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FACE to FACE with Leadership: A Work in Progress

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Introduction

According to the Bureau of Labor Statistics, the demand for engineers is expected to increase by 15% to meet growing industry needs and replace the retiring baby boomer generation [1]. Despite this increasing demand, many institutions continue to face high attrition rates among undergraduate engineering students.

Recent societal efforts to address issues of diversity, inclusion, and leadership initiated a reshaping of the conversation, yet the engineering profession continues to struggle with underrepresentation. In 2023, only 24% of underrepresented groups (Black or African American, Hispanic, Multiracial, American Indian/Alaskan Native, and Native Hawaiian/Other Pacific Islander) earned their engineering bachelor's degrees, while women made up just 24% of graduates [2]. Without a sense of belonging, students may feel disconnected, therefore making them more likely to withdraw [3]. Understanding why students do not persist in engineering programs is crucial for designing effective solutions to bridge the gap between higher education institutions and the engineering industry.

A growing body of research has demonstrated that a strong sense of belonging correlates with better academic outcomes, higher engagement, and increased motivation to persist [4], [5]. Similarly, engineering identity and self-efficacy are crucial factors that influence students' confidence and drive to succeed. Thus, the Fulton Accelerated Community Engagement (FACE) program aims to help students strengthen their engineering identity and sense of belonging, boost their self-efficacy, and cultivate the leadership qualities necessary for their academic and professional success. By fostering these attributes, FACE seeks to ensure that students continue engagement, feel connected to the engineering field, and ultimately persist through their engineering programs toward graduation.

At the Ira A. Fulton Schools of Engineering (FSE) at Arizona State University (ASU), one of the central goals of the Student Success and Engagement team is to support various co- and extra-curricular programs that enrich students' experiences, promote community engagement, and foster both academic and career development. These initiatives are designed with the hope of increasing intentional support of student persistence toward graduation within engineering programs. As we continue advancing equity, diversity, and inclusion efforts, it has become increasingly important to develop leadership programs grounded in research focusing on developing empathy and social awareness. These skills are often underrepresented in traditional technical education and play a critical role in improving a student's sense of belonging. Programmatic efforts are essential for supporting diversity initiatives and for ensuring their sustainability in the face of ongoing challenges in engineering education.

Literature Review

There are numerous factors contributing to the high attrition rates in engineering education, including the inherent rigor of the discipline, challenges with teaching and advising, and the difficulty of the curriculum [3]. However, a significant and often overlooked barrier is the lack of diversity and inclusion within engineering programs. It is essential to recognize that the lack of diversity and inclusivity compounds these issues, particularly for minoritized groups. Often, these inequitable student outcomes are attributed to perceived student deficits, resulting in programs that attempt to "fix" students who are considered "at-risk" [6]. Alternatively, asset-based approaches, such as those that center on a student's unique ways of knowing, abilities, and skills [6], foster student success and persistence [6], [7]. Additionally, drawing upon a minoritized student's sense of family, community development, or societal advancement provides a sense of purpose that supports their decision to persist toward graduation [8], [9].

Tinto's theory of individual student departure, which encompasses the stages of separation, transition, and incorporation, is widely utilized to describe student success and underpins numerous intervention programs in higher education [10]. This theory underscores the significance of academic and social integration, highlighting that students' perceptions of interactions with faculty, staff, and peers in both academic and extracurricular contexts are pivotal to their success [7].

Nevertheless, critiques of Tinto's theory point out its inadequacy in addressing the varied experiences of students, emphasizing the importance for these students to feel a sense of belonging rather than merely integrating into the college community [11]. Retention programs designed to support these students focus on fostering a supportive culture, challenging negative stereotypes, developing communities of supportive peers and faculty, and affirming students' capabilities as learners [9], [11]. Tinto's subsequent research expanded the conversation on student persistence by examining students' beliefs in their own success (sense of self-efficacy), their affiliations and connections within the community (sense of belonging), and their perceptions of the curriculum [5].

Strayhorn describes a *sense of belonging* as a basic human need, a need that is more important in certain contexts at certain times and often results from the intersection of multiple identities within that context [4]. Within the context and climate of STEM, evidence emphasizes the need to promote a student's sense of belonging [12]. The absence of belonging results in students feeling marginalized, isolated, and alone, which has been shown to lead to student departure.

While much of the existing literature focuses on academic and social involvement, there is a gap in research on how leadership programs and models can bridge the connection between belonging and academic success to support persistence. Sense of belonging and engineering leadership development through the lens of identity provides a level of interconnectedness that can prove beneficial in creating a more holistic and effective learning environment. Developing a leadership identity can be a powerful way to foster a sense of belonging, which in turn plays a big role in student persistence in engineering programs. As Strayhorn describes, belonging directly impacts student engagement and success [4]. Similarly, Tinto highlights that students' academic and social integration influences whether they stick with their program [5]. By

combining leadership development with discipline-specific identity, these models help us understand how leadership and belonging work together to support student persistence in engineering.

Komives et al. (2005) introduced the Leadership Identity Development (LID) Model, which frames leadership as a growing identity shaped by experience, mentorship, and reflection. Recognizing the need for a more field-specific perspective, Schell and Hughes (2016) adapted this model into the Engineering Leadership Identity Model [13], [14]. Their version emphasizes that engineering leadership is not just about leadership behaviors; it is also deeply connected to professional identity and engagement in the discipline. This idea plays a key role in FACE, especially in the early modules, where students explore their leadership identity through structured learning experiences [14]. The LID also discusses the importance of various interactions. First, there must be student-faculty-promoted interactions by fostering mentorship opportunities. Likewise, providing structured peer-to-peer interactions allows students to develop their leadership skills and self-efficacy in leading [14]. Schell and Hughes argue that this approach is more effective than a standalone leadership program [14]. An engineering identity is "a particular style of role identity that students author during their experiences in engineering" [15]. A leadership identity is typically described as a set of behaviors that leaders exhibit [14].

Recent research supports the idea that leadership development can significantly influence student retention. A study by Soria and Werner (2018) found that students who participated in academic leadership courses had six times greater odds of enrolling in their second and greater odds of graduating within four years compared to those who did not [16]. This underscores the potential of leadership programs not only to foster academic and social integration but also to directly contribute to students' persistence to graduation, addressing the critical gap between belonging, academic success, and retention.

By combining leadership identity development with engineering education, programs can create a more holistic support system for students. The Engineering Leadership Identity Model aligns with these perspectives by framing leadership identity development as a process that occurs through structured mentorship, team-based projects, and engagement with professional communities [16]. These components mirror FACE's design, particularly through its peer leader model and team-based Systems Thinking Project, which intentionally create opportunities for students to build leadership identity while strengthening their connections to the engineering community. In their research, Schell and Hughes adopted LID, which considers how a student approaches the processes of leadership development as they build awareness, explore and engage, and then describe their identity as a leader. Both engineering identity and leadership identity are predicated on a student's active participation in the development of those identities.

Program Overview

The Fulton Accelerated Community Engagement (FACE) program supports first-year students (FYS) by creating opportunities to develop leadership skills and connect with resources that promote career and educational goal achievement while providing financial compensation. FACE participants learn and apply professional skills identified to aid their leadership journey. FACE aims to provide the students with a sense of belonging, foster their engineering identity, and promote inclusive leadership through their engagement in an asset-based curriculum.

The content and deliverables of FACE are facilitated online via Canvas, the learning management system that the university utilizes. The cohort practiced various professional skills that were identified to aid their leadership journey. FACE is organized into *Part 1: Learn* (first semester) and *Part 2: Engage* (second semester). Each cohort member is placed into a team for the *Systems Thinking Project* [17], and each team is assigned to one *Peer Leader (PL)*, a student who has completed FACE previously and wants to serve as a mentor to the new cohort. The PL provides previous program participants the opportunity to engage with the skills they developed within FACE. The value of peer-to-peer mentoring is that it allows for social support in the cohort experience aimed at college adjustment [18].

TABLE I
MODULES STUDENTS ENGAGED WITH DURING PART 1: LEARN

Module Name	***Learning Outcome/Objective***	***Framework Utilized***
Welcome to FACE!	The objective of this module is to introduce the program objectives, the leadership team, and the peer leaders and expose the cohort to the idea of being an inclusive engineering leader.	[14], [19], [20]
Framework of Engineering Leadership Identity	The objective of this module is to expose the framework that the program uses to help students develop their inclusive engineering leader identities and remove the “expert” hurdle.	[14], [19], [20]
SMART Goals	The objective of this module is to expose the cohort to goal setting, specifically with SMART Goals.	[21]
Discover Your CliftonStrengths	The objective of this module is to have the cohort take their CliftonStrengths® Assessment to identify their top five CliftonStrengths and to aim their focus on their greater opportunities for development and success rather than on their weaknesses.	
Analysis of Your Strengths	The objective of this module is to have students develop a thorough analysis of application touchpoints and actions that promote the development of their strengths.	

Inclusive Leadership	The objective of this module is to introduce students to diversity, equity, and inclusion in the context of being an inclusive leader.	[22]
Conduct Informational Interview with Current Student Leader	The objective of this module is to provide the cohort with additional insight into the journey of becoming and being a student leader.	[7], [18]
Attending Student Organization Meeting and Conducting Qualitative Research	The objective of this module is for the cohort to use their developed knowledge of the various strengths and observe a student organization meeting of their choice.	[23]

Modules students engaged with during *Part 1: Learn* with the listed learning outcome/objective. These modules are engaged both individually and asynchronously.

TABLE II
MODULES STUDENTS ENGAGED WITH DURING PART 2: ENGAGE

Module Name	***Learning Outcome/Objective***	***Framework Utilized***
Welcome Back to FACE	The objective of this module is to introduce the program objectives for the semester and to reintroduce the leadership team and the peer leaders.	
Revisiting SMART Goals	The objective of this module is to review the practice of goal setting with SMART (**s**pecific, **m**easurable, **a**ttainable, **r**elevant, and **t**ime-bound) goals.	[21]
Co- and extra-curricular Spring Summit	The objective of this module is to encourage the cohort to further engage with the various co- and extra-curricular opportunities.	
Scholarships	The objective of this module is to motivate students to apply for the General Engineering Scholarship application as the support scholarships provide can enhance student success and community engagement.	[3]
Networking	The objective of this module is for the cohort to evaluate their current network and investigate ways to expand as they continue throughout their academic journey at our engineering school.	
Showcasing Leadership on Engineering Resumes and Cover Letters	The objective of this module is to provide the cohort skills needed for technical resume and cover letter writing.	
Attending Student Organization Meeting and Conducting Qualitative Research	The objective of this module is for the cohort to use their developed knowledge of the various strengths and observe a student organization meeting of their choice.	[23]

Diversity, Equity, Inclusion, and Belonging (DEIB)	The objective of this module is to provide the cohort with tools to engage with difficult topics regarding DEIB through academically robust, objective, and research-based content.	
Public Speaking	The objective of this module is to provide the cohort with the skills necessary for effective oral communication.	
Program Symposium	The objective of this module is to prepare the cohort for the annual poster symposium. Each member of the cohort presented their experiences in an engaging poster session.	

Modules students engaged with during *Part 2: Engage* with the listed learning outcome/objective. These modules are engaged both individually and asynchronously.

TABLE III
MODULES STUDENTS ENGAGED WITH FOR THE SYSTEMS THINKING PROJECT

Module Name	***Learning Outcome/Objective***	***Framework Utilized***
Systems Thinking Project	The objective of this project is to introduce systems thinking to the cohort and further their thinking mindset by promoting leadership and situational thinking in a systemic way.	[17]
Action Plan Template	Each systems thinking project group is asked to provide a detailed description of the problem and why it is an important problem to solve, create a system map of the different systems that may be involved in the problem, identify one feedback loop to improve the solution, gather peer-reviewed articles to inform the solution to the problem, and engage with their stakeholders.	[17]
Solution/Design/ Redesign	Each group is asked to showcase their design/redesign by generating a sketch, mockup, or infographic of the design to help depict the solution in a creative way.	[17]
Final Systems Thinking Portion and Presentation	Each group is asked to reflect on potential risks that may arise from implementing their design or solution and providing a plan on mitigation. Afterward, each group created and practiced their presentations, which were presented as the deliverable associated with the ***Public Speaking*** module.	[17]

Modules students engaged with during *Systems Thinking Project* with the listed learning outcome/objective. These modules are engaged both with a team and synchronously.

As the students engage with the modules, FACE aims for the cohort to explore answers to the following questions about themselves as leaders: What do leaders do, why do you want to be a

leader, how do you want to be a leader, how do you plan to get there, and how do you create an inclusive community as a leader? FACE aims to develop leadership skills, create opportunities for students to engage in co- and extracurricular activities, and promote career and educational goal achievement within our engineering FYS to aid in retention of their programs.

FACE is intentionally designed to align with leadership identity development models, particularly Komives et al.'s (2005) LID Model and Schell & Hughes' (2016) Engineering Leadership Identity Model [13], [14]. These frameworks emphasize that leadership identity is cultivated through structured experiences, reflection, and mentorship. Accordingly, FACE incorporates structured peer mentorship, self-assessment tools like CliftonStrengths, and leadership reflection activities to help students actively construct their leadership identity. Additionally, by integrating leadership identity development with an asset-based approach to student success, FACE fosters belonging and persistence, particularly for students from historically underrepresented backgrounds in engineering.

Data Collection and Preliminary Findings

Data collection followed a mixed methods approach. Data regarding demographics, students' majors, and GPA were pulled from analytic student data files. Data regarding cohort opinions on whether the objectives were met, the student leadership positions the cohort applied for, and any general comments they wanted to leave were collected via survey research in the form of an end-of-program questionnaire. In addition, longitudinal retention and engagement of students is measured by collecting data on their current major and grade point average at the end of each semester, both during and after FACE.

Retention is measured by the extent of the cohort that stayed within a STEM major at the university level in comparison to equivalent student populations. With the specific objective to increase access to experiential opportunities, FACE was advertised to the entire incoming FYS population within engineering; however, specific recruitment emails were sent to FYS who were identified as historically marginalized, female-identified, or first-gen students.

Data was analyzed in comparison to the overall incoming class of the engineering college. Reported ethnicities, gender, and first-gen status of the cohort were decomposed and compared against that of each respective graduating class of the engineering school.

Preliminary findings show the demographic engagement of FACE, with respect to historically marginalized students, female-students, and first-gen students, has a higher engagement when compared to the demographic of the enrolled student population for the engineering college. In addition, preliminary findings show that most of our cohorts agreed that they can articulate the value of being an engineering student, that participating in FACE helped them secure an on-campus student leader position, they are able to describe their own leadership profile, and they can reflect upon the application of leadership skills. Both the first and second cohorts of students demonstrated 100% retention in a STEM major from the end of FACE into the start of their second year of undergraduate studies.

Future Work and Implications

In the coming years, we will adopt a more systematic research methodology, starting with obtaining Institutional Review Board (IRB) approval to collect more extensive qualitative and quantitative student data. This will enable us to assess the effectiveness of our initiatives, refine and improve FACE, and disseminate our findings to the broader community. To evaluate the impact of FACE on leadership identity and belonging, surveys would be administered to the first-year engineering student cohort. The survey will assess constructs derived from the Engineering Leadership Identity Development Model, such as leadership self-perception, social integration, and engagement in leadership behaviors. Future research will include qualitative interviews to further explore students' experiences in leadership development and their impact on persistence in engineering.

This study will employ a longitudinal data collection approach to further examine the impact of leadership identity development on belonging and persistence. Building on Tinto's model of student persistence and Strayhorn's concept of belonging, we will track students who participate in FACE throughout their undergraduate careers [4], [5]. This approach will allow us to evaluate the long-term effects of engineering leadership identity development on engineering persistence, professional engagement, and academic success. By collecting data at multiple points, from program participation through graduation, we will assess how engineering leadership identity formation contributes to student retention and success. Metrics will include students' continued enrollment in engineering, participation in extracurricular leadership roles, peer mentorship engagement, and career-related activities such as internships. This longitudinal analysis will provide critical insights into the sustained impact of leadership development on engineering persistence beyond the first-year experience.

Ultimately, the implication of this work provides support that these models of belonging can be put into practice and, moreover, can be effective in creating environments of belonging, which can lead to the persistence and retention of engineering students. In addition, this work can demonstrate that these models can be implemented into a co-curricular program and, in essence, begin to create a top-down way of fostering belonging in engineering. This would be immensely impactful given how hard it has been over the last few years to shift away from the harshness of the current engineering environment and potentially create a new environment that is conducive to supporting a diverse body of students through leadership identity.

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