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Transfer Student Pathways to Engineering Degrees: Progress and Preliminary Findings from a Multi-institutional Study Based in Texas

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Transfer Student Pathways to Engineering Degrees: Progress and Preliminary Findings from a Multi-institutional Study Based in Texas

Abstract

In 2015 President Obama introduced America's College Promise, a new $80 billion proposal to make two years of community college free for individuals willing to earn the benefit. To maximize results from such a substantial investment, it is important to address and resolve existing challenges related to degree completion and upward transfer for community college students, especially within engineering. In this paper, we provide an overview of preliminary data from our current National Science Foundation study focused on transfer students in Texas that is aiming to better understand the transfer process in engineering so that the transfer student pathway to an engineering bachelor's degree may become better enhanced. Following a mixed methods research approach and using a conceptual framework of transfer student capital to organize the study, we use qualitative data from semi-structured focus groups with students, administrators, faculty, and staff to extend quantitative findings from an engineering transfer student survey that was administered to more than 7,800 engineering transfers students at four 4-year institutions in Texas. This study uniquely combines engineering transfer student survey responses with education outcome data (i.e., student records) to increase understanding of the complete transfer pathway experience. The sample is unique because it is comprised of a disproportionately large percentage of Hispanic students, which is the fastest growing demographic in the country and a subpopulation that engineering is seeking to attract and support. We envision that our research findings on what helps and hinders the transfer process can be used to 1) make improvements and revisions to existing policy, and 2) serve as a guide for states and institutions seeking to adopt new policies that promote upward transfer in engineering.

Background & Objectives

For decades, there has been a strong demand for STEM professionals in the U.S. workforce. Based on national rhetoric, it is clear that the demand for skilled professionals in STEM fields will continue to be on the upswing for many years to come. To meet both current and future workforce needs, the President's Council of Advisors on Science and Technology projects that that the United States will need to produce an additional 1 million STEM professionals by 2025.[1] As we think creatively about how to identify and train human talent to the meet this demand, great potential exists among the growing population of students who begin their pursuit of a higher education within the community college system. According to the National Center for Education Statistics, 41% of first time freshmen in undergraduate education, and 46% of all U.S. undergraduates during Fall 2013 were enrolled in 2-year public colleges; the headcount total for that academic year was 12.4 million students.[2]

In addition to sheer numbers of students that reside within 2-year institutions, the diversity of that student body composition offers another compelling reason to investigate ways to better cultivate and support this population as a potential source of STEM talent for the U.S. workforce. Profile characteristics for students enrolled in 2-year institutions tend to be more diverse than students who matriculate directly into 4-year public and private colleges and universities from high school in terms of socio-economic status, race, ethnicity, gender, age, and prior work experience.[3,4] Moreover, research on teamwork and problem solving indicates that teams

comprised of diverse members who have different backgrounds and perspectives have the potential to achieve increased levels of creativity during the ideation process[5,6,7,8,9,10]—this outcome is greatly desired and much needed in a 21st century STEM workforce faced with global challenges that require innovative, equitable, and sustainable solutions. In summary, not only is tapping into the diverse talent pool of students enrolled in 2-year institutions a reasonable and effective approach to meet future workforce demands, it is also a promising approach that offers great potential to broaden participation in STEM disciplines that can ultimately lead to increased creativity and innovation in the U.S. workforce.

The purpose of this study is to develop a clearer understanding of how to support students moving through the transfer student pathway with the ultimate hope that the efforts can provide a potential means to broaden participation in engineering. This research joins and expands the small body of literature on engineering transfer students and provides data to institutions and systems of higher education as they consider policies and practices that impact students as they make the transfer to 4-year engineering institutions.

Specifically, the broad investigation addresses the following research questions:

1. How does transfer student capital relate to academic achievement and degree attainment for transfer engineering students at 4-year institutions?
2. How do Hispanic and non-Hispanic transfer students compare on measures of transfer student capital and its relation to academic achievement and degree attainment?
3. How do students decide to transfer into engineering at a 4-year institution?

In this paper we provide an overview of the rich data set that has been generated from this project as well as findings from preliminary data analyses.

Research Design

This study's data collection and analyses were organized using a framework of transfer student capital[11,12] (see Figure 1). A context-specific extension of social and cultural capital theories, this framework assists researchers in identifying the variables to take into account when studying transfer students. For a variety of reasons, students begin their academic careers at one or more different institutions than their final degree-granting institution. As shown in the "Background" portion of the framework, students can have multiple motivations or reasons for transferring to a different institution; an important aspect of our study is to untangle those reasons for engineering transfer students in Texas. Students accumulate transfer student capital, or knowledge about the transfer process, at sending institutions (i.e., the place(s) where students begin their degree paths), receiving institutions (i.e., the final degree-granting institution), and potentially from non-institutional sources. The development of transfer student capital may come from experiences related to learning and study skills, course learning, perceptions of the transfer process, academic advising and counseling, and experiences with faculty. Upon arriving at the receiving institution, students must adjust to the new environment academically, socially, and psychologically, all of which may influence a variety of educational outcomes.

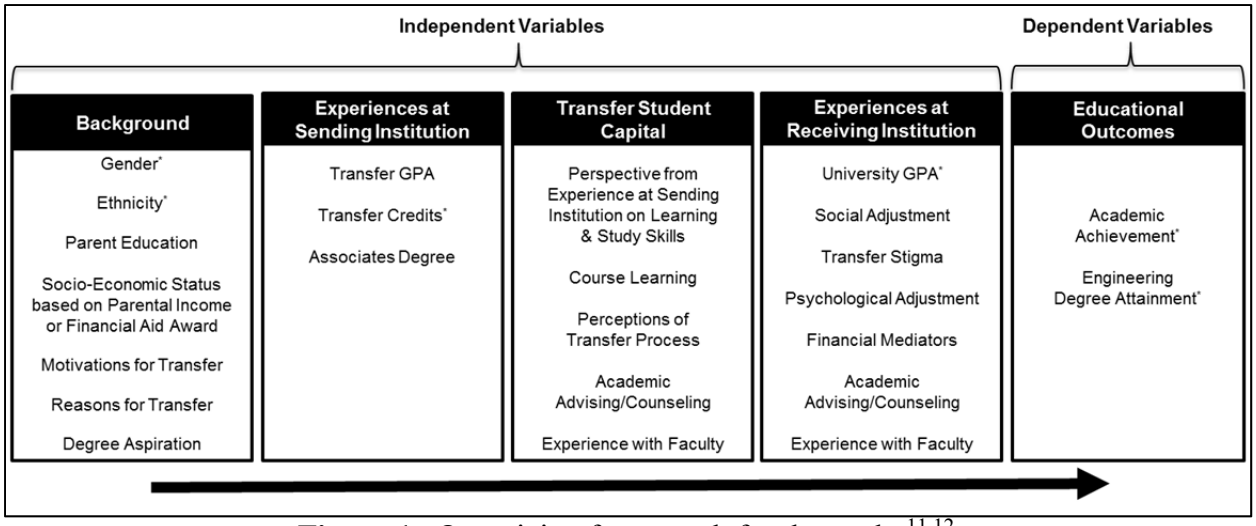

Figure 1. Organizing framework for the study.[11,12]

Our NSF project has been operationalizing this framework via an explanatory sequential mixed method research approach. We administered an online survey to 7,806 engineering transfer students at four 4-year institutions in Texas (all among the top-10 producers of Hispanic engineers) (see Table 1) and received responses from over 1,070 current transfer students or alumni. The sample is unique because it is comprised of a disproportionately large percentage of Hispanic students, which is the fastest growing demographic in the country and a subpopulation that engineering is seeking to attract and support. In ensuring data were collected across all elements of the framework, multiple survey items were compiled from an adaptation of the Laanan-transfer students' questionnaire,[13,14,15] a survey from the NSF-funded Prototype to Production study,[16] and Measuring Constructs of STEM Student Success Literacy: Community College Students' Self-Efficacy, Social Capital, and Transfer Knowledge.[17,18] For a full description of the survey development process, steps that were put into place to support construct validity, and individual campus customization procedures, please see our work in progress paper from the 2015 Frontiers in Education (FIE) Conference titled *Transfer Student Pathways to Engineering Degrees: A Multi-Institutional Study Based in Texas*.[19]

Table 1. Project four-year institutions and partner community colleges.

Four-Year Institution	Community College Partner Institution
Texas A&M University	Blinn College
The University of Texas at Austin	Austin Community College
The University of Texas at El Paso	El Paso Community College
The University of Texas Rio Grande Valley	South Texas College

At present, partner 4-year institutions are merging individual survey responses with student record data. These institutional data include: demographic information, mode of admission, initial major of enrollment, number of transferred credit hours, multiple captures of internal credit hours, university and major grade-point averages, academic achievement from semester 1–4 following the transfer, and for alumni semester of graduation and final major and degree attainment. Thus, this incredibly rich data set will allow for analyses that examine relationships between transfer student capital collected via the survey and multiple direct measures of student outcomes at their receiving 2-year institution.

The study has also produced qualitative data that were collected via 18 semi-structured focus groups with 84 students, administrators, faculty, and staff who were either transfer students or whose university roles require interaction with and support of transfer students. Focus groups were held at all eight of the project partner institutions shown in Table 1, which will allow for investigations of the system from both the 4-year and community college perspectives. These qualitative data will be used to extend quantitative findings and offer an in-depth examination of the engineering transfer student processes occurring within the state of Texas. Protocols used the transfer student capital framework to frame interview questions, and the objectives of these interviews were to identify: 1) institutional policies and practices that facilitate success and enable transfer pathways into engineering at 4-year universities for transfer students, 2) ways institutions hinder transfer students in their transition to engineering at 4-year universities, and 3) ways institutions help students accumulate and leverage their transfer student capital. All interviews have been conducted and recorded, and the transcription and data analysis process is underway.

Preliminary Results: Survey Data

An early contribution of this study is to provide a better understanding of the backgrounds of students who comprise the engineering transfer student population, in particular within Texas universities. In this paper we provide a descriptive portrait of our survey participants and describe how this information demonstrates the value of this new data set. Current students comprised 53.4% of respondents, alumni comprised 41.4%, and 4.4% of respondents did not complete the degree and are no longer at the university (0.8% did not respond to this question).

Of the respondents who identified a gender, 20% identified as female, which is on par with the national average for engineering students but higher than previous research on engineering transfer students. However, 18% of respondents did not answer this question, likely because these items were placed at the very end of the fairly lengthy survey. We may assume that members of the dominant demographic group (i.e., males) would be more likely to skip this question or drop out of the survey earlier in the process (which would reduce the female proportionality) but will test that assumption as we merge institutional demographic data.

Table 2. Hispanic/Latino backgrounds of engineering transfer student survey respondents.

Are you Hispanic/Latino?	
Yes	33.4%
No	48.1%
Prefer not to answer	0.4%
Missing Data	18.1%
Total (n=1070)	**100.0%**

The project's institutional sampling plan sought to gather information from a disproportionately high percentage of Hispanic engineering students and alumni relative to the national representation. As shown in Table 2, data collection did meet this objective, as one-third of all respondents who answered this question identified as Hispanic/Latino (note: this percentage jumps to 41% when missing data were removed). The 18.2% who did not answer this question will be filled in following the institutional data merge. Therefore, the data set produced in this

project will allow for the exploration of interaction effects by Hispanic/Latino when relating students transfer student capital to other variables, which has been called for but is rare because of sample size limitations.[20]

Survey responses also produced sufficient sample sizes of categories of parents' education status for comparative analyses (see Table 3). Half of the survey respondents indicated that at least one of their parents earned a Bachelor's degree or higher, 15% had no college, and 15% had at least some college or an Associate's degree. When only considering participants who answered this question, the Low and Medium categories jump to 36.6%. Thus, sufficient sample sizes are present for analyses that can determine whether this continuum of parental experience with higher education bears relationships with students' accumulation of transfer student capital.

Table 3. Highest parent education status of engineering transfer student survey respondents.

Parent Education Status	
Low – *both parents earned HS diploma or less*	15.0%
Medium – *at least one parent attended some college and/or earned an Associate Degree or Certificate*	15.0%
High – *at least one parent earned Bachelors or higher*	50.6%
Don't Know	0.4%
Not applicable	0.2%
Prefer not to answer	0.7%
Missing Data	18.1%
Total (n=1070)	**100.0%**

One of the narratives that we hope our data will help change is the notion that there is a single transfer student pathway to a four-year engineering degree. Although the recent focus has been on leveraging the community college sector to help grow and diversify the engineering field, our data demonstrate that transfer students should not be considered a single bloc of students who have similar postsecondary backgrounds. As laid out in Ogilvie et al. (2015) during the survey development process, there are many different kinds of transfer pathways that should be accounted for when designing these kinds of studies.[21] In this sample, 40% of transfer student respondents indicated that they had transferred from one or more institutions mainly within the four-year sector; and 56% of the sample predominantly came from the community college sector (see Table 4). Although we would expect these groups of students to have a variety of different needs, expectations, backgrounds, and access to transfer student capital, we will conduct analyses separately for different pathway types to empirically identify differences.

Table 4. Prior institutional types attended.

In addition to [receiving institution], I attended:	
a community or two-year college	46.5%
a four-year institution	32.1%
> 1 institution, but mostly a community or two-year college	9.2%
>1 institution, but mostly a four-year institution	7.8%
Co-enrollment Program	3.5%
Missing Data	0.9%
Total (n=1070)	**100.0%**

Finally, our preliminary analyses have already identified a potential gap in the ways in which transfer student pathways are communicated to students. As shown in Table 5, a variety of mechanisms are currently in place in Texas to facilitate inter-institutional transfer. Administrators on the project team agreed that engineering transfer students would not be familiar with jargon used at the state-level to advance upward transfer policies, such as *2+2 programs, course or program articulation agreements, and the Texas Voluntary Transfer Compact Program*. To craft this survey question on pathways, we identified different modes in consultation with our institutional site partners from both the 4-year and community college sectors and replaced the upward transfer policy jargon with local terminology (i.e. EPCC-UTEP Degree Agreements, Texas A&M Engineering Academy, Texas A&M University System Program for System Admission, UT System Coordinated Admission Program) to increase relevance for study participants. Despite current mechanisms designed to facilitate transfer, less than 28% of the survey respondents used one of these modes of admission. Moreover, over one-third of respondents did not know how they were admitted at the receiving institution. And, it is important to note, these surveys were only administered to students who were successfully able to navigate the transfer process and matriculate at a 4-year institution. Perhaps having students recognize nomenclature and understand technical higher education jargon are not essential to eventual student success, but if an objective for the United States is to facilitate easy, smooth, and transparent transfer processes, it appears as if there is room for growth in helping students recognize available mechanisms.

Table 5. Mode of Admission at Receiving Institution.

When you first entered [receiving institution], were you admitted:	Total
Through a course or program articulation agreement	16.3%
Under a System Admission Program	7.8%
None of the Above	37.5%
I Don't Know	34.1%
Co-enrollment Program	3.5%
Missing Data	0.8%
Total (n=1070)	**100.0%**

Future Research

At this phase of the project, we are actively compiling population data for our sampling frame and collecting academic performance data for individual students who completed the engineering transfer student survey. Next steps in our analyses include imputing for missing data and weighting survey responses by institution to adjust for gender, race/ethnicity, entry term, and engineering discipline so that we can begin exploring the data set using factor analysis and inferential statistics to identify differences across groups (i.e., lateral vs. vertical, Hispanic vs. non-Hispanic, first-generation status). We expect that our first round of analyses will yield three publications focused on: 1) reasons why students start at another institution and factors in their decision to transfer; 2) forms of transfer student capital activated by students who transfer into engineering; and 3) the transition experience for engineering transfer students.

Findings from these aforementioned publications will inform the second phase of our analysis which includes building analytic models to explore relationships between transfer student capital and: 1) outcome variables (i.e., academic achievement and degree attainment), and 2) adjustment

variables (i.e., academic and psychological adjustment) for engineering transfer students. By linking education outcome data to student survey responses on their experiences with negotiating the transfer process and transiting between institutions, our study takes a more holistic approach to understand engineering transfer students and their pathway to an engineering degree.

In a similar vein, our future research will use qualitative data from the semi-structured focus groups with students, administrators, faculty, and staff to extend quantitative findings from survey responses and education outcome data for this sample of 1,070 engineering transfer students who successfully transferred to one of four 4-year Texas institutions as new engineering students between 2007 and 2014. Collectively, this research brings data to higher education administrators (i.e., deans, department chairs, and admissions officers) so that they may better understand the barriers and perceptions that prevent more students from transferring into engineering at 4-year institutions so that they can make more informed adjustments to their existing institutional practices. We envision that our research findings on what helps and hinders the transfer process can serve as a guide for states and institutions seeking to adopt new policies that promote transfer in engineering.

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