Examining Academic Success and Retention of Post-Traditional Students in Engineering Undergraduate Programs

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Examining Academic Success of Post-traditional Students in Engineering Undergraduate Programs

Abstract

The purpose of this WIP paper is to examine the unique characteristics and challenges faced by underserved post-traditional students (formerly known as non-traditional students) in undergraduate engineering programs. The number of post-traditional students in higher education has increased rapidly during the past decade. Scholars have argued that many undergraduate students have characteristics of post-traditional students, therefore, post-traditional students have become the typical undergraduate students on college campus [1]. In this context, the term "post-traditional" has replaced "non-traditional" to describe this population. The literature has identified a few key characteristics of post-traditional students, such as individuals who start college at age 25 or older, attend college part-time, and have dependents. Despite the large number of post-traditional students, researchers in higher education and engineering education have devoted limited attention to this population. Additionally, extant scholarship has not unpacked the differences between this group of students and traditional students with respect to gender, race, and socioeconomic status. This study aims to fill this gap in the literature by investigating how post-traditional student characteristics and their demographics as well as the interactions of these variables affect students' academic performance in engineering undergraduate programs. It uses the institutional deidentified data in the 2023-2024 academic year of students in the undergraduate engineering programs at a large Hispanic-Serving Institution in the Southeastern U. S. The data were analyzed by using descriptive statistics, linear and logistic regressions, and moderation analyses.

The findings of this study enhance our understanding of the differences between traditional and post-traditional students from underserved backgrounds. By evaluating post-traditional students holistically, accounting for their unique characteristics, Hispanic Serving Institutes (HSIs) and other minority serving institutions can better support post-traditional leaners' academic success and persistence. This will contribute to a more equitable and diverse engineering workforce.

Introduction and Literature

Post-traditional student learners represent the fastest-growing segment of the college learners. This population, which includes groups like adult learners and individuals who support themselves financially, is very diverse and yet largely understudied. In the undergraduate engineering context, scholars and datasets typically do not consider the educational pathways of these students. Rather, the "normative" student is considered a first time in college (FTIC) undergraduate who recently graduated from high school, and has few encumbrances that would hinder his/her/their ability to be academically successful. Accordingly, infrastructure in undergraduate engineering programs is designed for these normative students, making them the archetype not only for how curricula and programs are structured, but also how colleges and schools of engineering define success.

Thus, efforts to broaden participation in engineering (BPE) for underserved racial and ethnic minorities, is, for example, framed around this normative student. By implication, BPE research does not consider what it means to, for example, be an Latine/x or Black adult leader or part-time student. For example, a fairly recent systematic literature review by Holloman et al. (2021) found that most BPE studies emphasized K-12 pathways to engineering degrees for Black students. None of the articles that the team uncovered in the literature review spoke to what it means to be a student who falls outside of this "norm." The irony here is that, as mentioned above,

undergraduates who do *not* take these traditional student pathways are actually *overrepresented* in higher education [13].

Building on prior work, we define post-traditional learners as students who: 1) Have delayed college enrollment by a year or more since completing high school; 2) Are enrolled part-time (less than 12 credits per semester); 3) Support themselves financially while in college; 4) Work full-time while enrolled in college; 5) Have dependents other than a spouse; 6) Are single parents; and/or 7) Earned a GED or other equivalent certificate rather than a high school diploma [14] . We also draw from Soares et al. [15] who recommend the use of the term "post-traditional" over the more-recognized "non-traditional" descriptor due to the rapid growth of this population. Indeed, post-traditional learners, scholars argue, are the new normal in higher education [1]. Post-traditional students (PTS) face unique challenges compared to their traditional, residential counterparts due to less campus interaction and the competing demands of work, family, and financial obligations [2]. Bean and Metzner's [2] model highlighted that limited academic integration and external pressures increase the likelihood of attrition among PTS, particularly as this population often comprises commuter students over the age of 25, typically enrolled part-time. Predictors of PTS success and persistence include GPA, stress levels, and external support systems, alongside academic factors such as clear career goals and practical connections between coursework and real-life applications [2] [3].

Moreover, while the term "post-traditional" is growing in usage, the better known label "non-traditional" is still much more widely accepted. Yet the term "nontraditional" has faced criticism for perpetuating inequities and perpetuating this deficit framing. By labeling these students, many of whom are from Historically Excluded Groups (HEGs) as "non-traditional," institutions risk fostering feelings of imposter syndrome and self-doubt while failing to create equitable educational opportunities [8]. Critics of this framing argue that the higher education system must move beyond token measures and adopt equity-minded, student-centered practices to better serve these populations, recognizing their contributions and addressing their unique needs [8] [9].

Within engineering education, predictors of student success are often linked to high school academic performance, standardized test scores, and grades in foundational courses such as Calculus and Physics [4] [5]. Studies have shown that first-year performance, particularly GPA, plays a crucial role in retention and graduation rates, alongside students' confidence in math and science abilities [6] [7]. Emphasis on these metrics primarily without attention to other factors like work and family responsibilities can lead to deficit framing of post-traditional students, for whom these metrics do not tell the "whole story." [11] [12]

Research questions

1. What are post-traditional characteristics of undergraduate engineering students at a large racially and ethnically diverse HSI?
2. What post-traditional characteristics have significant relationships with undergraduate engineering students' cumulative GPA at a large racially and ethnically diverse HSI?
3. To what extent do two post-traditional characteristics have significant interaction effects on undergraduate engineering students' cumulative GPA at a racially and ethnically diverse HSI?

Methods

Data Source and Sample

Data for this study comes from a large, public four-year Hispanic-Serving Institution (HSI) in the Southeastern State. The university offers over 12 engineering and computing majors. At present, the Engineering and Computing Program of the university enrolls more than 7,400

undergraduate students. In the 2023-2024, the program awarded over 1,600 bachelor's degrees. Approximately 21% of the bachelor's degrees went to female students. About 65% of engineering and computing bachelor's degree graduates identified as Hispanic, while 9% of engineering and computing bachelor's degree graduates identified as Black. To address this study's research questions, we limited the institution data to undergraduate students of engineering majors in the 2023-2024 academic year, resulting in the sample size (N = 7, 089). The university institutional staff assisted in creating the institutional dataset with our request. All data was de-identified before data analysis.

Measures

The institutional data include students' enrollment status (full-time or part-time), whether or not they had dependents, and students' age at first matriculation. These were directly used in the analyses. We used the following measures or proxies when the direct measures were not available for the eight characteristics of the post-traditional students identified in the literature. More specifically, 1) we used student age at first matriculation as a way to represent whether students delay college enrollment by one year or more; 2) we treated students who all live off campus as commuter students; 3) we treated students who are not married but have children as single parents; 4) we used students' earned income of $26,000 as the threshold for working full time based on the FAFSA guidelines [10]; 5) we used the combination of students' earned income of $26,000 and Pell eligibility as a proxy for supporting students financially while enrolled or students' financial independence.

Data Analysis

A few of our variables are dichotomous variables in the original dataset, such as gender, enrollment status, dependent status, and on-campus housing. We coded the variables that used proxies into dichotomous variables, with 1 being students with the characteristic and 0 being students without characteristic. For example, we recoded students' matriculation age into two categories: we used 1 to represent students who were 25 and old at first matriculation and 0 to represent students who were 24 and younger at first matriculation.

We employed regression analysis with non-confounding student post-traditional characteristics to answer our second research question. For instance, because whether students were aged 25 or above at first matriculation and delaying college enrollment by one year or more are from the same variable, we only included the former in the analysis. In the same vein, because financial independence and work full-time are determined by the same variable, we only included work full-time in the analysis. Additionally, we included students' background variables that the literature often shows to have significant effects on students' academic outcomes, such as gender, race, transfer status, in the analyses so that we can see their effects and the unique effect of each post-traditional characteristic on the outcome variables. For our third research question, we conducted interaction analyses to examine whether the interaction between students' enrollment status (full-time vs. part-time) and their matriculation age had a significant effect on CGPA.

Results

RQ1- What are post-traditional characteristics of undergraduate engineering students at a large racially and ethnically diverse HSI?

The sample includes 7,089 undergraduate students in all engineering programs at a southeastern institution for the 2023-2024 academic year. Over half of the students are first time in college (FTIC) students, while about 40% are transfer students from community colleges. There are more male students (78.6%) than female students. Most students are Hispanic (66.7%), and about 10% of students are black, 8% White, 4% Asian American, 2% multiple races, and less

than 1% American Indian or Pacific Islander. In terms of post-traditional student characteristics, over a third (38.9%) of all of these students are part-time learners, and about 15% matriculated at 25 years old or above (see Table 1). About 3% of students have full-time jobs while enrolled, and about the same percentage of students have children. About 1% of students are single parents, and about the same percentage of students have dependents other than children. Other characteristics of this student sample that are worth noting are: about half have Pell eligibility, and about a third have an associate's degree (see Table 1 for a full set of descriptive statistics associated with undergraduates included in this dataset).

Table 1. Descriptive Statistics of Sample

	Yes	*No*	*Not Reported*					
Pell Eligibility	3,381 (47.7%)	3,708 (52.3%)						
Off-Campus Housing	6,538 (92.2%)	551 (7.8%)						
Married	241 (3.4%)	4,772 (67.3%)	2,076 (29.3%)					
Dependents	54 (0.8%)	4,959 (70%)	2,076 (29.3%)					
Children	182 (2.6%)	4,831 (68.1%)	2,076 (29.3%)					
	Part-Time	*Full-Time*						
Enrollment	2,759 (38.9%)	4,330 (61.1%)						
Admission	*CC Transfer*	*FTIC*	*Other Transfer*	*Non-FTIC*				
	2,678 (37.8%)	3,347 (47.2%)	948 (13.4%)	116 (1.6%)				
Gender	*Female*	*Male*	*Not Reported*					
	1,515 (21.4%)	5,573 (78.6%)	1					
Ethnicity	*White*	*Hispanic*	*Black*	*Asian*	*Multiple*	*American Indian*	*Pacific Islander*	*Others*
	547 (7.7%)	4,730 (66.7%)	775 (10.9%)	300 (4.2%)	117 (1.7%)	3	3	614 (8.7%)
Degree	*AA*	*AS*	*HS*	*No Degree*				
	2,473 (34.9%)	119 (1.7%)	3,729 (52.6%)	768 (10.8%)				
Age	*15-24*	*25*	*26-30*	*31-40*	*41-50*	*51-61*		
	6,002 (84.7%)	205 (2.9%)	531 (7.5%)	282 (4.0%)	54 (0.8%)	15 (0.2%)		

Note. Dependents refer to individuals who are not students' children but rely on students for financial support and/or care, typically a parent, or a relative.

Intersectionality between racial minority status and post-traditional student characteristics was also observed in this sample. Racially minoritized students altogether accounted for 91% of part-time students, 83.5% of students who matriculated at 25 years old or above, 83.7% of students who are working full time while enrolled, 84.6% of students with children, 92% of students who are single parents, and 100% of students who have dependents. It follows that many other HSIs and potentially other MSIs may have similar populations that are not only racially/ethnically diverse, but also are largely post-traditional.

RQ2-What post-traditional characteristics have significant relationships with undergraduate engineering students' cumulative GPA at a large racially and ethnically diverse HSI?

For multiple regression analysis we conducted to answer RQ2, the results (see Table 3) indicate that gender, race, and transfer status were significant predictors of students' CGPA. Two post-traditional student characteristics—enrollment status and matriculation age—are significant predictors of CGPA, suggesting that enrolling as a part-time student negatively predicts CGPA while being an older student positively predicts CGPA. Among these significant predictors, students' enrollment status had the strongest effect, followed by transfer status and race. The effects of gender and matriculation age were identical. Other post-traditional student characteristics are not significant, suggesting that students' CGPA would be similar, regardless of whether they have dependents, are single parents, work full-time or live off-campus.

Table 3. Multiple regression analysis of CGPA and post-traditional student characteristics

Predictor	B	SE	*b*	*t-value*	*p*
(Constant)***	3.331	.048		68.810	<.001
Gender***	.077	.023	.047	3.365	<.001
Race***	-.159	.037	-.060	-4.298	<.001
Transfer Status***	-.180	.021	-.133	-8.548	<.001
Enrollment Status***	-.227	.020	-.163	-11.438	<.001
Matriculation Age*	.071	.032	.038	2.238	.025
Dependents	-.153	.093	-.023	-1.645	.100
Single Parents	-.036	.078	-.007	-.458	.647
Work Full-Time	.028	.035	.012	.787	.432
Housing	.054	.036	.021	1.495	.135

*** $p < .001$ *$p < .05$ ($R^2 = .052$)

The interaction effect of matriculation age and part-time student status on CGPA

The results of the first model without the interaction indicate that only students' part-time student status has a significant relationship with CGPA, but its effect was negative. The results of the second model including the interaction of matriculation age and enrollment status indicated a significant interaction (see Table 5). There is also a significant difference between the model without interaction and the one with interaction ($F(1,7077) = 13.52$, $p < .001$). The simple slope analysis shows that when students enroll full-time, there is a significant but negative relationship between matriculation age and CGPA, suggesting matriculating at an older age negatively affects CGPA. However, when students enroll part-time, there is a significant positive relationship between matriculating at an older age and CGPA, suggesting that being an older student may be a protective factor for part-time students (Table 6). Further, Figure 1 shows that although full-

time students' CGPA are in general higher than part-time students' CGPA, older, part-time students' CGPA increased while older, full-time students' CGPA decreased, leading to smaller differences in CGPA between full-time and part-time older students.

Table 5. Interaction of matriculation age and part-time on CGPA

Model 1					
Predictor	B	SE	*b*	*t-value*	*p*
(Constant)***	3.185	.010		308.898	<.001
Matriculation Age	.019	.022	.010	.856	.392
Part-time***	-.272	.017	-.196	-16.418	<.001
Model 2					
Predictor	B	SE	*b*	*t-value*	*p*
(Constant)***	3.194	.011		301.394	<.001
Matriculation Age*	-.078	.035	-.042	-2.257	.024
Part-time***	-.298	.018	-.215	-16.543	<.001
Interaction***	.167	.045	.073	3.677	<.001

Table 6. Simple slope analysis

Simple Slope Analysis of Matriculation Age When Students Enroll Full-Time				
Predictor	B	SE	*t-value*	*p*
Matriculation Age*	-.08	.03	-2.26	.02
Simple Slope Analysis of Matriculation Age When Students Enroll Part-Time				
Predictor	B	SE	*t-value*	*p*
Matriculation Age***	.09	.03	3.02	.00

* $p < .05$; *** $p < .001$

Figure 1. Matriculation Age* Part-time on CGPA

Notes. The solid and dotted lines do not indicate enrollment status is a continuous variable. Solid line shows part-time students, 0 in the solid line indicates part-time students who matriculated at 24 years and younger, 1 in the solid line indicates part-time students who matriculated at 25 years and older. Dotted line shows full-time students, 0 in the dotted line indicates full-time students who matriculated at 24 years and younger, 1 in the dotted line indicates full-time students who matriculated at 25 years and older.

Discussion and Implications

Post-traditional students are at times framed in a negative way, with engineering faculty holding beliefs that are very deficit oriented [11]. Given the well-known pervasive challenges that impact *traditional* learners from underserved backgrounds in engineering, this additional layer of negative framing has considerable implications. This framing can suggest that post-traditional learners who are also members of underserved racial/ethnic minority groups are especially prone to stereotyping, microaggressions, and other issues. With that as background, this article depicts post-traditional learners from these groups who are actually performing relatively well. In particular, the data indicate that being older and a part-time student, for example, actually has a positive impact on students' GPA.

Considering within-group differences has some immediate implications. First, one might imagine that advising can and probably should look different for older, part-time students in engineering. This group may not have the time to engage fully with school and should not be pressured to do so in order to meet the university's definition of "success." Rather than push this group, for example, to take 12 credits per semester, it would be useful to remember that part-time, older, and other post-traditional students are different. Second, as Berhane and colleagues learned in their prior study with community college/transfer students, part-time or older students may not have the advantage of participating in groups like the Society of Professional Engineers or the American Society of Mechanical Engineers. Thus, colleges of engineering should reimagine and reconceptualize what it means to be an engineering student in light of the competing demands that post-traditional learners face.

Finally, while post-traditional students in general may take longer to graduate and have slightly lower GPAs than their traditional student counterparts, their post-traditional status seems to have an overall positive effect on what is often framed as gaps. Opportunity, and previously, achievement gaps have long been lamented across the educational ecosystem. HEGs have often been compared, and often unfairly and without proper context, to majority students. Contrary to that line of argumentation or conceptualizations, being post-traditional seems to remove these gaps from having any sort of significance. That is, when post-traditional students are separately analyzed, in this study there is no longer evidence of a gap. Post-traditional students more broadly may therefore be an inspiring group of students to study for scholars seeking to find ways of conceptualizing "a level playing field" in engineering education.

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