WIP: Thriving Where We Learn - Institutional Contexts and Early Engineering Identity Formation

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Introduction

The purpose of this Work-in-Progress paper is to describe the development and initial deployment of a pilot study comparing thriving-related non-cognitive factors among first- and second-year engineering students at two institutions.

Engineering programs are notoriously difficult and often promote a weed-out culture that can be particularly detrimental to underserved minority, female, and first-generation students [1]. Even students who are successful in engineering programs, meaning that they graduate on-time with high grades, might find themselves struggling to find balance and feel good in their work and personal life. Indeed, some of the habits picked up in engineering programs, such as a tendency to skip sleep or meals to complete assignments, could be expected to set students back in personal thriving. Reference [2] found that non-cognitive factors that support student success tended to decrease among engineering undergraduates between the first and second years of college, indicating that developing strategies to counteract this trend is a key need in engineering programs.

We define *thriving* as the ability to feel good and function optimally, responding to stress in a productive manner that promotes growth and success. For example, feeling good in a university setting could include having the skills to manage stress and anxiety, effective study strategies, and a strong sense of belonging and identity in their major. Students who are able to thrive, meaning they have thriving competencies, will be most likely to learn from and become more resilient after an academic setback or adverse event, rather than succumb and leave engineering or simply survive without growth. While there are many aspects to thriving, some non-cognitive factors that lead to success are currently being explicitly targeted by Place-Based Learning Community (PBLC) programs for incoming first-year students at [redacted] In particular, a sense of belonging within the local, university, and engineering community is promoted within the PBLC.

A PBLC is a cohort of new students who are intentionally grouped together starting during orientation and continuing throughout the first year of university, to foster a sense of community, belonging, and support within a major. The students have a summer immersion experience together that involves field trips and major-based activities, with a particular emphasis on Indigenous history and innovation specific to the local region. Then, throughout the first year, students are placed with others in their major in their required classes and take a first-year seminar together. They also have the option to live in PBLC-themed housing. Place-Based Learning Communities have been shown to improve first-year student outcomes and decrease equity gaps in STEM retention [3].

The Place-Based Learning program was initiated at [redacted] in 2015 for certain STEM majors, including Engineering, and has since expanded to encompass most incoming

first-year students across the university. In 2023, a new Engineering-focused PBLC was created, [redacted] which introduces students to the tribes, environment, and some engineering projects in the local community around [redacted]

The student population within the [redacted] School of Engineering (SOE) is currently changing. New [redacted] degree programs opened in Fall 2023, in addition to the existing [redacted] major. This is expected to drastically increase the number of Engineering students at [redacted], with Mechanical Engineering being the largest driver of growth and expected to be about double the size of the other two programs in the long term. Because ME tends to have a lower share of women, we expect that this will shift the gender ratio in the SOE [4]. Another notable shift in the incoming student population is the increase in students who must take remedial math courses before they can start the engineering curriculum, a population with historically high attrition rates.

[redacted] first became a Hispanic-Serving Institution in 2013, meaning that at least 25% of its full-time undergraduate students identify as Hispanic. The engineering student population is 31% female, with a racial make-up of 51% white, 27% Hispanic or Latino, with all other categories being 5% or less [5]. Before expanding to include [redacted], students in the [redacted] department regularly noted the department's collaborative, non-competitive, and supportive culture. This is highly valued in the department and is something the engineering faculty hope to retain and build on during this period of change.

The Mechanical Engineering program at [redacted], the peer comparison school for this study, is widely recognized for its strong academic curriculum and the campus-wide “Learn by Doing” ethos. Its graduates are highly sought after as both career professionals and graduate students. Despite this success, however, a recent study showed that their students, while academically successful, are not thriving [6]. This suggests that much improvement could be achieved if students learned and adopted thriving competencies. [redacted] is a predominantly White institution with an engineering student demographic distribution of 50.4% White, 18.1% Asian, 14.9% Hispanic or Latino, 0.8% Black or African American, 8.1% multi-racial and 7.8% other or unknown. University-wide, the percentage of Hispanic/Latino students is quickly rising, with the 2022 incoming class at 21.1% and the 2023 incoming class at 24.0%. The campus is expected to be designated a Hispanic-Serving Institution within the next few years.

This paper describes our project approach, lessons learned, and next steps for our comparison case study investigating how the [redacted] PBLC contributes to the development of thriving competencies in their engineering students compared to their peers at [redacted]. We will also work to honor and explore the importance of place and the unique cultural, structural, and historical contexts of the institutions involved and analyze any differences that emerge between the two campuses.

Project Approach

This study builds on previous NSF-funded research at [redacted] that tracked the role of non-cognitive and thriving competencies in the success of mechanical engineering students throughout their undergraduate career [7]. The main instrument for this work is the SUCCESS (Studying Underlying Characteristics of Computing and Engineering Student Success) for which the construction, validation, and explanation of the 28 non-cognitive factors it measures can be found in references [8-10]. The constructs and factors included in the survey are mapped in Table 1 as published in [11]. The findings of this previous longitudinal study demonstrated the importance of these factors for students' academic success, specifically that they account for roughly 25% of the variance in students' grade point averages. For comparison, standardized test scores accounted for less than 10% [12]. It was also found that five of the 28 factors (stress due to changes, reactions to stress, belongingness, engineering identity, and motivation by expectancy) were negatively associated with students' academic success. These changes occurred at some point between the students' first and second years of study [11].

Table 1: Constructs and factors measured through the SUCCESS survey [11]

Construct	Factors	No. of items in survey
Personality (Big 5)	agreeableness conscientiousness extraversion openness neuroticism	15
Meaning & purpose	meaning & purpose	3
Future time perspective	perceptions of future value instrumentality connectedness expectancy	18
Growth/fixed mindset	mindset	8
Grit	persistence	8
Self-control	impulsivity	9
Gratitude	gratitude	4
Mindfulness	mindfulness	4
Perceptions of faculty caring	empathetic understanding social support	13
Engineering identity	interest recognition	19
Sense of belonging	belongingness	5
Test anxiety	test anxiety	4
Time & study environment	time & study environment	8
Stress	reactions changes conflict frustrations support for stress	28

In the next phase of this work, a similar study will be conducted at Cal Poly Humboldt to compare these two peer institutions and help us understand which interventions support students

in their thriving and success. Data collection will be completed at both institutions simultaneously. For this work-in-progress update, we are collecting base data for the two institutions and exploring how the PBLC already influences these factors as currently implemented.

The two main types of data to be collected are course enrollment, course grades and retention rates of Engineering students, and survey data from surveys administered every year that the students are in the program. At [redacted], all engineering students will be asked to complete the survey, which will be linked to grade and retention data. This external data will also provide us with information about student participation within the PBLC. Time will be given in classes to complete the survey whenever possible to increase engagement. At [redacted], all Mechanical Engineering students will be asked to complete the electronic survey and will also be given time to do so in class.

Next Steps

We have begun initial data collection and currently have one semester of student data from both institutions. We will continue to present this survey, focusing our recruitment primarily on first- and second-year engineering students to better understand the larger comparisons between the two peer institutions. Once we have this initial data completed, we can begin exploring specific interventions currently being developed as part of another NSF-funded project at Cal Poly SLO, how these interventions affect the development of thriving competencies, and whether they are transferable across these peer institutions.

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