

Stickiness of Nontraditional Students in Engineering

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STICKINESS OF NONTRADITIONAL STUDENTS IN ENGINEERING

Introduction

Defining academic success for undergraduate students has been widely debated among many disciplines, as there are many metrics available to researchers attempting to quantify such a construct (Ohland et al., 2011). Existing metrics of success in academic programs include six-year graduation (Carey, 2005; Horn, 2006), eight-semester persistence/attrition (Astin & Astin 1992; Lord et al., 2009; Ohland et al., 2008; Seymour & Hewitt, 1997), and integrative multi-measure metrics that rely on a “blending” of more than one measure as a prediction of student success (Alvord, 2004; Kroc, Howard, & Hull, 1997) as examples (Ohland et al., 2011).

Generally speaking, these measures are used to define not only the success of students, but the success of academic departments (Atwood & Pretz, 2016). Despite the wide use of these metrics in the literature for defining student and disciplinary success, these metrics fail to paint the full picture of success within an academic department, including engineering.

The metrics of success have been applied to nontraditional students (NTS) to determine how well they do in higher education (e.g., Yates, 2001). According to reports published by the National Center for Educational Statistics (NCES), 72.6% of all undergraduates, across all types of undergraduate institutions, are in some way nontraditional (Choy, 2002). This initial figure, however, is a bit misleading at first glance. Per the NCES report, NTS are ranked by level based on how many nontraditional characteristics they possess broken down into minimal, moderate, and high (Choy, 2002). The NTS characteristics include being married, part-time student status, financial independence, having dependents, single-parent status, no high school diploma, taking a significant break after high school or during college, being age 25 or older, and working full time. Under this ranking system, minimally NTS have one nontraditional characteristic, moderately NTS have two or three, and highly NTS have four or more characteristics (Choy, 2002). Recent reports have indicated that 67% of college students now hold a job during their enrollment (Carnevale, Smith, Melton, & Price, 2015), thus making them at least minimally nontraditional. Further discussion of NTS will only refer to moderate and high levels of nontraditional characteristics, based on the previously cited information about undergraduate employment related to those students being minimally NT. The importance of studying success of NTS cannot be stressed enough. Choy’s (2002) report is an example of the use of both metrics of student success as NTS, although it utilizes a five-year, instead of six-year, graduation model and a three year (i.e., six-semester), instead of eight-semester, attrition model.

NTS are a population of students that may sometimes need support, just like traditional students do, but they do not have access to the same support of traditional students because of how the university system operates. Because NTS are balancing additional responsibilities, beyond the responsibilities of traditional undergraduate students, university faculty and administrators can help NTS if they have a better understanding of this population (Brown, 2002). Previous work has shown that NTS students are as successful in engineering as traditional students (McNeil, Ohland, and Long, 2015).

Stickiness as a metric of success

Stickiness is a relatively new metric that has been proposed to gauge the long-term success of academic programs (Ohland, Orr, Layton, Lord, & Long, 2012). This metric is touted as a way to determine how much students “stick” to a particular major once it is their chosen course of study (Ohland et al., 2012). Stickiness of any degree program, currently, is calculated by dividing the number of students that graduate from a specific major by the number of students that have declared that major at any point in time and is expressed as a percentage (Ohland et al., 2012). Additionally, the researchers that proposed this metric applied it to many different sub-groups to see which ones tend to stick to a particular program. As it currently stands, Ohland and colleagues (2012) have found that industrial engineering has the highest level of stickiness and that stickiness is less variable for transfer students than for first generation (FTIC) undergraduate students. A general overview of recent data using the stickiness metric can be found in *Figure 1* below.

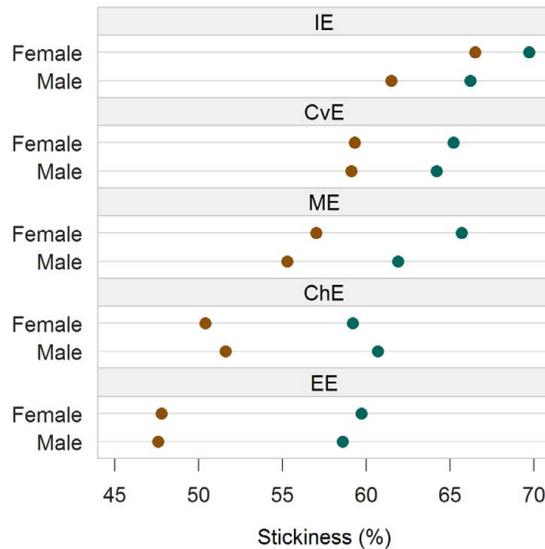


Figure 1. Stickiness by major and gender in engineering (Lord, Layton, & Ohland, 2014, page 4)

Additional research has also employed the stickiness measure as a metric of student success. For example, research on longitudinal success rates in Civil and Mechanical Engineering students has used stickiness as a metric to gauge the differences between genders and ethnicities in these fields (Ohland, Lord, & Layton, 2015; Orr, Lord, Layton, & Ohland, 2014). The present study will apply the metric of stickiness to NTS to show trends within this population of students.

Data Selection

Numerous longitudinal studies on engineering education have been conducted through the Multi-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD; e.g., Orr et al., 2012). MIDFIELD is an excellent database for conducting longitudinally-designed studies on trends in engineering education, as the database contains a sample of 1,014,887 undergraduate students from 11 different participating institutions (Ohland & Long, 2016). This database has been used to explore such topics as nontraditional student pathways to the engineering degree (McNeil & Ohland, 2015), age differences (McNeil, Long, & Ohland, 2014), and student socioeconomic status (Orr, Ramirez, & Ohland, 2011; McNeil & Ohland, 2015), to name a few. The MIDFIELD database comprises approximately 10 percent of all engineering graduates from U.S. institutions that attended between 1988 and 2009.

From almost a million data points in the database, 218,902 full-time engineering students were originally selected for the stickiness analysis. With the limitations of the MIDFIELD database, as it is virtually impossible to construct a database that includes every detail about its participants, NTS students were solely selected based on age (i.e., being older than 24). There included 6,330 participants that met the criteria of being full-time engineering students above the age of 24.

Stickiness of Nontraditional Engineering Students

The data selected for the NTS stickiness analysis was further cleaned to only include data for the most popular seven majors selected by NTS in engineering: Computer Engineering (CpE), Aerospace Engineering (AsE), Industrial Engineering (IE), Chemical Engineering (ChE), Electrical Engineering (EE), Civil Engineering (CvE), and Mechanical Engineering (ME). This study models Ohland and colleagues' (2012) original paper on stickiness, but we focus on nontraditional students instead of traditional students. Frequency data in *Figure 2* shows the number of students ever declaring a major in the selected disciplines (Ever), the graduation major (GradMajor), and the number of students that graduate within 6 years of matriculation at the institution (Grad6). The original trend in the stickiness metric between different engineering disciplines can be found in *Figure 3*.

| Discipline | Ever | GradMajor | Grad6 |
|------------|------|-----------|-------|
| CpE | 364 | 113 | 107 |
| AsE | 163 | 63 | 61 |
| IE | 159 | 60 | 60 |
| ChE | 350 | 145 | 141 |
| EE | 1239 | 555 | 531 |
| CvE | 682 | 335 | 313 |
| ME | 855 | 433 | 396 |

Figure 2. Frequency data for the most popular majors chosen by NTS with the number of students graduating in the major in total and over six years.

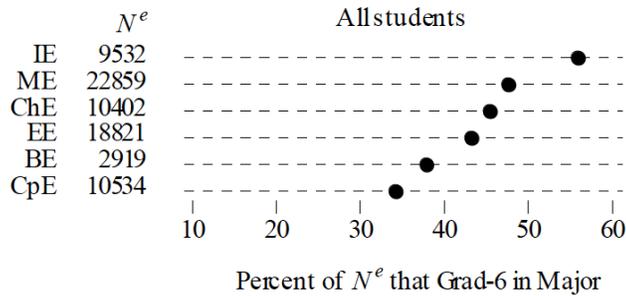


Figure 3. Representation of the data from the original stickiness paper (Ohland et al., 2012, page 3). The trend is a steady increase in stickiness between the disciplines; IE has the highest stickiness. N^e represents the number of students ever declaring a major in the discipline.

Among NTS, the original trend in stickiness is not a consistent match. As noted in *Figure 3*, the differences in the stickiness values for the different disciplines is mostly linear with IE having the highest value. For this study, as noted in *Figure 4*, there is still a linear trend between the disciplines but with Computer Engineering (CpE) being less than 30, which is lower than all other majors of NTS and traditional students. Aside from CpE being the lowest stickiness engineering discipline for both traditional and nontraditional students, another surprising finding was that Industrial Engineering has much lower stickiness for NTS than traditional students. Historically, Industrial Engineering retains female students at a much higher rate than the other engineering majors (Brawner, Camacho, Lord, Long, & Ohland, 2012), but that does not seem to be the case with NTS students, even though NTS has the same percentage of females as traditional students (McNeil & Ohland, 2015). It should be noted that stickiness in the values for NTS in their top-choice majors has a lower maximum value than the general student top-choice majors discussed in Ohland and colleagues' (2012) paper.

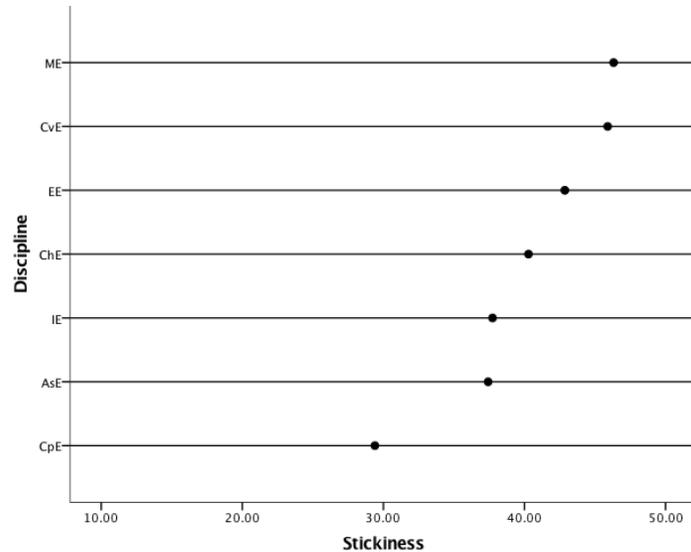


Figure 4. CpE shows the least stickiness for NTS. Variations in stickiness for the seven most popular majors chosen by NTS. Little variation is seen between the other disciplines.

Conclusion

NTS generally have similar stickiness values in their primary majors compared to the general student population, with the exception of industrial engineering. With NT engineering students showing similar stickiness values as traditional students, based on popular majors, this study provides further support for the fact that nontraditional engineering students are as resolute as traditional students in their major choice.

Earlier research has indicated that IE generally has higher stickiness values than other disciplines (Ohland et al., 2012), however this did not hold true for this research. In fact, IE was toward the lower end of the disciplines in terms of stickiness. As it appears, NTS tend to “stick” more to ME (mechanical) and CvE (civil) instead. This could be due to the popularity of traditional majors among nontraditional students, considering they choose mechanical, civil, and electrical at higher rates than traditional students (McNeil, Ohland, & Long, 2016). This paper focused on the stickiness measure for NTS students, and other statistical tests of prediction were outside the scope of this paper. Further research is needed to explore why NTS’ stickiness follows a different trend than traditional students.

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