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Understanding Non-Traditional Students in Engineering and Computing (Work in Progress)

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When post-secondary schools design academic and co-curricular programs and student performance goals, they often frame them around traditional student populations (Chen, 2017). Traditional students are generally full-time, live on campus, are 18-24 years old, and are financially supported by parents (Figure 1). Chen (2017) notes that these traditional students "receive the vast majority of attention and resources from colleges and universities" (p. 1). There is some irony here since "the majority of students in undergraduate programs can be classified as nontraditional, suggesting that the traditional student…is now actually the exception rather than the norm" (Chen, 2017, p. 1). For this reason, nontraditional students as we describe them here are now often referred to as *post-traditional* learners, a term acknowledging that nontraditional student populations are now often the "norm." Moreover, Kim et al. (2010) suggest that using predefined labels to define nontraditional students may be less useful than allowing this population to self-identify based on particular affinities (e.g., parents, employees) that are most salient to them. Indeed, these learners, as we describe in the literature review, face personal or interpersonal situations (e.g., a need to work to support family members) that are largely misaligned with the framing of post-secondary education for traditional students.

Considering the specific context of engineering and computing programs, we derive our definition of nontraditional students in engineering from Minichiello (2018), who defines this population as students (see Figure 1) who would be classified in at least one of the following categories: "(a) Delaying college enrollment by one year or more; (b) attending college part-time, meaning they enroll in fewer than 12 credits per semester; (c) supporting themselves financially while enrolled; (d) working full-time while enrolled; (e) having dependents other than a spouse; (f) being single parents; and (g) having earned a GED or other equivalency certificate in place of a high school diploma" (Horn & Carroll, 1996, p. i; Minichiello, 2018, p. 267). We also consider commuter students (Andres & Carpenter, 1997; Minichiello, 2018; Wengert, 2018), economically disadvantaged students (Minichiello, 2018), students over the age of 24 (Minichiello, 2018), and students that work a minimum of 20 hours per week as nontraditional. For our purposes, Pell grant eligibility is a proxy for economic disadvantage (Delisle, 2017).

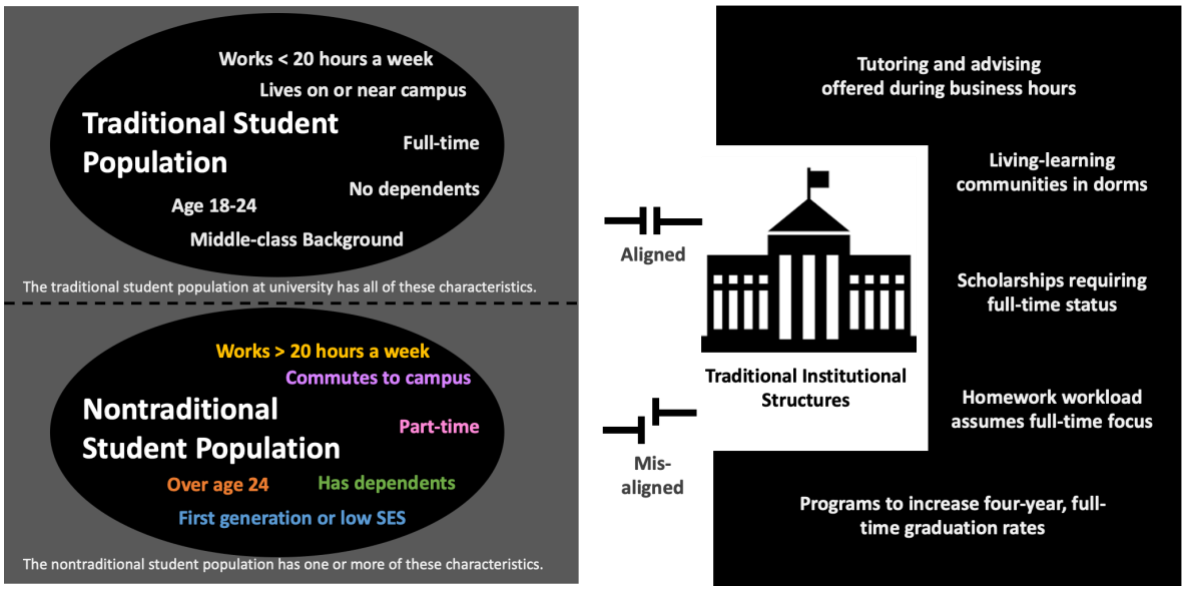

Figure 1: Visual Representation of Misalignment Between Nontraditional Students and Traditional Institutions

Engineering colleges tend to rely heavily on performance metrics such as four- or six-year graduation rates, but these metrics are often derived from and aligned with traditional students' pathways to and through

post-secondary school. Four-year graduation rates, for instance, tend to presume a linear pathway from the freshman through the senior year. This conceptualization does not account for the complex circumstances that nontraditional students may face. In addition, university infrastructure like engineering tutoring programs, living-learning communities, and college advising units have been designed for traditional undergraduates rather than nontraditional students (Chen, 2017). As such, there is a *misalignment* between expectations of and attention to nontraditional students, as well as the measures available to support them, as we note in Figure 1. Moreover, in the COVID-19 and post-pandemic eras, many traditional students are/will be faced with disrupted schedules, remote learning, and financial uncertainties that mirror those of their nontraditional counterparts (El Masri & Sabzalieva, 2020). In a COVID-19 and post-COVID reality, this misalignment may be more widespread than in the past (Li & Lalani, 2020).

This work-in-progress paper presents findings from a mixed-methods pilot study that explores persistence of nontraditional learners in engineering. Using both institutional data and interviews with current engineering undergraduates, we seek to understand challenges related to persistence in these majors at a macro level (through historical institutional data). At the same time, by presenting students' individual accounts of their experiences engaging with campus administrative structures, we explore the extent to which these structures are aligned or misaligned with their co-curricular needs.

1. Literature Review

Scholarship on retention in engineering and other STEM fields offers several factors that impact student success in these fields. Among these factors, themes related to race/ethnicity and gender tend to be heavily cited. In their foundational text, *Talking About Leaving Revisited* (*TALR*), Seymour and Hunter (2019) provide evidence that Black, Indigenous, and People of Color (BIPOC) and female students are more likely than racial majority groups and men in engineering/STEM majors to transition to non-STEM degree programs. Scholars cite several individual and institutional factors that impact BIPOC student success in engineering/STEM, including: 1) Interest in a non-STEM career (Carpi et al, 2013); 2) Negative interactions with faculty (Figueroa et al., 2013); 3) Engagement with peers on campus (Strayhorn et al., 2013); 4) Pre-college preparation (Figueroa et al., 2013); and 5) Campus climate (Palmer & DuBord, 2013). Research on undergraduate engineering education reveals similar challenges, including disinterest in the field, loss of self-confidence, classroom climate, and racial/gender bias (Lichtenstein et al., 2014). Although this body of work has been foundational for understanding the STEM discipline-specific aspects of retention (e.g., high credit requirement majors), the vast majority of studies have been situated in Predominately White Institutions (PWIs) and have not explored themes specific to nontraditional students. Below we describe a fuller picture of the engineering/STEM education landscape, which accounts for the unique contexts of Minority-Serving Institutions (MSIs). Then, we describe the state of the corpus of nontraditional student literature.

Unlike challenges noted in much of the STEM retention literature, research on MSIs illustrates that many undergraduate students at these schools benefit from having professors and advisors who are invested in student persistence and engagement, as well as familial peer groups (Fleming & Smith, 2013). In research on Tribal Colleges and Universities (TCUs), scholars note that TCUs often offer students a sense of belonging and community and cultural connections; these contribute to success in STEM fields (Page-Reeves et al., 2019). Within research on Historically Black Colleges and Universities (HBCUs), scholars suggest that HBCUs have the capacity to strengthen students' engineering identities through positive interactions with faculty or peers (Fleming & Smith, 2013). Literature also suggests that collegians who take part in math and science-based interventions at HBCUs, as well as summer research programs, tend to have stronger retention rates (Fakayode et al., 2014).

Similarly, scholarship on Hispanic-Serving Institutions (HSIs) has advanced the concept of *servingness* as a measure of HSIs' supportive institutional climate (Garcia, Nuñez & Sansone, 2019). Researchers also posit that engineering students at HSIs benefit from having professors who show interest in students, peers

who are more like family members, and a sense of self-efficacy that they gain from a supportive institutional culture (Fleming & Smith, 2013). Additionally, undergraduates at HSIs benefit from co-curricular experiences such as research opportunities, as well as tutoring and other types of engagement on campus (Garcia & Hurtado, 2011). Garcia and Hurtado (2011) have further described issues that nontraditional students at HSIs in engineering might face, such as the need to work and major financial concerns. In general, however, the research on undergraduates at HSIs and other MSIs and HSIs has not unpacked the personal factors that impact nontraditional engineering students' overall success. Given the reality that many engineering undergraduates at HSIs are nontraditional students, further work that situates the nontraditional engineering students within the HSI context is needed.

Extant scholarship indicates that nontraditional students face attrition rates up to twice that of traditional undergraduates and graduation rates that are considerably lower than traditional students. Moreover, in STEM disciplines, while traditional students who leave these majors often change to different degree programs (Seymour & Hewitt, 2019), nontraditional students who depart STEM programs frequently leave colleges/universities entirely (Chen & Weko, 2009). Nontraditional students are also more likely to delay college enrollment or take fewer courses than their traditional counterparts as a result of their financial/employment or family obligations (Horn & Carroll, 1996; Goncalves & Trunk, 2014), potentially increasing their time to degree.

Minichiello (2018) notes that research on nontraditional students in *engineering* has typically only looked at age and enrollment status despite the complex challenges these students face, and offers that "consideration of additional nontraditional student aspects is important for understanding the nontraditional student experience in engineering" (p. 269). For instance, Andres & Carpenter (1997) note that for *commuter* students in particular, academic integration is more crucial than extra-curricular/social integration, since these undergraduates often do not have the time to interact socially on campus due to other obligations (Andres & Carpenter, 1997; Wengert, 2018). Financial challenges, as suggested earlier, are also pervasive for nontraditional students, increasing the probability that students will leave colleges/universities entirely (Bean & Metzner, 1985). More recent studies indicate that there may be a correlation between the *number* of hours that undergraduates work and their outcomes, suggesting that working more than 20-25 hours per week may have negative effects on students and significantly increase their risk of withdrawing from school (Bean & Metzner, 1985; Moulin et al., 2013; Hovdhaugen, 2015).

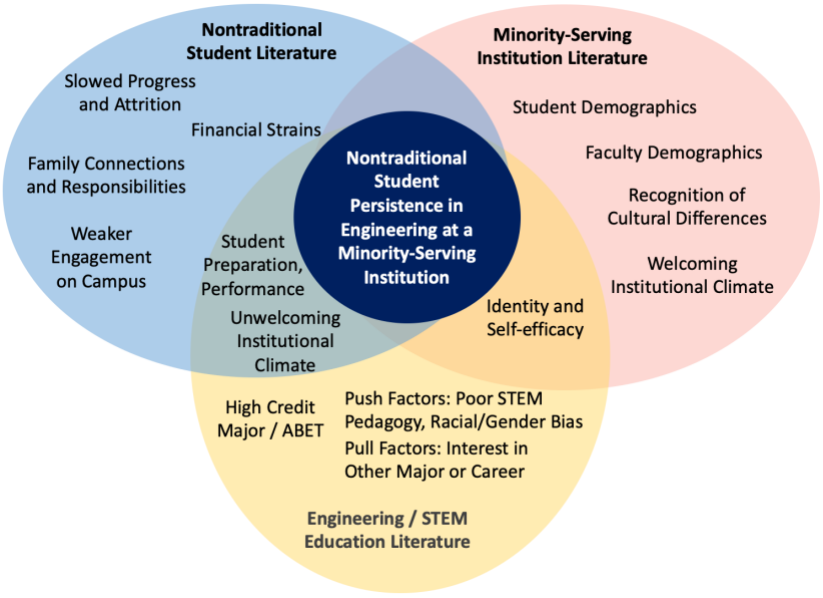

Figure 2: Overlapping Literature Bases Regarding Nontraditional STEM Students at HSIs

In conclusion, "there is evidence [in extant scholarship] to suggest that nontraditional students in STEM may encounter pronounced bias due to cultural norms existing within STEM disciplines" (Minichiello, 2018, p. 270). Nontraditional students in fields like engineering are navigating disciplines that celebrate competition, blame failure on the student rather than the institution, and do not consider the challenges that students from different demographic groups face (Minichiello, 2018). Therefore, undergraduates in general and BIPOC learners in particular who do not fit a *traditional* narrative may experience isolation and exclusion. However, most of the scholarship around nontraditional students tends not to emphasize aspects that are specific to engineering disciplines, BIPOC students, or MSI institutional contexts. In light of the disruption that COVID-19 has caused in engineering and across the entire landscape of higher education (El Masri & Sabzalieva, 2020), including disruptions in learning and co-curricular experiences for BIPOC undergraduates at many MSIs, scholarship on nontraditional students is especially relevant. A summary of the overlapping research bases that contribute to this topic are presented in Figure 2.

2. Research Questions

In this pilot research project, we employ a mixed methods approach to identify themes related to the persistence of nontraditional undergraduates in engineering and computing and identify institutional misalignments that affect their learning. This approach aims to improve the persistence of nontraditional students and offer insights that can be applied across other institutions. The research questions that we plan to address are as follows:

What factors and experiences impact nontraditional students' persistence in engineering at a large MSI?

- What challenges to persistence do nontraditional engineering students encounter at MSIs?
- How do nontraditional engineering students engage with MSI support structures and resources or respond to misaligned university infrastructure?

3. Research Method

3.1 Institutional Context

Florida International University is a public, research-intensive, Hispanic-Serving Institution (HSI) that graduates both the highest number of Hispanic students overall and the higher number of Hispanic engineering graduates of any college or university in the country (Gamarra, 2019). The diversity represented by institutions like Florida International University is particularly important because these demographics reflect the diversity that will likely be reflected throughout the US in the coming decades (Vespa et al., 2018). In addition, as we note in Section 4.1, a substantial number of Florida International University students in the College of Engineering and Computing (CEC) are nontraditional. Thus, any initiatives that better align Florida International University CEC infrastructure with nontraditional students have a high potential to broaden participation of URM students on this campus and offer transferable findings to other campuses.

3.2 Methods

We used a mixed methods research approach that combines elements of quantitative and qualitative research approaches together in a single study (Creswell & Plano Clark, 2018; Johnson & Onwuegbuzie, 2004; Johnson et al., 2007). Viewed as the "third methodological movement" (Tashakkori & Teddlie, 2003, p. ix), mixed methods research focuses on "breadth and depth of understanding" (Johnson et al., 2007, p. 123) and can provide a fuller picture of the phenomenon of interest (Johnson & Onwuegbuzie, 2004). The quantitative and qualitative data collected in the project cross-validate and corroborate each other (Creswell & Plano Clark, 2018; Greene et al., 1989).

Quantitative data collection consisted of a large data set of prior cohorts of nontraditional CEC students, assembled with the help of the Florida International University Office of Analysis and Information Management. The institutional data was compared to national datasets from the American Society for Engineering Education, American Association of Colleges and Universities, and National Student Clearinghouse Research Center.

To facilitate our qualitative data collection, we interviewed four nontraditional CEC undergraduates using a semi-structured protocol to understand factors that may impact their persistence, their interactions with university infrastructure such as advising and coursework, and their assessment of university support systems as being either aligned or misaligned with their unique needs. We also explored their identities as nontraditional students.

4. Findings

4.1 Quantitative Findings

The dataset included 63,294 CEC students enrolled between the 2009-2010 and 2015-2016 academic years. About half of the students received Pell grants (51%), about two thirds of the students were part-time (66%), and about a third were between 25 and 34 years old in their last term (34%). These figures are significantly higher than national data for part-time students (25%), students who are between 25 and 34 years old (22%), and students receiving a Pell grant (34%), respectively (Hussar et al., 2020; see Table 1). Although we do not include transfer status within our definition of *nontraditional*, over half (56%) of the CEC undergraduates during this period were transfer students. Florida International University supports the fifth-largest transfer student enrollment in the country, with most transfers coming from Miami Dade College (Gamarra, 2019; Miami Dade College, 2013). We thus reported descriptive statistics of first time in college (FTIC) undergraduates separate from that of transfer students (Table 1).

Our analysis revealed that the four-year graduation rate of all of these CEC students was 32% and the six-year graduation rate was 53%. Of all CEC students included in this data set, 44% were FTIC students. About half of these FTIC students received Pell grants (48%), over half were part-time students (60%), and most of them were between the ages of 18 and 23 years old (82%). The four-year graduation rate of the FTIC students was 14% and the six-year graduation rate was 46%. By comparison, just over half of the transfer students received Pell grants (54%), most of them were part time (71%), and most were older than 24 years of age (61%). The two-year graduation rate of transfer students in CEC was only 7%, the four-year graduation rate was 46%, and the six-year graduation rate was 59%. These quantitative data indicate that both FTIC and transfer students at CEC share similar attributes; they are part-time students, need more financial support, are older than traditional students, and many do not earn their degrees within four or even six years.

All of the CEC graduation rates are considerably lower than reflected in some national data sets (see Table 1). For instance, the national four-year graduation rate for engineering undergraduates is 32% (American Society for Engineering Education or ASEE, 2019), compared to just 14% at Florida International University. The six-year graduation rate for CEC and all engineering undergraduates in the US is nearly the same (ASEE, 2019), but lower than the comparable rate for graduates across all majors (American Association of Colleges and Universities or AACU, 2015; National Student Clearinghouse Research Center or NSCRS, 2020, see Table 1). As such, the traditional four-year and even six-year graduation rates may be misaligned to the academic and personal/financial/institutional realities that these students face, in comparison to their peers at other schools.

		Florida International University CEC Data			National Data	
		All Students	**FTIC Students**	**Transfer Students**	**Engineering Students**	**Undergraduate Students**
Nontraditional Demographics	**Part-time Students**	66%	60%	71%	Unavailable	25%
	Age 25-34 in Last Term	31%	9%	52%	Unavailable	22%
	Pell Grant	51%	48	54%	Unavailable	34%
Graduation Rates	**Two-Year**	N/A	N/A	7%	12% (transfer students)	16% (transfer students)
	Four-Year	32%	14%	46%	32%	41%
	Six-Year	53%	46%	59%	54%	66% (4-year, public)

Table 1. Comparison of Florida International University CEC Student Data and National Data (ASEE, 2019; AACU, 2015; NSCRS, 2020)

4.2 Qualitative Findings

Participant pseudonyms and population groups are included in Table 2. Student population group categories were developed through a combination of a participant recruitment survey and the content of the one-on-one interviews.

Participant Pseudonym	Student Population Groups
Barbara	Commuter, Transfer student, Hispanic woman
Ashley	Commuter, Lives at home, Woman
Rodrigo	Student worker, (> 20 hours) to support themselves, Hispanic man

Table 2: Pseudonyms and Student Population Groups

In the following sections we summarize the pilot data using key emerging themes.

Commuting/Living at Home

One experience that Florida International University was common among some of our participants but atypical for college students writ large is living at home with family and commuting to college rather than living in a dormitory. In spite of commuting being the norm, commuting creates challenges for students, such as Barbara:

> I think my biggest thing would be commuting to school, because I live an hour away. I forgot to mention— it takes me like about an hour and 22 minutes to get to school… It just makes you tired going to school. And then if I ever forget something at home, it's basically another hour drive to trying to get it and stuff like that. ~Barbara

The implied impact on students includes loss of time ("if I ever forget something at home, it's basically another hour drive") and energy ("It just makes you tired going to school"). The additional strain placed on these students may point toward implications for institutional policy changes. Although a university cannot move someone's house or shorten their commute, a number of programmatic and curricular aspects could be structured with commuting students in mind, such as allowing flexible and evening hours and remote access options for services and support. In addition, university constituents such as faculty members can stay mindful of the additional strain placed on commuting students as they plan their curriculum and activities. We conducted our pilot interviews remotely during the COVID-19 pandemic while Florida International University was shut down for most curricular activities. Many students who were typically commuting to campus were currently completing their studies at home. The pandemic shutdown magnified an issue that often already takes place for individuals who live at home:

> Being at home is very distracting. Like right now, my aunt has the washing machine on and it kind of is just always there. So I don't really have a quiet place. ~Ashley

The commuting and living arrangements of nontraditional students place additional burdens on them, such as the strain of finding a quiet location to study and access to WiFi and other resources. Once again, these aspects of students' lives are beyond the university's direct control, but the university does have a responsibility to help enable equitable access to students living at home to complete their studies, whether due to the pandemic or other factors faced by nontraditional students. Indeed, the COVID-19 environment has forced postsecondary institutions to create accommodations due to a critical need. A similar approach can be taken when considering the nontraditional student "environment" and the needs that these learners have.

Significant Part-Time Work

A second major theme for Florida International University nontraditional students is significant part-time work. While a small amount (10 or fewer hours) of academically-related (e.g., paid research, tutoring) work is demonstrated as neutral or beneficial for students with those jobs, a large amount (20+) of non-academically related employment is often noted as a challenge for persistence and retention. Rodrigo, who typically works more than 20 hours a week at a retail job describes how those challenges impact him:

> In Black Friday seasons, that's really, really tough and I was taking classes while working full time. Sometimes they were low on staff, I needed to do this stuff on the spot. I needed to be able to improvise a lot. […] So, I didn't really have days off, my days off I was doing homework and I really felt like all my days off were not really for resting, and more for studying. ~Rodrigo

The implied impact on student time and energy echo the comments from Barbara (the commuter student in the previous section). While commuting students choose to live at home for a slightly wider set of reasons, the reasons for Rodrigo to work this much were clearly financial. Thus, universities could consider how financial aid and keeping tuition costs low will help students like Rodrigo to focus on their studies to the same degree as his more traditional student counterparts.

Advising

The final theme that emerged from the pilot data dealt more directly with students' interactions with university systems. Here Rodrigo explains a frustrating experience he had with an undergraduate program director:

> I talked to the director who told me you're missing one class. They basically enrolled me in one class that was not the one I needed. I still need to figure out the issue. And they basically just washed their hands...I mean that's money, like the classes are not cheap. That's $2,000 lost. […] All of the administration made it hard for me to graduate. ~Rodrigo

While this experience of an advising mishap could have happened to any student, Rodrigo's financial circumstances exacerbated the problem. While working at a retail job to put himself through school, that tuition likely took 100 hours of his time in hourly wages and came at a major cost to his time and energy.

Later Rodrigo expanded on his frustration with advisors: "In my experience, tutors had knowledge and were prepared. I wish I could say the same things about the advisors." He also noted that the lack of availability was the biggest issue, requiring students to wait in long lines during regular business hours to get an appointment and a meeting. This setup is understandable given the staff role and the large student body they are trying to serve. As a possible proactive alternative, Rodrigo had a suggestion for an alteration

to advising: “Say a platform where the advisors are more available, maybe be able to meet with advisors online.”

5. Discussion and Future Work

From this pilot study we have adapted our interview protocol, noting that the term “nontraditional” includes several different student population categories that connect closer to the student experience than the term nontraditional itself. By extension, the interview protocol must allow for focus on the specific categories of experience that are most salient to the student as it relates to interactions with university systems and support structures.

Overall, the quantitative and qualitative data resulting from the pilot study provide us with an initial view into the backgrounds and experiences of nontraditional students in the CEC. It also offers methodological insights on how to examine the research questions addressed in this proposal. We will build on these initial findings to create surveys, revise interview protocols, collect larger-scale quantitative and qualitative data, design an intervention, and assess the effectiveness of the intervention.

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