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# Engineering Pathways of Nontraditional Students—an Update on NSF Award 1361058

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### Major Goals of the Project

The research on nontraditional students aims to add to the diversity as well as increase the quality and quantity of engineering baccalaureate degree recipients. In a broader sense, our long-term goal is to identify pathways to diversify the composition of the engineering profession and to increase the academic and professional success of engineering undergraduates from a broad range of backgrounds, interests, and experiences.

### Specific Objectives

The research on nontraditional students specifically focuses on answering the research questions below.

**A. What are the demographic characteristics of nontraditional engineering students?**

- What is the composition of the nontraditional student population in terms of gender, transfer, age, ethnicity, and other factors?
- What is the typical curricular entry point for nontraditional students?
- Do nontraditional students differ from traditional students in terms of performance (graduation, time to graduation, GPA), demographic characteristics, and other factors?

**B. What pathways do nontraditional engineering students take?**

- What majors do nontraditional students take after matriculating/articulating?
- Do their pathways vary by gender or other characteristics? Do they change majors less or more often? Do they take more or fewer credits than would be expected? Are women more likely to follow a non-linear path than men?
- Are nontraditional students more likely than traditional students to persist in engineering and/or to graduate?
- Are different paths (e.g., certain majors) more likely to be associated with successful outcomes (such as timely completion of an engineering degree) for nontraditional students?
- Are there differences between nontraditional and traditional students in regard to time to degree or time to attrition?
- Are nontraditional students more likely than traditional students to have better course performance or to receive higher grade-point averages?

## Major Activities

Many researchers have defined nontraditional students as being over the age of 24,[1-7] and this is the definition that is used in the present study.

***The Population Studied in This Work.***

Relevant to the current study, MIDFIELD includes data from 6,330 engineering students who are over the age of 24, of whom 2,751 graduated in engineering. Many more students—17,069 students ever enrolling in engineering—were classified as part time students. There are 1,678 students who are in both groups, which will allow some exploration of different degrees of nontraditional status as defined in an earlier NCES study.[8] Thus, the MIDFIELD database includes 21,721 students who were either over the age of 24 or enrolled part time, comprising 10% of the 218,901 students in the database who ever enrolled in engineering. These numbers are large enough to permit meaningful analysis and are even large enough to disaggregate to explore effects by race/ethnicity, gender, discipline, and institution—although it will not be possible to disaggregate by all four simultaneously. Some MIDFIELD institutions enroll reasonable numbers of commuter students, but MIDFIELD does not include a designation to identify those students.

A further 52,131 engineering students are included in MIDFIELD for whom no age was reported, of whom 14,807 graduated in engineering. We will seek data updates to fill in values where data are currently missing.

Of the total MIDFIELD population, this work focuses on the 141,125 students who ever declared engineering as a major and have sufficient data in MIDFIELD to calculate six-year graduation rates. Nontraditional students (NTS) make up 3.2% (4,500) of the group studied. In this paper, nontraditional students are defined as students who have surpassed their 24$^{th}$ birthday at first matriculation to the institution. Traditional students (TRS) are defined as being younger than 24 at first matriculation. MIDFIELD institutions offer several matriculation pathways.[9,10] We study students in multiple pathways: First-time in College students (FTIC) who matriculate directly into engineering (ENGR), FTIC students who matriculate in other majors and migrate into engineering (NonENGR), and transfer students (TFXR) who have previously attended another college or university and make their way into engineering. In this paper, graduation is defined as having graduated by the sixth year from matriculation, following a standard of reporting by the Integrated Postsecondary Education Data System (IPEDS).[11] Graduation time for transfer students is calculated using transfer hours accepted by the institution, student level at first matriculation and where in the curriculum the transfer student begins. Fulltime/Part-time status is determined by the average of attempted credit hours taken each term. Having an average of less than 12 attempted credit hours per term classifies the student as Part-time. Having an average of 12 or more attempted credit hours per term classifies the student as Full-time.

## Significant Results

### *Nontraditional student access*

Non-traditional students represent approximately 10% of all enrolled students at MIDFELD institutions, a number that is relatively stable over a large number of cohorts. While the NCES reports that 33% of undergraduates enrolled part time for at least one semester, the MIDFIELD designation that a student is part time is one assigned by the institution as a characteristic of the student rather than one that changes each semester based on the student's credit load, so the actual incidence of part-time enrollment using the NCES definition would be higher. Similarly, the NCES definition of delayed enrollment is based on whether a student enrolls in undergraduate education in the same year they graduate high school, which is broader than the definition based on age alone. Again, the actual incidence of delayed graduation using the NCES definition would be higher. MIDFIELD contains no data to create an operational definition of any of the other nontraditional characteristics. As a result of these differences, it is difficult to determine to what extent the MIDFIELD institutions are representative of other U.S. public four-year institutions. Even within MIDFIELD, nontraditional student enrollments are certainly not distributed uniformly by institution—on average, 4-5% of student enrollment is nontraditional by age, but the percentages range from 1% to 25% by institution.

Of the 6,330 nontraditional students ever enrolled in engineering, 80% started in engineering, compared to 87% of traditional students—yet equal fractions of graduates in both populations started in engineering. It may be that nontraditional students who switch into engineering are not prepared for it or that nontraditional students explore a wider range of academic pathways before selecting a major. These possibilities raise interesting questions about nontraditional students and their fit with engineering and highlight the need for further study. Considering students who switch into engineering after matriculating in other disciplines, another important question arises. While 37% of traditional students who switch into engineering graduate in engineering, only 16% of nontraditional students who switch into engineering make it to graduation. This suggests that nontraditional students face additional barriers that limit their ability to switch into engineering. It will be valuable to explore disciplines and institutions that provide nontraditional pathways, since the NCES reports that U.S. students are increasingly nontraditional.

### *Nontraditional student graduation rates and time-to-graduation*

Table 1 shows the graduation rates in percentages of students who ever enrolled in engineering and graduated within six years of matriculation. NTS graduate in six years at a higher rate than TRS. Part-time graduation rates are similar between the groups. NTS graduate 7.2 percent higher than TRS. The lowest graduation rate is TRS NonENGR TFXR at 17.6 percent. The highest graduation rates came from the group of students that declared ENGR as soon as the institution let them declare a major. NTS had higher graduation rates as TFXR and FTIC than TRS FTIC.

**Table 1**: Six-year graduation rates for students who ever declared ENGR as a major and graduated in engineering.

| | Full-time | Part-time | All |
|---|---|---|---|
| TRS ENGR TFXR | 58.5 | 42.6 | 56.2 |
| NTS ENGR TFXR | 64.0 | 27.7 | 55.1 |
| NTS ENGR FTIC | 57.9 | 36.8 | 52.8 |
| TRS ENGR FTIC | 48.8 | 38.0 | 48.1 |
| NTS NonENGR FTIC | 48.1 | 41.7 | 47.0 |
| NTS NonENGR TXFR | 41.6 | 16.3 | 37.8 |
| TRS NonENGR FTIC | 33.1 | 9.9 | 31.2 |
| TRS NonENGR TFXR | 20.8 | 7.4 | 17.6 |
| All NTS | 60.4 | 27.6 | 52.8 |
| All TRS | 47.0 | 31.7 | 45.6 |
| All TXFR | 52.2 | 30.4 | 48.4 |
| All FTIC | 46.1 | 32.1 | 45.1 |
| All Students | 47.4 | 31.4 | 45.9 |

**Table 2**: Time (in years) to graduation.

| | Full-time | Part-time | All |
|---|---|---|---|
| NTS ENGR FTIC | 3.1 | 3.3 | 3.2 |
| NTS NonENGR FTIC | 3.2 | 5.0 | 3.5 |
| TRS ENGR FTIC | 3.9 | 4.0 | 3.9 |
| NTS ENGR TXFR | 4.1 | 5.3 | 4.2 |
| TRS NonENGR TFXR | 4.2 | 4.5 | 4.2 |
| TRS ENGR TFXR | 4.2 | 4.8 | 4.3 |
| TRS NonENGR TFXR | 4.9 | 5.0 | 4.9 |
| NTS NonENGR TXFR | 5.0 | 5.1 | 5.0 |
| All TRS | 4.0 | 4.3 | 4.0 |
| All NTS | 4.1 | 5.1 | 4.2 |
| All FTIC | 3.9 | 4.0 | 3.9 |
| All TXFR | 4.2 | 4.9 | 4.3 |
| All Students | 4.0 | 4.4 | 4.0 |

NTS and TRS take similar time to six-year graduation. Part-time students have the largest difference between time to graduation (0.8 year). TRS and NTS NonENGR students take the longest time to graduate.

***Nontraditional students and the transfer pathway***

Transfer students have attended another institution before being admitted to their current university. Typical of MIDFIELD studies, institutional definitions prevail—a student is designated as a first-time student or a transfer student when the institution transmits the data. Generally, a student is a transfer student if 30 or more credits are transferred to the receiving institution from a single previous institution. As a result, students may receive large numbers of credits from Advanced Placement, dual enrollment, and other pathways and still be designated as a first-time-in-college student. Table 3 shows that the fraction of the nontraditional population entering as transfers varies by institution from 26% to 94%. Institutions with a higher fraction of nontraditional students tend to enroll a lower fraction of nontraditional students through the transfer pathway—some institutions seem to have policies or recruiting procedures that reach out to nontraditional students beyond the transfer pathway.

**Table 3:** Institutions with more nontraditional students rely less on the transfer pathway.

| Institution | Nontraditional fraction of engineering students | Transfer fraction of nontraditional engineering students |
|---|---|---|
| A | 8% | 94% |
| B | 15% | 92% |
| C | 2% | 90% |
| D | 6% | 75% |
| E | 7% | 70% |
| F | 10% | 68% |
| G | 18% | 66% |
| H | 14% | 54% |
| I | 11% | 42% |
| J | 12% | 31% |
| K | 28% | 26% |

***Nontraditional student grades***

As published in Frontiers in Education 2014, non-traditional students have a higher mean grade (2.92) than traditional students in the same classes (2.84). While the result is statistically significant, the effect size is small.

***The diversity of nontraditional students***

Adding to institutional variability, nontraditional students enter exclusively as transfer students at some institutions, while at other institutions 25% of first-time-in-college students are of nontraditional age. Nontraditional engineering students are significantly more likely to have entered MIDFIELD institutions as transfer students. While 19% of traditional students are transfers, 58% of nontraditional students are.

Because they are different from traditional students, nontraditional students by definition contribute to the diversity of an institution, to the engineering student body, and the engineering profession after graduation. It is relevant to ask whether nontraditional students are more diverse than traditional students in other ways. The nontraditional student body is 20% female, which is typical of U.S. engineering enrollments. As in our earlier work, however, results can vary when the intersection of race/ethnicity and gender are considered. Table 4 shows the distribution of race/ethnicity and gender of the nontraditional and traditional engineering students. Native American, Other, and Unspecified are omitted.

**Table 4:** The demographics of nontraditional and traditional engineering students.

| Race/ethnicity and Gender | Nontraditional engineering students | Traditional engineering students |
|---|---|---|
| White Male | 54% | 59% |
| White Female | 17% | 17% |
| Black Male | 9% | 6% |
| Asian Male | 4% | 5% |
| International Male | 4% | 4% |
| Black Female | 4% | 4% |
| Hispanic Male | 3% | 3% |
| Asian Female | 1% | 2% |
| Hispanic Female | 1% | 1% |
| International Female | 1% | 1% |

Thus, nontraditional and traditional engineering students have a similar distribution of race/ethnicity and gender. A careful examination reveals that the nontraditional population has a lower fraction of White males and Asian students and concomitant gains in the fraction of Black males. Noting the severe underrepresentation of Black males and their low graduation rates in engineering,[12] nontraditional students may represent an untapped source of this underserved population.

**How have the results been disseminated to communities of interest?**

The research on nontraditional students has been published and presented at two academic conference proceedings. American Society for Engineering Educators in 2014 at Indianapolis, Indiana called “Nontraditional Student Access and Success in Engineering” and Frontiers in Education in 2014 at Madrid, Spain called “Getting Better With Age: Older Students Achieve Higher Grades and Graduation Rates”.

**What do we plan to do during the next year to accomplish the goals?**

The researchers plan on investigating the relationship between economic status and nontraditional students to see if it is significant. There will be further investigation as to determining if the institution is a contributing factor. The researchers plan on finishing a journal paper and submitting for publication in 2015. They also plan on submitting a paper to the Frontiers in Education Conference in 2015.

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