Board 355: Outcomes & Observations in the Transfer Success Co-Design in Engineering Disciplines (TranSCEnD) Program at the University of Tennessee, Knoxville

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Abstract

The Transfer Success Co-Design in Engineering Disciplines (TranSCEnD) program was designed to assist in the transition of community college graduates to four-year undergraduate programs in the Tickle College of Engineering at the University of Tennessee Knoxville (UTK). Graduation rates among transfer students are lower than students entering four-year programs in year one, and the TranSCEnD program was deliberately designed to provide these students with academic, social and financial support. Three major components were included to improve cohort-building and thereby impact success. Students admitted to the program (1) engaged in a group summer bridge project, (2) completed a single-term success seminar, and (3) were provided a scholarship for continued informal engagement with the comprehensive TranSCEnD team throughout their years at UTK. The NSF-supported project has entered the fifth and final year of the program and the results of the effort show positive impacts on transfer student success. Students participating in the summer bridge program built lasting relationships with one or more individuals in the same cohort, improving their sense of belonging and community in their initial transition to UTK. The seminar series introduced students to resources on campus and best practices for academic success, and students in the program were well prepared for job fairs. Many engaged in internships and other professional practice activities, and generally engaged with the professional development resources provided on campus. Each year, with the addition of new cohorts, occasional informal meetings with all students in the program were well attended. The financial support provided by the scholarship typically reduced the financial burden in transitioning to a more expensive institution; coupled with introductions to undergraduate research and paid internships, most students were better funded through the program, leading towards improved retention.

Introduction

The University of Tennessee at Knoxville (UTK) hosts a thriving Tickle College of Engineering and the land grant mission for the school encourages all faculty to support the success of all students serving the state of Tennessee. Recently, relationships between UTK and community colleges have strengthened the formal link to improve transfer success. The Tennessee Promise scholarship program [1] serves hundreds of thousands of students in the state and offers financial support for all tuition and student fees for in-state community colleges. To complement the program, state universities have created formal transfer programs to encourage students finishing their studies to proceed towards 4-year degree opportunities offered at the university level. The Transfer Success Co-Design in Engineering Disciplines (TranSCEnD) program [2] was designed to assist in the transition of community college graduates to four-year undergraduate programs at the University of Tennessee Knoxville (UTK).

Prior to the implementation of the TranSCEnD grant, transfer students in the Tickle College of [i]Engineering were nearly twice as likely to not complete the degree within five years compared to students who entered the program as freshmen (29% vs 15%). Formulation of the program was deliberately designed to reduce likelihood of drop-out rates known to be common for transfer students entering university programs. In engineering, transfer students also statistically represent a different demographic population than the student body of entering freshmen. The fraction of first-generation college students is double (32% compared to 15%) among transfer students, which can potentially bring cultural challenges as well. The following summary clarifies the characteristics of this program and articulates the major observations recognized as the project closes.

Project Concept

The TranSCEnD program was designed to provide academic, social and financial support to engineering transfer students [3]. The need for academic support is based on the fact that the level of rigor and the time commitment required to pass core engineering courses may be greater than what students were accustomed to during their (typically) two years at a community college [4]. The need for social support stems from the fact that students who enter as freshmen have built a cohort during the common curriculum in year one. Members of this cohort create study groups for particular classes and provide extracurricular support through shared recreational activities. Transfer students arrive on campus at a disadvantage due to the isolation imposed by the absence of a pre-existing cohort. The need for financial support was demonstrated through Pell Grant eligibility, as established by the UT financial aid office, which was a requirement of receiving funds from the TranSCEnD grant.

Program Timeline

The TranSCEnD Program began in Fall 2018. Since program inception, the TranSCEnD team has hosted four cohorts of transfer students on the UTK campus. Each cohort began their program in the fall semester, though cohorts were made up of students whose transfer occurred in the fall semester or the prior spring semester. A previous publication on this work describes specific selection criteria for being accepted into a TranSCEnD Cohort [2].

Financial Support

To address financial need, the TranSCEnD program provided approximately $3,000 per semester of financial aid for up to six semesters. While transfer students typically have spent two years at a community college, our analysis of historical data indicated that it was unrealistic to expect that the average student could complete the engineering degree in two additional years at UT. The delay is due to students largely having completed the common first year and many general education requirements while at the community college, but still having to take the sophomore, junior and senior level course sequence in their major. Thus, the maximum of six semesters was established.

To jointly address academic and social support, two critical elements were designed to build a cohort of students better equipped to overcome the common challenges encountered by transfer students.

Summer Bridge Project

A summer bridge program was designed to both support initial technical learning and build rapport internally between the year's student participants as well as externally with the students from previous cohorts and the TranSCEnD faculty. The bridge program offered the opportunity for a hands-on build project incorporating fundamental physics and early engineering principles for the students to apply during the multi-day activity. Because a majority of the transfer students work, the bridge program was offered in a way that did not conflict with job obligations. It was kept compressed, 3 days of eight hours each. Also, it was offered immediately before fall classes started, so that students who were moving to Knoxville for university study did not have to make a special trip in the middle of the summer. During the bridge program, students were offered mini-lessons, asked to perform some analysis and design calculations, and were involved in the construction of a prototype engineering system. During these experiences, the faculty and staff encouraged the application of fundamentals learned in the community college experiences with the intention of reiterating the value of their previous academic experiences, emphasizing the concept of life-long learning, and highlighting the need to ask questions to overcome obstacles in engineering design challenges. The physical build required teamwork and collaboration which allowed the students an opportunity to build trust and a network of peers pursuing similar academic programs. Ultimately, the summer bridge program offered a quick introduction to the peers in the group and the seminar strengthened their unity while also easing the students into campus life and resources available at that campus.

<u>Year 1</u>

For the year 1 bridge project, TranSCEnD students designed and built a solar powered portable shower. While many uses for this design were discussed, one potential customer base for this design was the population of people without homes who are served by the local Knox Area Rescue Ministries. This portable shower could be transported across the county to provide hot showers for those without access to heated water. For this design, TranSCEnD students also considered the needs of patrons attending multi-day music festivals that encouraged on site camping.

Members of the cohort learned principles related to solar radiation, passive solar systems, calculating performance and using specifications to make part selections through interaction with faculty and staff and using a publication from the *Journal of Design Innovation for Hydronics Professionals* [cite]. They learned to use pipe cutting tools, woodworking power tools and learned basic principles of pipe fitting. They also had the opportunity to learn about digital and analog instrumentation. Their design used both analog and digital pressure sensors for flow control.

At the end of the bridge project, the cohort conducted a full day test of their system to determine the maximum water temperature that could be achieved with the system. Each member took turns reading and recording data throughout the day. The data was graphed so that the team members could discuss the practical reality of the design on an average weather day in Knoxville.

The cohort developed a poster presentation at the end of their 3 day bridge project to share the results of their design, build and testing. This presentation solidified their work and served as a community building activity at the end of this portion of the program.

Figure 1: TranSCEnD Cohort 1

Year 2

For the year 2 bridge project, TranSCEnD students expanded on the year 1 concept by designing and building a hot water powered hand wash station to support the use of four sinks

concurrently. In this iteration, the primary customer was the Tickle College of Engineering Professional Practice Office. Each year, the office holds a BBQ for all students in the college to advertise the Professional Practice Program and connect students with companies for experimental work opportunities. The BBQ is very popular and serves thousands of students over a three hour period during the middle of a day in late August. The hand washing station served as an opportunity to follow hygiene best practices while also conforming to campus policies for waste water dumping. While TranSCEnD members gained knowledge and skills in solar power, manufacturing and instrumentation in a similar way to year 1, cohort 2 had the opportunity to consider scale and local standards in their design through this project iteration.

This design was significantly more complex than the previous year's design. The TranSCEnD team found challenges related to volume of heated water based on the solar design. They found that, while they were able to achieve flow of water through the system, they were not able to maintain the temperature standard they had set for the water due to the volume required and the number of available solar panels. This was a good learning opportunity for students in the cohort on the importance of continuous improvement and iteration in engineering design.

Figure 2: TranSCEnD Cohort 2

Year 3

Year 3 presented a challenge to the TraSCEnD team as it was the first summer of the COVID-19 pandemic. The team understood the importance of the in-person hands-on build project for members of the third cohort. After significant work, the TranSCEnD team developed a working

protocol to align with campus safety standards for in person work. The project prompt was re-designed so that members of the cohort could work in spaced out smaller teams throughout the day. This effort was made to minimize long term contact among large groups of students and instructors. When possible, work was conducted outside.

For the year 3 bridge project, TranSCEnD students modified the designs from year 1 and year 2 to build a solar powered portable sink with a smaller footprint. The motivation to build a smaller, more portable hand washing station was in large part due to the COVID-19 pandemic. The team and cohort believed that a portable hand washing station could serve the public good in the local area during the pandemic. Past reflections on the designs from year 1 and year 2 noted the large size of each final design. As the goal was to make a hand washing station that was portable, the team was required to modify previous designs so they could fit in the towing trailer used by the TranSCEnD team.

Figure 3: TranSCEnD Cohort 3

Year 4

For the year 4 bridge project, TranSCEnD students were presented with the problem of developing a way for members of a remote village in Panama to pump water from the middle of the river that serves the village. Members of the cohort modified the design of a current senior design team in our Civil and Environmental Engineering Department to build a floating dock outfitted with a pump that could be used to pump water from the river.

The TranSCEnD cohort learned concepts around buoyancy, settlement of sediment in water sources, and the selection of pumps and motors based on design criteria. They also had the opportunity to consider cultural, economic and governmental factors associated with designing a solution for a community in another country.

Members of the team built a floating dock outfitted with a pump, submersible piping and a power source. They took their structure and tested it in the waters of the Tennessee River, adjacent to the UTK campus.

Figure 4: TranSCEnD Cohort 4

Transfer Success Course

In addition to the summer build, students were included in a one-semester student success skills seminar series which reinforced the cohort structure and offered success lessons for the students new to the UTK campus. The course was based on an existing "First Year Studies" student success seminar but was altered to specifically address the needs of transfer students. Since the beginning of the TranSCEnD program, UT has adopted TRNS 201 as a general one-hour introductory course for transfer students of all disciplines, not just engineering. The course offered through the TranSCEnD program intended to continue to provide the academic and social support built in the bridge program while also preparing students to engage in a high impact practice, like experiential work, undergraduate research, study abroad or significant leadership experiences, as quickly as possible. Topics for our course included:

- UTK Culture
- Planning Your Professional Development Path

- Developing an Elevator Speech
- Developing Interview Skills
- Engaging with Career Fairs
- Developing a Personal Mission Statement
- Academic Advising and Academic Planning
- Developing an E-Portfolio
- Experiential Work, Undergraduate Research and Study Abroad
- Networking Practice and Reflection

The cohort members developed an e-portfolio to display their work and be used to gain opportunities in their preferred high impact practice.

Observations

As the TranSCEnD program closes, a number of observations can be made. Below, we organize these observations into the following categories: Admission, Academic Support, Social Support, Financial Support, Dissemination and Impact.

Admission

The application to the TranSCEnD program originally had deadlines for completion in the spring semester with a complete roster of scholarships to be determined by the beginning of the summer. The application also had an essay requirement as well as two external letters. After the first year, the TranSCEnD leadership team modified the application process. The deadlines were pushed back to mid-July just a couple weeks before the summer bridge program began. This change was required because many students were finishing their associates degree in the spring semester and their application to the university was not processed until their final grades and degree award were transmitted to UT. As a result, we filled slots as candidates applied but did not fill them all until late in the summer. The application itself was also changed. We dropped the essay and also began accepting brief emails as letters of reference. We ultimately decided that we were making Pell Eligible students work too hard for this additional financial aid. The ability to fill all of our scholarship slots depended on a relaxation of the application requirements. Initial attempts to distribute TranSCEnD scholarship in some particular way among the seven departments with the Tickle College of Engineering were abandoned. We accepted applicants irrespective of engineering discipline and created an inter-disciplinary engineering cohort.

Social Support

Most students informally surveyed indicated the summer bridge program was a key memory welcoming them to the UTK campus. The opportunity to visit campus before a semester began allowed the students time to become familiar with basics such as parking, campus walking distances, and general way-finding on the campus typically larger than those in the local community college sites. The build opened them up to a network of peers also visiting campus for the first time which allowed them to share advice they'd heard about campus life, courses, studying, libraries, food on campus, and other basics. The bridge program also connected them

to TranSCEnD faculty with whom they had a direct line of communication. Accessing faculty is often cited as an obstacle when transfer students move from a small community college to a large university. In many cases, the queries that came to the TranSCEnD faculty were outside their expertise but they were able to relay them to the appropriate parties. In this regard, the bridge program removed the obstacle to faculty access.

Academic Support

The seminar was referenced by the students as the most impactful experience in the program. The seminar offered learning in a low-risk environment as students were encouraged to engage with people in different campus offices with a goal, structure of schedule, and aligned with some fundamental goals presented by the seminar professor. University staff from the Division of Student Services guest lectured to provide guidance on time management and available tutorial services. In one sequence of events, students refreshed their resume, had their resume critiqued, performed mock interviews, and were simply asked to participate in an engineering hiring event. The course offered the structure and small academic incentive to participate in these activities; effort which might not have been made without the schedule and format of a seminar encouraging the ideas. Ultimately, the students were introduced to these strategies for success and the concepts were universal to accommodate students at different life stages and event academic preparedness levels.

Financial Support

The approximately $3,000 of support per semester for six semesters made a significant contribution to student expense. In most cases, students continued to have unmet need. Many continued to work during the semester. Others pursued engineering-related internships and co-op opportunities through the Tickle College of Engineering Office of Professional Practice. The six-semester duration was justified in most cases. Some students finished in five semesters. When students had one remaining semester that did not require full-time enrollment, we relaxed the requirement for full time registration and pro-rated the scholarship based on their fractional enrollment, with 12 credit hours constituting full time.

Many students indicated that the scholarship provided the greatest incentive to participate in the program and was a critical element in graduation success.

The program could be enhanced with a more robust financial support program which could include a detailed survey of the financial burden encountered by the student and extended opportunities through paid co-ops, internships, undergraduate research, work-study opportunities on campus, or other improved financial plans for the students. Some respondents to the TranSCEnD survey indicated that the program could have provided greater emphasis to directly encourage students to pursue paid opportunities which could have satisfied their financial needs in a way better supported by the academic experience and with direction towards professional growth.

Dissemination

The dissemination documents resulting from the TranSCEnD project have fallen both inside and outside the usual venues. Work has been presented at professional meetings [2, 5, 6]. Additionally, reports on the internet have showcased some of the TranSCEnD Summer Transition Showcases [7-10]. There have also been public-facing highlights of individual TranSCEnD scholars in UT publications, such as the UTK MSE Newsletter.[11]

Impact

The TranSCEnD program impacted five cohorts of students, totaling fifty students. The program appears to have successfully closed the graduation gap between engineering transfer students and engineering students who entered as freshman. For example, 15 of the 18 students (83%) in the first two cohorts graduated.

Closing Remarks

The TranSCEnD program can be considered a successful project as the program structure demonstrated a positive impact on students transferring from state community colleges to UTK. However, long-term success of a transfer support program needs to consider not only the academic and peer support, but financial support. The small sample size impacted by this program challenges the statistical merit of the study, but the students involved in the program needed the financial support included in this project.

While the summer build project and success seminar were valuable, the complete package required the financial impact for the students involved. The program encouraged and supported peer network building and academic success traits, but many students involved in the program had these skillsets and the program only complimented their baseline awareness. Without a financial component to the program, community college transfer students will likely continue to have varying levels of graduation rates and graduation successes. Programs expanded from this study would benefit from the basic structure, but require additional expansions into more elaborate financial package designs.

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