



Understanding and Diversifying Transfer Student Pathways to Engineering Degrees: Preliminary Findings on Engineering Transfer Students' Perception of the Transfer Process

Dr. Andrea M. Ogilvie P.E., Texas A&M University

Andrea M. Ogilvie, P.E. (aogilvie@tamu.edu) serves as Assistant Dean for Student Success and Assistant Professor of Instruction at Texas A&M University. Since 2013, her research has focused on engineering transfer students and their experiences at both sending and receiving institutions. To further enhance understanding of this unique student population, her research explores differences across subgroups of engineering transfer students. Andrea Ogilvie has multiple degrees in engineering and public affairs from UT Austin (BSCE, MPAff) and Virginia Tech (MS ISE, PhD).

Dr. David B. Knight, Virginia Tech

David Knight is Assistant Professor and Assistant Department Head for Graduate Programs in the Department of Engineering Education at Virginia Tech. He is also Director of International Engagement in Engineering Education and affiliate faculty with the Higher Education Program at Virginia Tech. His research tends to be at the macro-scale, focused on a systems-level perspective of how engineering education can become more effective, efficient, and inclusive.

Dr. Maura Borrego, University of Texas, Austin

Maura Borrego is Professor of Mechanical Engineering and STEM Education at the University of Texas at Austin. She previously served as a Program Director at the National Science Foundation, on the board of the American Society for Engineering Education, and as an associate dean and director of interdisciplinary graduate programs. Her research awards include U.S. Presidential Early Career Award for Scientists and Engineers (PECASE), a National Science Foundation CAREER award, and two outstanding publication awards from the American Educational Research Association for her journal articles. Dr. Borrego is Deputy Editor for Journal of Engineering Education. All of Dr. Borrego's degrees are in Materials Science and Engineering. Her M.S. and Ph.D. are from Stanford University, and her B.S. is from University of Wisconsin-Madison.

Dr. Arturo A. Fuentes, University of Texas, Rio Grande Valley

Arturo Alejandro Fuentes is an Associate Professor of mechanical engineering at the University of Texas Pan American. He holds a Ph.D. and M.S. degrees in mechanical engineering from Rice University. Among his research interests are nano-reinforced composites, dynamic response analysis, non-destructive evaluation, and engineering education. Among his teaching responsibilities are Finite Element Method, Mechanical Vibrations, and Introduction to Mechanical Engineering at the undergraduate level, and Structural Dynamics, Advanced Mechanics of Materials, and Finite Element Analysis at the graduate level.

Understanding and Diversifying Transfer Student Pathways to Engineering Degrees: Preliminary Findings on Engineering Transfer Students' Perception of the Transfer Process

Abstract

With recent calls and a current movement for more research that uses an anti-deficit approach to understand the experiences of students historically underrepresented in higher education [1,2], researchers commonly draw on theories of capital (e.g. cultural, social) to explain differences in how students navigate and experience the higher education system (e.g., Martin, Simmons, & Yu, 2013) [3]. A unique form of capital that has gained traction with researchers who specialize in the study of community college students is the concept of transfer student capital (TSC) [4]. Coined by Laanan in 2006, TSC is defined as the accumulation of knowledge about higher education that develops in a student as he or she interacts with faculty, receives academic advising/counseling, studies for coursework, navigates through university transfer policies to fulfill academic requirements, and proceeds through the transfer process from a 2-year institution to a 4-year institution [5]. In his prior work, Laanan posits that relationships may exist between transfer students' post-transfer transition experiences and their prior accumulation of TSC. On this premise, Laanan suggests that transfer students' accumulation of TSC can be activated to enhance (or ease) the post-transfer transition process at receiving institutions [5].

Our investigation of transfer student pathways to engineering degrees is motivated and informed by Laanan's prior research. The purpose of this research is to identify constructs that emerge when operationalizing the concept of transfer student capital in an engineering context. Part of a larger mixed methods research investigation funded by the National Science Foundation (NSF EEC Grant No. 1428502), this study draws on survey data from a sample of 1,070 engineering transfer students who transferred to one of four 4-year Texas institutions as new engineering students between 2007 and 2014. Research sites include four of the top ten producers of U.S. Hispanic/Latino engineers; the framework of transfer student capital was used to organize this study's data collection and analytical plan.

For our 2018 ASEE poster, we explore engineering transfer students' reflective responses to questions about their perceptions of the transfer processes; it represents an area of investigation that falls under the Transfer Student Capital component of Laanan's research framework. Through our analyses, we identify emergent constructs and explore differences across subgroups of transfer students (i.e., type of institution - selective versus open enrollment; type of transfer pathway - lateral versus vertical; student status as Hispanic/Latino; student status as first generation). This work feeds into analytical models that will explore relationships between transfer student capital and: 1) outcome variables (academic achievement and degree attainment), and 2) adjustment variables for engineering transfer students [6,7,8].

Executive Summary

In recent decades, recruitment and retention efforts to meet workforce demands and broaden participation in colleges of engineering across the country have focused primarily on catering to the needs of first-year, traditional age college students who matriculate from high school into 4-year institutions [9,10]. While these efforts have moved the needle on enrollment and retention

for undergraduate students in engineering, growth and improvement measures have started to taper in recent years [2]. To meet current and future workforce demands for more STEM professionals in the United States, we must be creative about how to move beyond this ceiling effect; and, great potential exists among the growing population of students who begin their pursuit of a higher education at institutions other than 4-year public/private colleges [11].

The purpose of this research project is to increase understanding of engineering transfer students and their experiences at both sending and receiving institutions. Research sites include four of the top ten producers of U.S. Hispanic/Latino engineers; the framework of transfer student capital was used to organize the project's data collection and analytical plan (Figure 1). Specifically, our 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?
4. What institutional policies facilitate success and enable transfer pathways into engineering at 4-year universities?
5. How do institutions hinder transfer students in their transitions into engineering at 4-year universities?

To address these research questions, the project was organized in two concurrent phases. A quantitative phase draws on student performance data plus cross-sectional survey data (collected specifically for this project) from a sample of 1,070 engineering transfer students who transferred to one of four 4-year Texas institutions as new engineering students between 2007 and 2014. In addition, we completed a qualitative interview-based phase that draws on data from 18 semi-structured focus groups with 84 students, administrators, faculty, and staff who represented those four 4-year institutions as well as their partner community colleges.

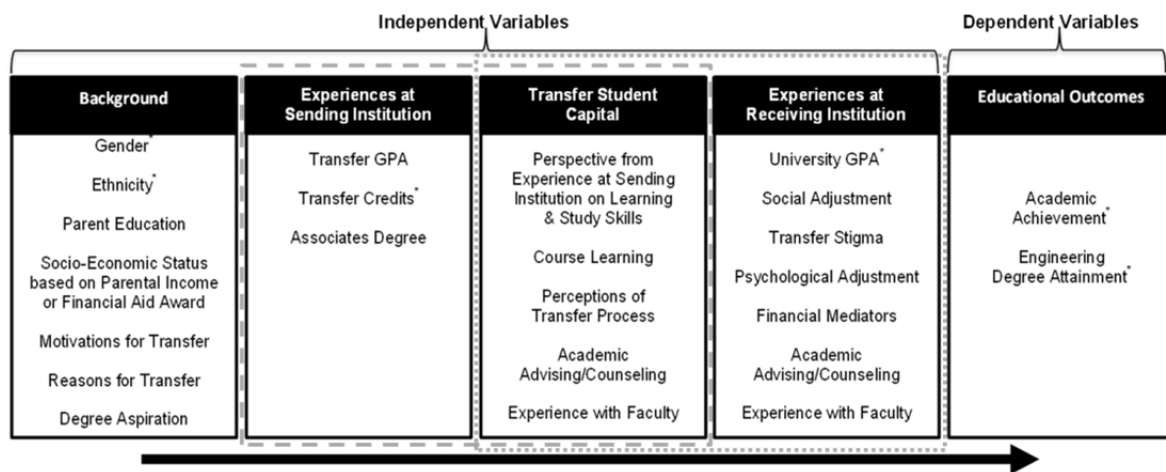


Figure 1. Model to investigate the role of TSC in academic achievement and degree attainment for engineering transfer students; adapted & modified from Laanan et. al. framework for TSC [5,12].

Preliminary Project Results

All data for the research project were collected between Spring 2015 and Spring 2016. Since then, focus group data has been transcribed and survey data has been treated (i.e., cleaned, weighted, and missing data was imputed). Much of our analysis to date has focused on unpacking quantitative data focused on engineering transfer students' background (including reasons for starting at another institution and factors that influence their decision on where to transfer) [8,14] and their experiences at both sending and receiving institutions [13]. Through our work, we have identified emergent constructs in each of these areas, and for each, we have explored differences across subgroups of transfer students (i.e., type of institution - selective versus open enrollment; type of transfer pathway - lateral versus vertical; student status as Hispanic/Latino; student status as first generation) [8,14].

Our current analysis explores measures of transfer student capital in an engineering context. For ASEE 2018, our poster focuses on engineering transfer students' reflective responses to questions about their perceptions of the transfer processes, a composite variable that falls under the Transfer Student Capital component of Laanan's research framework. Similar to prior analyses, we conducted exploratory factor analyses to identify emergent constructs in the data set, followed by independent samples t-tests to explore differences across subgroups of transfer students (i.e., type of institution - selective versus open enrollment; type of transfer pathway - lateral versus vertical; student status as Hispanic/Latino; student status as first generation). Table 1 shows mean results for each sub-item; aggregated by the collective group of engineering transfers. Table 2 shows mean results for emergent constructs and individual sub-items, aggregated by the collective group of engineering transfer students. Table 3 summarizes results from the independent samples t-tests.

The following points summarize preliminary findings from our analysis of engineering transfer students' reflective responses to questions about their perceptions of the transfer processes while still enrolled in their previous sending institution.

- Participants were asked to respond to 15 sub-items with statements designed to capture their perceptions about the transfer process. Response means and standard errors of the means for each of the 15 sub-items are shown in Table 1.
- Five constructs emerged following an exploratory factor analysis of the initial 15 sub-items: 1) Informed Prospective Student ($\alpha = .650$); 2) Access to Information ($\alpha = .827$); 3) Visited RI to get Information ($\alpha = .776$); 4) Financial Planning ($\alpha = .655$); and 5) Valuable info from Advisors/Counselors ($\alpha = .760$) (see Table 2).
- In aggregate, participants generally agreed with sub-items embodying perspectives that might be held by an Informed Prospective Student. After disaggregating the dataset by sub-groups, we found that participants at selective institutions reported significantly higher levels of agreement to this construct than their respective counterpart.
- In aggregate, participants reported mid-range responses for the following constructs and sub-items: Access to Information, "I researched...[RI] to get a better understanding of the environment and academic expectations," Visited RI to get Information, Financial Planning, and Valuable info from Advisors/Counselors.
 - For the construct Access to Information, we found statistically significant differences for one sub-group; participants at selective institutions reported significantly higher levels of agreements than participants at open enrollment institutions.

- For the sub-item “I researched various aspects of [RI] to get a better understanding of the environment and academic expectations,” we found statistically significant differences across two sub-groups; participants at selective institutions and non-Hispanic/Latino students reported significantly higher levels of agreements than their respective counterparts.
- For the construct Visited RI to get Information, we found statistically significant differences across three sub-groups; vertical transfer students, Hispanic/Latino students, and transfer students at open enrollment institutions reported significantly higher levels of agreements than their respective counterparts.
- For the construct Financial Planning, we found statistically significant differences across all four sub-groups; vertical transfer students, Hispanic/Latino students, first-generation students, and transfer students at open enrollment institutions reported significantly higher levels of agreements than their respective counterparts.
- For the construct Valuable info from Advisors/Counselors, we found statistically significant differences for one sub-group; vertical transfer students reported significantly higher levels of agreements than lateral transfers students.
- In aggregate, participants reported low-end responses for the sub-item “I spoke to former transfer students to gain insight about their adjustment experiences.” Participants at open enrollment institutions and vertical transfer students reported higher levels of agreement to this sub-time, but the effect sizes were small.

Table 1. Perceptions about the "transfer process" while students were enrolled at [SI]

Sub-items	Mean (N = 1024) ¹	Std. Error of Mean
I made sure that I thoroughly understood transfer requirements for [RI].	4.14	0.86
I made sure I understood the advice provided by my academic advisors/counselors regarding the transfer process.	3.72	0.92
I knew what to expect at [RI] in terms of academics.	3.69	1.09
Information about the transfer process at [RI] was clear and easy to find.	3.55	1.08
Information about the transfer process into engineering at [RI] was clear and easy to find.	3.53	1.07
I researched various aspects of [RI] to get a better understanding of the environment and academic expectations.	3.50	1.29
I made sure that I was aware of the financial aid available to me as a transfer student.	3.47	1.18
I visited the admissions office at [RI].	3.21	1.39
I visited the [RI] campus to learn where offices and departments were located.	3.20	1.34
Info that I received from the academic advisors/counselors at [RI] was consistent w/ the info that I received from my academic advisors/counselors at my previous institution.	3.18	1.06
I researched the availability of scholarship funds specifically allocated for transfer students at [RI].	3.05	1.30
Information that I received from academic advisors/counselors at my previous institution was helpful in the transfer process.	3.03	1.23
Academic advisors/counselors at my previous institution identified courses needed to meet the general education/major requirements at [RI].	2.89	1.30
I consulted with a representative from the financial aid office at [RI] prior to my transfer.	2.81	1.38
I spoke to former transfer students to gain insight about their adjustment experiences.	2.63	1.38

Scale: 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree; Means are of weighted data. ¹ Participants in co-enrollment program(s) were exempt from this survey item.

Table 2. Perceptions about the "transfer process" while students were enrolled at [SI]

Construct	Sub-items	Mean (N = 1024)¹	Std. Error of Mean
Informed Prospective Student ($\alpha = .650$)	<ul style="list-style-type: none"> ▪ I made sure that I thoroughly understood transfer requirements for [RI]. ▪ I made sure I understood the advice provided by my academic advisors/counselors regarding the transfer process. ▪ I knew what to expect at [RI] in terms of academics. 	3.85	0.74
Access to Information ($\alpha = .827$)	<ul style="list-style-type: none"> ▪ Information about the transfer process at [RI] was clear and easy to find. ▪ Information about the transfer process into engineering at [RI] was clear and easy to find. 	3.54	1.00
-	<ul style="list-style-type: none"> ▪ I researched various aspects of [RI] to get a better understanding of the environment and academic expectations. 	3.50	1.29
Visited RI to get Information ($\alpha = .776$)	<ul style="list-style-type: none"> ▪ I visited the admissions office at [RI]. ▪ I visited the [RI] campus to learn where offices and departments were located. 	3.21	1.23
Financial Planning ($\alpha = .655$)	<ul style="list-style-type: none"> ▪ I made sure that I was aware of the financial aid available to me as a transfer student. ▪ I researched the availability of scholarship funds specifically allocated for transfer students at [RI]. ▪ I consulted with a representative from the financial aid office at [RI] prior to my transfer. 	3.11	0.99
Valuable info from Advisors/Counselors ($\alpha = .760$)	<ul style="list-style-type: none"> ▪ Info that I received from the academic advisors/counselors at [RI] was consistent w/ the info that I received from my academic advisors/counselors at my previous institution. ▪ Information that I received from academic advisors/counselors at my previous institution was helpful in the transfer process. ▪ Academic advisors/counselors at my previous institution identified courses needed to meet the general education/major requirements at [RI]. 	3.03	0.99
-	<ul style="list-style-type: none"> ▪ I spoke to former transfer students to gain insight about their adjustment experiences. 	2.63	1.38

Scale: 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree; Means are of weighted data. ¹ Participants in co-enrollment program(s) were exempt from this survey item.

Table 3. Comparing means for subgroups: **Perceptions about the "transfer process" while students were enrolled at [SI]**

	SEL		OPN			LAT		VERT			Not		HIS			Not		1st Gen			
	N=	672	352		effect size	404	619		effect size	576	448		effect size	606	397		effect size				
Informed Prosp. Student (3 items)		3.91	3.75	*	M	-0.21	3.81	3.88				3.85	3.86				3.89	3.81			
Access to Info (2 items)		3.60	3.44	*	S	-0.15	3.48	3.58				3.52	3.57				3.53	3.57			
I researched various aspects of [RI] to get better understand. of environ. & acad. expectations.		3.66	3.18	**	M	-0.38	3.48	3.50				3.63	3.33	**	M	0.23	3.52	3.45			
Visited RI to get info (2 items)		3.07	3.47	**	M	0.33	3.10	3.28	*	S	0.14	3.11	3.34	**	S	-0.19	3.17	3.25			
Financial Planning (3 items)		3.02	3.29	**	M	0.28	2.98	3.19	**	M	0.21	2.93	3.34	**	M	-0.43	3.02	3.24	**	M	-0.22
Valuable info from Advisors/Counselors (3 items)		3.03	3.04				2.82	3.17	**	M	0.36	2.98	3.10				2.98	3.10			
I spoke to former transfer students to gain insight about their adjustment experiences.		2.56	2.76	*	S	0.15	2.47	2.73	**	S	0.19	2.55	2.72				2.63	2.60			

Scale: 1-Strongly disagree, 2-Disagree, 3-Neither agree nor disagree, 4-Agree, 5-Strongly agree

Means are of weighted data.

** p-value < .01, * p-value < .05

Effect size (Hedges' g): large ≥ .8; .8 > mid-range > .2; small ≤ .2

Future Work

To understand engineering transfer students' perceptions of the transfer processes more comprehensively (and variations by subpopulation), we plan to explore interaction effects for constructs and individual sub-items where we observed statistically significant difference across more than one sub-group population. As an example, for: 1) "I researched various aspects of the [RI] to get better understanding of the environment & academic expectations" we will explore interaction effects by type of institution and student status as Hispanic/Latino; 2) Visited the RI to Get Information by type of institution, type of transfer pathway, and student status as Hispanic/Latino; 3) Financial Planning by type of institution, type of transfer pathway, student status as Hispanic/Latino, and student status as first generation; and 4) "I spoke to former transfer students to gain insight about their adjustment experiences" by type of institution and type of transfer pathway.

Finally, findings from the analyses described herein inform the second phase of quantitative analyses, which will include building analytical models to explore relationships between measures of transfer student capital and: 1) outcome variables (academic achievement and degree attainment), and 2) adjustment variables for engineering transfer students [6,7,8]. By linking education outcome data to survey responses on respondents' experiences with navigating the transfer process and transitioning between institutions, the study takes a holistic approach in understanding engineering transfer students and their pathways to an engineering degree.

Acknowledgments

This material is based upon work supported by the National Science Foundation Division of Engineering Education and Centers (EEC) under Grant No. 1428502. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

References

- ¹ Harper, S. R. (2010). An anti-deficit achievement framework for research on students of color in STEM. *New Directions for Institutional Research*, 2010, 63-74. doi:10.1002/ir.362
- ² Lichtenstein, G., Chen, H. L., Smith, K. A., & Maldonado, T. (2014). Retention and persistence of women and minorities along the engineering pathway in the U.S. In A. Johri & B. M. Olds (Eds.), *Cambridge handbook of engineering education research* (pp. 311-334). New York, NY: Cambridge University Press.
- ³ Martin, J. P., Simmons, D. R., & Yu, S. L. (2013). The role of social capital in the experiences of Hispanic women engineering majors. *Journal of Engineering Education*, 102(2), 227-243.
- ⁴ Bahr, P. R., Toth, C., Thirolf, K., & Massé, J. C. (2013). A review and critique of the literature on community college students' transition processes and outcomes in four-year institutions. In M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 28, pp. 459-511). Dordrecht, Netherlands: Springer.
- ⁵ Laanan, F. S., Starobin, S. S., & Eggleston, L. E. (2010). Adjustment of community college students at a four-year university: Role and relevance of transfer student capital for student retention. *Journal of College Student Retention: Research, Theory & Practice*, 12(2), 175-209.
- ⁶ Ogilvie, A. M., Knight, D. B., Borrego, M., Fuentes, A., Nava, P. A., & Taylor, V. E. (2015). *Transfer Student Pathways to Engineering Degrees: A Multi-Institutional Study Based in Texas*. Paper presented at the 45th Annual Frontiers in Education Conference, El Paso, TX.
- ⁷ Ogilvie, A. M., Knight, D. B., Borrego, M., Fuentes, A., Nava, P. A., & Taylor, V. E. (2016). *Transfer student pathways to engineering degrees: Preliminary findings from a multi-institutional study based in Texas*. Paper presented at the American Society for Engineering Education, June 26-29, 2016, New Orleans, LA.
- ⁸ Ogilvie, A. M., Knight, D. B., Borrego, M., Fuentes, A., Nava, P. A., & Taylor, V. E. (2017). *Understanding and diversifying transfer student pathways to engineering degrees: An update on project findings*. Paper presented at the American Society for Engineering Education, June 25-28, 2017, Columbus, OH.
- ⁹ McLoughlin, L. A. (2012). Community colleges, engineering, and social justice. In C. Baillie, A. Pawley, & D. Riley (Eds.), *Engineering and social justice: in the university and beyond*. West Lafayette, Ind: Purdue University Press.
- ¹⁰ Riley, D., Slaton, A. E., & Pawley, A. L. (2014). Social justice and inclusion: Women and minorities in engineering. In A. Johri & B. M. Olds (Eds.), *Cambridge handbook of engineering education research* (pp. 335-356). New York, NY: Cambridge University Press.
- ¹¹ Terenzini, P. T., Lattuca, L. R., Ro, H. K., & Knight, D. B. (2014). America's overlooked engineers: Community colleges and diversity in undergraduate education. Retrieved from <http://hdl.handle.net/2027.42/107460>
- ¹² Laanan, F. S., & Hernández, I. (2011). *Transfer student capital: Examining the role of transfer student capital in the academic adjustment of transfer students in STEM majors at Iowa State University*. Ames, IA: Office of Community College Research and Policy.
- ¹³ Ogilvie, A. M., & Knight, D. B. (accepted for publication). Transfer students' recommendations for enhancing success and easing the transition into the middle years of engineering at receiving Hispanic-serving institutions. *Advances in Engineering Education*.
- ¹⁴ Ogilvie, A. M., & Knight, D. B. (accepted for publication). Engineering transfer students' reasons for starting at another Institution and variation across subpopulations. *Journal of Hispanic Higher Education*.