Board 402: The First Two Years: An Overview of Contributions of the NSF CAREER: Valuing Education and Career Transition Opportunities Raising Student Success Project

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1. Project Overview

Two-year (or community) colleges, with their open access missions, have a significant impact in the higher education landscape. These institutions enroll a large percentage of the total undergraduate population (between 36-41 percent), and it has been found that 49 percent of all students who completed a four-year degree had some type of previous enrollment at a two-year college. Yet, in engineering education, there is little empirical understanding of this potentially large, pre-transfer two-year college student population. Research that does exist examines students' post-transfer experiences at a single institution and little to none examines the impact of geographic and demographic variances between students. The overall aim of this NSF CAREER grant Valuing Education and Career Transition Opportunities Raising Student Success (VECTORS) is to address this gap and advance understanding of the assets, factors, and strategies that increase two-year college engineering transfer student outcomes and improve broad access to engineering education and baccalaureate degree programs especially for underrepresented minority, low-income, first-generation, and nontraditional students. The purpose of this grant is two-pronged. The first, is a mixed methods study to create new knowledge to increase engineering transfer numbers and preparedness more broadly through investigating the geographic and cultural assets of transfer intending two-year college students (Years 1-3). The second is to integrate these research findings into digital educational interventions aimed at improving transfer student capital and to test the efficacy of those interventions (Years 3-5).

The theoretical framework which guides this work is Laanans's theory of transfer student capital (TSC)[1]. TSC is a theory that helps to identify and explain the impact of various constructs that aim to measure student and higher education knowledge, available resources, and information which help to make students more successful before, during, and after the transfer process[1], [2], [3]. Since its introduction TSC has been widely used and even adapted to include a more robust set of constructs [3], [4]. The constructs that the theory seeks to operationalize and measure include: perceptions of the transfer process, academic advising support/experiences, learning and study skills, experiences and collaboration with faculty at the two-year college, faculty and staff validation, financial knowledge, motivation and self-efficacy, and social support [1], [3], [4]. The research questions are designed with TSC in mind and to support achievement of the purposes of the project. The research questions guiding this grant are:

> RQ1: What are assets, factors, and strategies that enable access for two-year college students to engineering transfer pathways?
> RQ2: Do assets, factors, and strategies vary in magnitude and/or presence across student demographics, locations, institutions, or intention to transfer?
> RQ3: How does use of digital learning tools and resources impact transfer

outcomes for pre-transfer engineering students?
RQ4: To what extent can transfer outcomes be improved, through use of digital learning tools, for students from underrepresented and disadvantaged backgrounds?

2. Overview of Year 2 Research

Years 1-3 are aimed at collecting, analyzing, and disseminating research on pre-transfer engineering students specifically focusing on utilizing a mixed methods approach to investigate the geographic and cultural assets of transfer intending two-year college students. During this project's second year of funding four studies were conducted which all aimed to develop new knowledge and to support an empirical basis for the second phase of the study, creating the digital engineering transfer student dashboard.

The first study was designed to provide a foundational theoretical understanding of TSC through creation of a systematic literature review of the theory of TSC in engineering and STEM educational contexts [5]. This literature review provided deep understanding of underlying theoretical frameworks focused on theories of student learning, development, and persistence (Pascarella, Tinto and Astin, Tinto) and capital based theories such as human, social, cultural, and others (Becker, [6], [7], [8]. Four primary themes emerged from the study: context (definitions and components of TSC, theories, and transfer challenges), empirical examination to understand prior research use (methodologies and research outcomes), implications and impact (strategic focus areas – see below, research gaps, and engineering specific emphases), and assets-based perspective (access and diversity). The study found that the largest implications and impact from prior use of the study was in development and improvement of institutional practices, providing support and advising, and student engagement. Data from the research revealed three strategic focus areas including support and advising (proactive pre-transfer advising, course transfer recommendations, and reducing transfer stigma), institutional practices (institutional coordination, information sharing, climate, and academic pathways) and engagement (events, resources, tools, and faculty engagement) which frame implications for practice. Gaps in understanding and research of TSC were also identified and framed implications for research. More research is needed that gives attention to the importance of the ability of two-year colleges, with their open access and lower cost, to democratize higher education and the ability of TSC to facilitate this access through use of transfer pathways and a focus on methods to increase TSC among pre-transfer students. There is also a need for research which disaggregates data by subgroup of student so that vertical transfers are not viewed as a one-size-fits-all approach but instead tailored to the uniqueness of various student populations. Finally, while this literature review provided a new theoretical understanding about the use of TSC in engineering education contexts, it also revealed that broad use of TSC in engineering and STEM contexts and nuanced and therefore there is a need for a tailored engineering-focused version of TSC. This literature is being used as a basis for adaptation of TSC in engineering and STEM contexts, a modified framework which is being adapted from the original is expected to be proposed in Year 3 of this study.

The second study was designed to get a fuller understanding of the issue within a national scope, 11 interviews were conducted with experts, influencers, programs, and leading researchers in the

field focused on collecting their perspectives, expertise, and knowledge of assets, factors, strategies, and digital tools for engineering transfer students [9]. Inductive analysis of the interviews resulted in 13 categories that formed four major themes: assets, factors, strategies, and challenges. These results build on prior transfer student research through a focus on practical strategies and tactics used to build transfer student capital for engineering transfer students. These interviews also identified specific demographic and geographic assets and "friction points", effective formal policies and interinstitutional and statewide collaborations supporting transfer students, and the importance of increasing meaningful financial aid and financial literacy for engineering transfer students. Most importantly, these results highlight a previously missing asset-based perspective of transfer students to shift the lens to strengths-based views and conversations about transfer students.

The next phase of this research project focused on distribution of surveys to pre-transfer two-year college students. The survey was adapted from Penn State Preparing the Engineer 2020 Community and Two-Year College Survey, Engineering Student Transfer Survey and the Iowa State University Transfer Student Survey. Findings from this study revealed significant differences skills developed and the importance of experiences with faculty and staff at two-year institutions based on institution of enrollment (or location), gender, first generation students, and nontraditional students [10]. Practical implications of this research provide faculty and staff working with engineering students with real world recommendations of how to best support specific geographic and demographic nuances of pre-transfer engineering students in areas of advising, support, and faculty-student interactions.

Finally, since later phases of the career project will focus on developing a digital engineering transfer student dashboard, a study of all existing digital transfer tools was conducted [11]. This study collected data from expert and lead researcher interviews, published transfer literature, and Internet searches. The three themes emerging from this data highlight (1) the importance of accessible, accurate, and utilizable information; (2) the need for tools and resources developed for transfer students; and (3) the lack of digital resources for engineering transfer contexts. This study also provided an expansive list of digital transfer tools and identifies ways to improve upon and expand these existing resources, especially into engineering education contexts. While these tools all have use and value, none had a specific focus on engineering transfer or students' personalized needs for building transfer student capital to support successful transfer to a baccalaureate institution.

3. Current and Future Plans

As this project is closing out the second year, much of the data collection to inform development of a digital engineering transfer student dashboard has been completed. Data have been collected from national transfer student experts, pre-transfer two-year college students at three different sites, and post-transfer engineering students at one four-year research institution. The spring semester of the second year will conclude with additional data collection of pre-transfer and post-transfer surveys and interviews with pre-transfer students and two-year college faculty, staff, and administrators. Following the collection of that data, all data collected during this project will be mixed to create greater understanding of the assets that assets, factors, and strategies that enable access to engineering transfer pathways and the ways in which these items

vary across student demographics, locations, institutions, or intention to transfer. Beginning in Year 3, with this information, and data from other studies conducted in this CAREER grant, the researchers plan to develop an interactive, digital Engineering Transfer Student Dashboard, based on constructs identified by transfer student capital, to provide support for engineering transfer students based on individual location and demographic needs. Years 4-5 will support piloting, implementation, and iterative improvement of the dashboard.

5. Evaluation and Project Outcomes to Date

This CAREER project is guided by a two-phase evaluation methodology. First, an ongoing formative internal evaluation is ongoing integrating the monitoring of research with evaluation through assessing achievement of milestones, reflection on project questions, fit-for-purpose data, and sense making. Summative, external evaluation is led by an Advisory Board chair who is an expert in transfer student STEM research is assisted by an Advisory Board of experts representing key disciplinary areas of study. The Chair and and the Advisory Board convene virtually each year and assess whether the project is progressing as proposed. Then, the chair shares an annual update report with the PI to use for project improvement and reporting.

In addition to the research findings of this project other important outcomes are emerging. These outcomes include bringing new participants into the discipline of engineering education including industry experts in the transfer field, administrators from two- and four-year institutions and new research collaborations with colleagues Educational and Organizational Leadership Development and Human Resource Development. The combinations of these collaborations served to expand existing networks and build new capacity for the collaborators on this project. This work also served to bring greater awareness to the specific problem identified in few prior research studies of viewing transfer students through a deficit-based perspective. The manuscripts resulting from Year 1 work and the emphasis of future work on this project will be to promote and disseminate an assets-based approach.

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