transfer credit. The survey is included in Appendix to this paper. The results of the survey are summarized in the table. The number of student responses is N and varied slightly because some didn't respond or gave multiple response, often when having to repeat a course. Table 1 includes the average rating on 5.0 scale. It also includes p-values which are used to assess a difference between the responses compared to UTSA.

Table 1. Summary of senior-level students in Mechanical Engineering about where they earn credit for 5 lower-level classes and perception of quality of instruction received in those classes. HS=High School, CC=Community College, UTSA=Univ. of TX as San Antonio.

Calculus I	HS	CC	UTSA
N	28 (22%)	50 (40%)	48 (38%)
avg rating	4.71	3.78	3.48
p-value	0.00	0.12	
Physics I	HS	CC	UTSA
N	7 (6%)	50 (41%)	66 (54%)
avg rating	5.00	3.36	3.24
p-value	0.00	0.56	
Graphics	HS	CC	UTSA
N	0 (0%)	31 (26%)	90 (74%)
avg rating	0%	3.26	3.29
p-value		0.91	
Statics	HS	CC	UTSA
N	0	25 (20%)	98 (80%)
avg rating		3.64	3.81
p-value		0.50	
Dynamics	HS	CC	UTSA
N	0	23 (18%)	103 (82%)
avg rating		3.35	2.88
p-value		0.11	

Figure 1 graphically shows the distribution of student evaluation of instruction for Calculus I. The results show 22% of the students earned credit for Calculus I in high school (HS) 40% at a community college (CC) and 38% at UTSA. The high percentage for HS was surprising to the authors of this paper. Likewise, there was a significantly higher rating of the quality of instruction, with average rating of 4.71 for HS compared to 3.48 at UTSA. A statistical two-tailed t-test was computed assuming unequal variance comparing CC versus UTSA. Results show the p-value=0.00, indicating a strong statistical difference between the groups. About 40% of the students earned credit for Calculus I at community college, and results show higher evaluation of instruction received at CC, yet a statistical analysis did not show a significant difference between CC and UTSA quality of instruction, with p-value = 0.12.

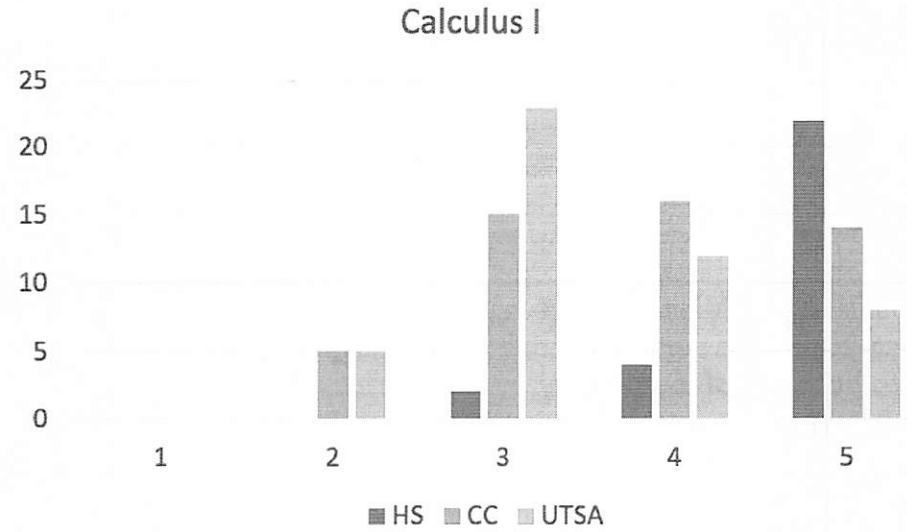

Figure 1. Student evaluation of quality of instruction in Calculus I, HS=high school, CC=community college, and UTSA, 1=poor and 5=excellent.

Figure 2 shows results for Physics I where only a small number of students earned credit for Physics I in high school. These students gave a significantly higher evaluation of instruction received in high school. All of the 7 students rated the high school physics quality of instruction as being 5/5, the highest possible rating. The survey didn't distinguish between AP or dual credit which is often taught with an instructor from a local community college. Based on limited discussion with student, it is believed most of the students were evaluating AP Physics taught by a high school teacher. A statistically significant difference between HS and UTSA evaluations result in a p-value of 0.00. The percent of students earning credit for Physics I at CC is also high at 41%, yet there was no significant difference in instruction with p-value =0.56 comparing CC with UTSA responses.

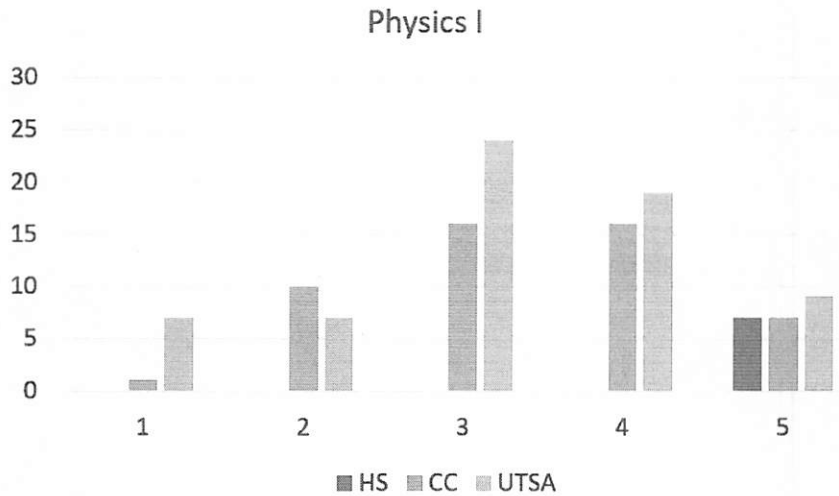

Figure 2. Student evaluation of quality of instruction in Physics I, HS=high school, CC=community college, and UTSA, 1=poor and 5=excellent.

Figure 3 show results for Graphics. The authors expected some HS graphics credits, but of the 121 students who responded to this section of the survey, none reported credit earned in HS. It was also unexpected that only 26% of the students earned Graphics credit at a CC. A higher percentage was expected. The average evaluation was 3.26/5.0 for CC and 3.29/5.0 for UTSA, hence there is no significant difference in the responses. An observation is that CC responses were more positive or negative, where in contrast the responses for UTSA had more 3 out of 5 evaluations.

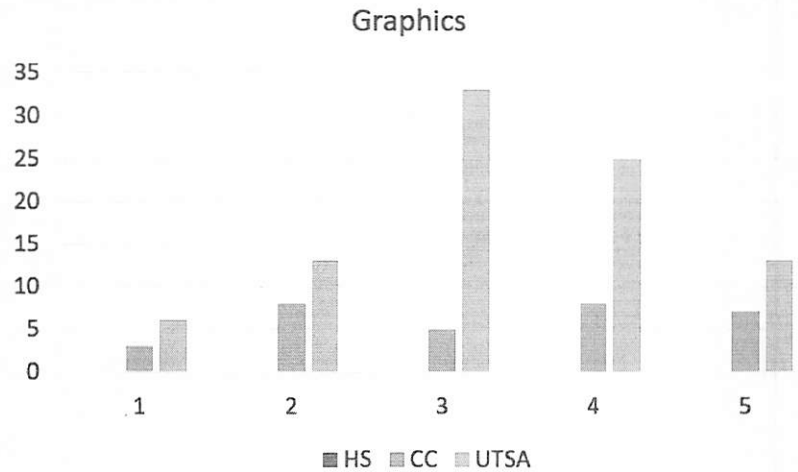

Figure 3. Student evaluation of quality of instruction in Graphics, HS=high school, CC=community college, and UTSA. 1=poor and 5=excellent.

Figure 4 shows results for Statics and Figure 5 for Dynamics. Neither course is known to taught at the high school level, but the survey allowed for such responses. For both courses, about 20% of the students earn credit at CC, which was lower than expected. The evaluation of instruction was higher for Statics at UTSA, yet p-value=0.50 shows that no significant difference could be shown. The histogram confirms that many students at UTSA rated it 5 out of 5. The course is taught by multiple

faculty, and it is known that some instructors have consistently earned high student evaluations of teaching.

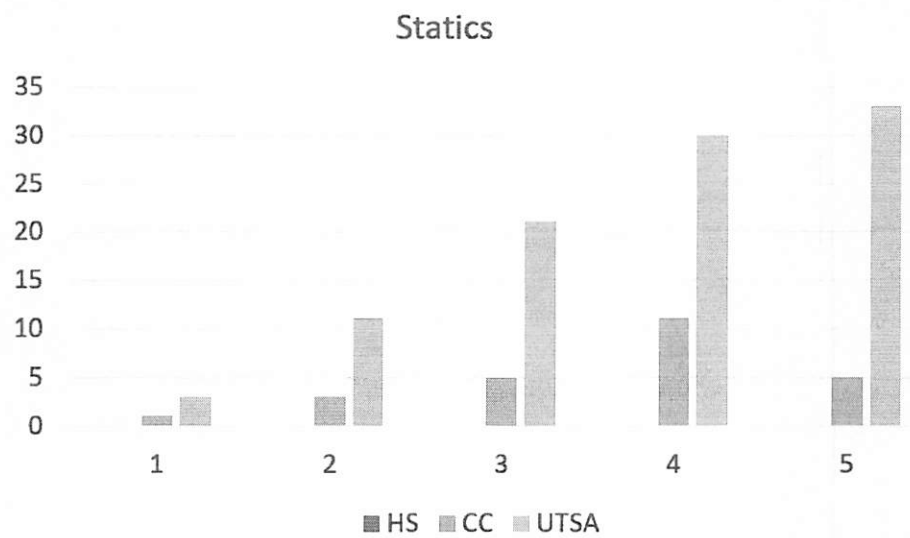

Figure 4. Student evaluation of quality of instruction in Statics course, from HS=high school, CC=community college, and UTSA. 1=poor and 5=excellent.

Figure 5 is for Dynamics showing results similar to Statics. Comparing CC and UTSA evaluations results in p-value=0.11 which is still considered insignificant. The evaluation of teaching at UTSA is more concentration around 3 of 5 evaluation.

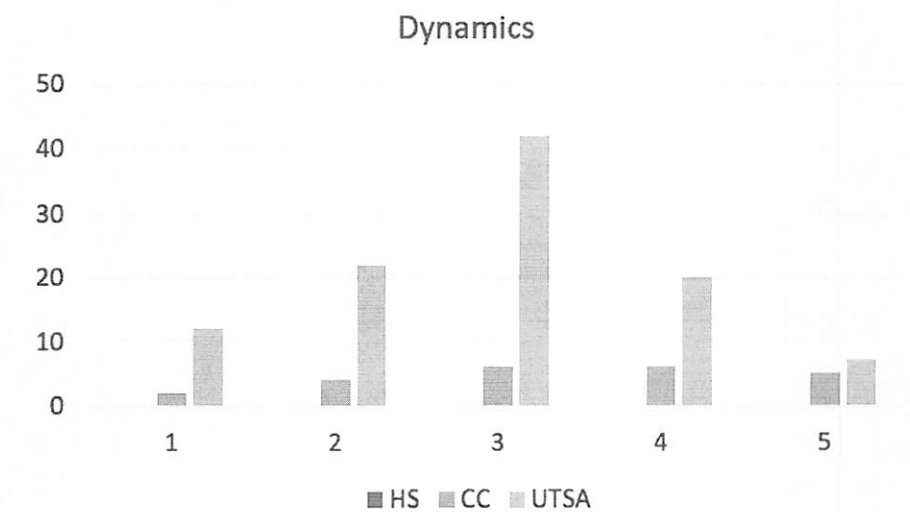

Figure 5. Student evaluation of quality of instruction in Dynamics course, from HS=high school, CC=community college, and UTSA. 1=poor and 5=excellent.

Summary and Conclusions

This paper evaluates the frequency of transfer credits earned for five lower-level classes in the mechanical engineering program, and documents the student evaluation of the quality of instruction in these classes. The findings are based on a voluntary survey of senior-level mechanical engineering students. Results show that a large percent of students earn Calculus I credit before graduating high school and they report high quality of instruction, which is significantly higher than the quality of instruction reported at 4-year university. Fewer students earn Physics I credit before graduating high school, yet they also report high quality of instruction. Although many students transfer credit for Calculus I and Physics I from community college, their evaluation of quality of instruction is slightly higher yet not statistically significant for Calculus I and indistinguishable for Physics I. No students participating in this survey reported earning credit for Graphics while in high school. The quality of instruction in Graphics, Statics and Dynamics was comparable between community college and 4-year degree granting university.

References

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RANDALL MANTEUFEL
Randall Manteufel is an Associate Professor of Mechanical Engineering at The University of Texas at San Antonio (UTSA). He has won several teaching awards, including the 2012 University of Texas System Regent's Outstanding Teaching Award and the 2013 UTSA President's Distinguished Achievement Award for Teaching Excellence, the 2010, 2014, 2018 and 2019 College of Engineering Student Council Professor of the Year Award, 2008 Excellence in Teaching Award for College of Engineering, and 2004- 2005 Mechanical Engineering Instructor of the year award, 1999 ASEE-GSW Outstanding New Faculty Award. Dr. Manteufel is a Fellow of ASME with teaching and research interests in the thermal sciences. In 2015-2016, he chaired the American Society for Engineering Education Gulf Southwest section and in 2018-2019 he chaired the Academy of Distinguished Teaching Scholars at UTSA. He is a registered Professional Engineer in Texas.

AMIR KARIMI
Amir Karimi is a Professor of Mechanical Engineering at The University of Texas at San Antonio (UTSA). He received his Ph.D. degree in Mechanical Engineering from the University of Kentucky in 1982. His teaching and research interests are in thermal sciences. He has served as the Chair of Mechanical Engineering (1987 to 1992 and September 1998 to January of 2003), College of Engineering Associate Dean of Academic Affairs (Jan. 2003-April 2006), and the Associate Dean of Undergraduate Studies (April 2006-September 2013). Dr. Karimi is a Fellow of ASEE, a Fellow of ASME, senior member of AIAA, and holds membership in ASHRAE, and Sigma Xi. He has served as the ASEE Campus Representative at UTSA, ASEE-GSW Section Campus Representative, and served as the Chair of ASEE Zone III (2005-07). He chaired the ASEE-GSW section during the 1996-97 academic year.

Appendix: Survey

Calculus I
where you earned credit: _____
when you earned credit: **semester:** _____ **year:** _____
The quality of instruction:
(1) poor (2) below average (3) average (4) above average (5) excellent
Comments: _____

Physics I
where you earned credit: _____
when you earned credit: **semester:** _____ **year:** _____
The quality of instruction:
(1) poor (2) below average (3) average (4) above average (5) excellent
Comments: _____

Engineering Graphics
where you earned credit: _____
when you earned credit: **semester:** _____ **year:** _____
The quality of instruction:
(1) poor (2) below average (3) average (4) above average (5) excellent
Comments: _____

Statics
where you earned credit: _____
when you earned credit: **semester:** _____ **year:** _____
The quality of instruction:
(1) poor (2) below average (3) average (4) above average (5) excellent
Comments: _____

Dynamics
where you earned credit: _____
when you earned credit: **semester:** _____ **year:** _____
The quality of instruction:
(1) poor (2) below average (3) average (4) above average (5) excellent
Comments: _____