

WIP: What's your major? First-year engineering students' confidence in their major choice

Katherine M. Ehlert, Marisa K. Orr, & Sarah Jane Grigg
Clemson University
marisak@clemson.edu

Abstract

In this work-in-progress study, the engineering identities of students enrolled in a first-year engineering (FYE) program were surveyed to investigate whether students identify with engineering (in general or with a specific engineering major) during their first year and how differences in identities impact intent to persist in engineering. Literature suggests a strong engineering identity is linked to student retention and can positively impact a student's trajectory within an engineering program. To investigate these interactions, a survey was distributed at a large public institution in the southeast at the beginning and end of the Fall semester. Most students reported they had decided on a specific engineering major even in the beginning of their first engineering course. While students are relatively confident in that major choice at the beginning of the year, their confidence increased by the end of the semester. Future work will invite students for interviews to elucidate understanding in how a student's views of the engineering profession affect their FYE experience and the role the FYE curriculum has in their anticipated engineering major and themselves as engineers.

Introduction and Background

A growing number of institutions require prospective engineering majors to participate in a first-year engineering (FYE) program. These programs typically restrict students from declaring a specific engineering major until they complete the FYE curricular requirements [1]. This study focuses on a single institution with a compulsory FYE program. While the requirements for admittance to specific engineering major differs, all FYE general engineering students are required to take a common sequence of first-year courses including calculus (2), lab science (2), general education (1), and general engineering (2) courses in the FYE program among other major specific program requirements. Students are advised by FYE advisors, who are a mix of faculty and staff from the general engineering program, until they are accepted into a degree-granting major, at which point the student is assigned an advisor within their new department, specific to their chosen major.

Recent studies have shown that students in FYE programs are more likely to persist to graduation in their first declared major relative to other matriculation models [2], [3]; however they did not state whether the first declared major was the only major they considered. The benefits of FYE discussed by Orr et al. [2] focused on the support the students receive through knowledgeable advisors. They also suggest that an ideal matriculation model would include experiences for students to associate with engineering yet retain some curricular flexibility to ensure students who switch or transfer into engineering are not kept out. Additionally, Brawner et al. [4] documented the benefits of introductory engineering courses for supporting student retention in engineering by either helping affirm a student's intended major or introducing them to an engineering major more aligned with their interests.

Providing a supportive environment that introduces undergraduates to engineering concepts, like those seen in FYE introductory courses, might be the key to sparking the development of an engineering identity. Studies have shown that engineering identity can have positive impact on the recruitment and retention of future engineers [5], [6] and it has been an increasing area of interest for engineering education researchers [7], [8]. The identity construct has been operationalized in engineering education research in various ways and researchers have focused on a number of different identity lenses when analyzing their data including the perceptions of self or profession [7]. In this study, we focus on the perception of engineering because we hope to gain understanding of how FYE students perceive themselves, their intended major, and the profession of engineering in general.

Previous work has documented relationships between how people perceive themselves, the profession of engineering, and their resultant engineering identities [9]–[12]. Our study uses the lens of professional identity and relies on the work of Beam et al. [9] and Dehing, Jochems, and Baartman [10] as guidance for our inquiry as these studies focused on how individuals perceive engineering and themselves within that profession. Overall, our research questions are listed below and we will specifically answer question (1) in this paper.

- (1) How confident are first-year engineering students in their intended major?
- (2) What do students in a FYE program believe their major is?
- (3) How does this perception of major impact their sense of fit and satisfaction?
 - a. Within engineering in general?
 - b. Within their intended engineering major?
- (4) How do students view the FYE curriculum related to their intended engineering major?

This work is a subset of a larger project that is exploring how students navigate engineering curriculum pathways and make adaptive decisions in major choice. Our research team has developed a survey to evaluate fit, satisfaction, and intent to persist in engineering; however, it is unknown how FYE students are interpreting these prompts in our survey. Therefore, we seek to understand how students identify as engineers and how the student's beliefs associate with responses to survey questions.

Methods

FYE Survey

A survey was distributed to over 1300 FYE students at a public, land-grant institution in the southeast at the beginning and end of the fall semester to determine their intended major, fit and satisfaction within their degree program, and intent to complete the engineering program. Students were offered extra credit for completing each survey within 10-days of administration. To ensure that every student could earn the extra credit, students who were under 18 years of age could participate in the survey, but their entries were removed prior to analysis.

Preliminary Results

Analysis includes only responses from participants over the age of 18 who consented to connecting their survey responses with their academic data. Approximately 580 responses for

each distribution of the survey were used for analysis (Fall Start = 585, Fall End = 586). Of these, 361 students completed both surveys. In general, students became more confident of their choice of major as the semester concluded, in some cases students changed their intended major throughout the semester.

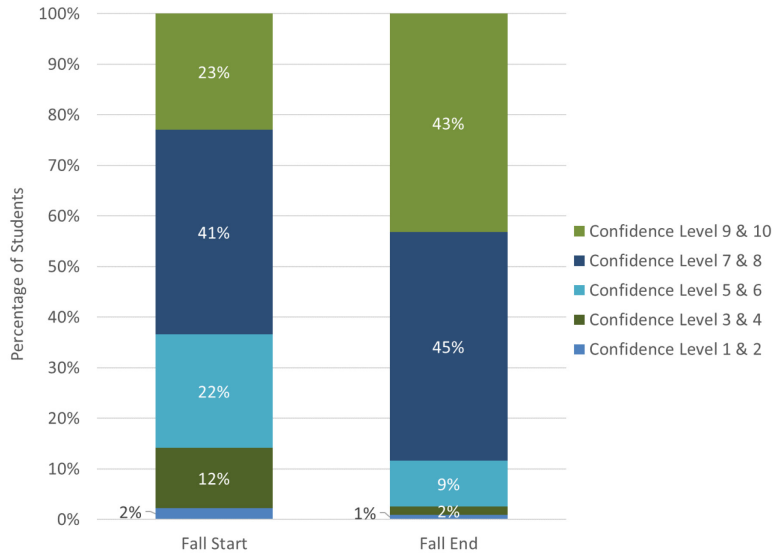


Figure 1: Student rated confidence in their intended major (rated 1 - 10) at the start and end of the fall semester. Participation in each survey deployment was voluntary.

Future Work

Initial survey results show that we should be seeking participation in these think-aloud interviews shortly after the fall semester begins. The data indicates that more students are more confident in their major choice at the end of the fall semester. Future work will include a think-aloud interview protocol asking students to explain what they were thinking about their major as they were responding to the survey. We anticipate two general outcomes of this work. First, this work will help improve the language used in surveys for FYE students to ensure that participants are consistently interpreting prompts that evaluate fit, satisfaction, and anticipated plans to complete the program. Additionally, this work will also help elucidate how students in FYE programs see that program relating to their discipline-specific engineering curriculum and how students begin to build their engineering identities.

Conclusions

This study begins to unpack how undergraduate engineering students in an FYE program perceive their majors, their major curriculum, and themselves as engineers. Future work will document in detail budding engineering identities and how they impact a student’s sense of fit and satisfaction in first-year programs. Additionally, we will document how students see FYE programs in general. Do they consider these programs as the first step within their intended major curriculum, as a stand-alone program that they must complete prior to beginning their major curriculum, or as something completely different? Understanding student’s sense of engineering identity can inform effective retention strategies.

Acknowledgments

This material is based upon work supported by the National Science Foundation (NSF) under Grant No. 1734347. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the NSF.

References

- [1] X. Chen, C. E. Brawner, M. W. Ohland, and M. K. Orr, "A Taxonomy of Engineering Matriculation Practices," *120th ASEE Annu. Conf. Expo.*, 2013.
- [2] M. K. Orr, C. E. Brawner, S. M. Lord, M. W. Ohland, R. A. Layton, and R. A. Long, "Engineering matriculation paths: Outcomes of Direct Matriculation, First-Year Engineering, and Post-General Education Models," *Proc. - Front. Educ. Conf. FIE*, 2012.
- [3] M. K. Orr, C. E. Brawner, M. W. Ohland, and R. A. Layton, "The Effect of Required Introduction to Engineering Courses on Retention and Major Selection," *2013 ASEE Annu. Conf.*, p. 23.1192.1-23.1192.9, 2013.
- [4] C. E. Brawner, X. Chen, M. W. Ohland, and M. K. Orr, "The Effect of Matriculation Practices and First-Year Engineering Courses on Engineering Major Selection," *Front. Educ. Conf.*, pp. 1–7, 2013.
- [5] H. M. Matusovich, R. A. Streveler, and R. L. Miller, "Why Do Students Choose Engineering? A Qualitative, Longitudinal Investigation of Students' Motivational Values," *J. Eng. Educ.*, vol. 99, no. 4, pp. 289–303, 2010.
- [6] O. Pierrakos, T. K. Beam, J. Constantz, A. Johri, and R. Anderson, "On the development of a professional identity: Engineering persisters vs engineering switchers," *Proc. - Front. Educ. Conf. FIE*, no. 2, pp. 1–6, 2009.
- [7] J. R. Morelock, "A systematic literature review of engineering identity: definitions, factors, and interventions affecting development, and means of measurement," *Eur. J. Eng. Educ.*, vol. 42, no. 6, pp. 1240–1262, 2017.
- [8] A. D. Patrick and M. Borrego, "A Review of the Literature Relevant to Engineering Identity," in *American Society for Engineering Education Annual Conference & Exposition*, 2016.
- [9] T. Beam, O. Pierrakos, J. Constantz, A. Johri, and R. Anderson, "Preliminary Findings On Freshmen Engineering Students' Professional Identity: Implications For Recruitment And Retention," *ASEE Annu. Conf. Expo.*, 2001.
- [10] F. Dehing, W. Jochems, and L. Baartman, "Development of an engineering identity in the engineering curriculum in Dutch higher education: An exploratory study from the teaching staff perspective," *Eur. J. Eng. Educ.*, vol. 38, no. 1, pp. 1–10, 2013.
- [11] W. Faulkner, "'Nuts and bolts and people': Gender-troubled engineering identities," *Soc. Stud. Sci.*, vol. 37, no. 3, pp. 331–356, 2007.
- [12] L. Mann and F. Nouwens, "Influences on the Development of Students' Professional Identity as an Engineer," *Proc. Res. Eng. Educ. Symp. Palm Cove, QLD*, pp. 1–6, 2009.

Author Biographies

Ms. Katherine M Ehlert, Clemson University

Katherine M. Ehlert is a doctoral student in the Engineering and Science Education department in the College of Engineering, Computing, and Applied Sciences at Clemson University. She earned her BS in Mechanical Engineering from Case Western Reserve University and her MS in Mechanical Engineering focusing on Biomechanics from Cornell University. Prior to her enrollment at Clemson, Katherine worked as a Biomedical Engineering consultant in Philadelphia, PA. Her research interests include identity development through research experiences for engineering students, student pathways to engineering degree completion, and documenting the influence of co-op experiences on academic performance.

Dr. Marisa K. Orr, Clemson University

Marisa K. Orr is an Assistant Professor in Engineering and Science Education with a joint appointment in the Department of Mechanical Engineering at Clemson University. Her research interests include student persistence and pathways in engineering, gender equity, diversity, and academic policy. Dr. Orr is a recipient of the NSF CAREER Award for her research entitled, “Empowering Students to be Adaptive Decision-Makers.”

Dr. Sarah Jane Grigg, Clemson University

Dr. Sarah Grigg is a senior lecturer in General Engineering at Clemson University. She is a human factors design engineer specializing in process improvement and error mitigation across various contexts including engineering education, healthcare, and transportation. She received Ph.D., M.S. and B.S. degrees in Industrial Engineering, a Certificate in Engineering Education, and a Masters degree in Business Administration from Clemson University.