

Should I Stay or Should I Go? Undergraduates' Prior Exposure to Engineering and Their Intentions to Major

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From the era of Sputnik through to the present, concerns about preparing sufficient numbers of engineers to meet the demands of industry and national security have gained national attention. From 1975 through 1999, attrition from science, technology, engineering, and math (STEM) programs has continued to where the U.S. has slipped from third to fourteenth place among twenty countries worldwide in the proportion of twenty-four-year olds who hold STEM degrees. This research contributes to the body of literature relating to how environmental effects of classroom instruction, departmental culture, and institutional structure influence students' decisions to major in engineering.

Implications of Findings

Our data suggest that students' decisions whether or not to major in engineering are malleable. This provides both challenge and opportunity for those seeking to increase the numbers of undergraduates who complete degrees in engineering. If our initial analyses are borne out through further study, we believe that important but relatively minimal changes in classroom instruction as well as institutional structure and outreach could tilt the odds of students' declaring an engineering major in favor of doing so.

Method and Background

This study is part of the Center for the Advancement of Engineering Education (CAEE)—a longitudinal study of undergraduate engineering education involving five partner institutions. Data in this study is from two of the partner institutions that are part of the Academic Pathways Study (APS) research element of CAEE. There is a significant difference between these two institutions in terms of institutional focus and academic offerings—one (Coleman) offers a broad range of alternatives to majoring in engineering while the other (Mountain Tech) does not.

Students ... wrestle actively with the decision to major in engineering.

The two institutions also vary in terms of student demographics. Both enroll similar numbers of women and Latinos/as, Coleman's engineering students are fifty percent non-white while Mountain Tech's are approximately fifteen percent non-white. Both institutions are highly selective, with many students having completed at least one and often several Advanced Placement (AP) courses before entering college.

Data for this paper include semi-structured interviews and informal conversations from a targeted sample of students (n=32), complemented by survey data from a larger cohort of students (n=76). The qualitative data collected from the targeted sample is the focus of this work;

survey data is included only as it further informs the interview data. Students were asked questions about their high school experiences, how their interest in engineering evolved, their collegiate experiences, and their post-baccalaureate intentions. (For a full description of the methods used, please follow the link below.)

What We Found

Student interviews were evaluated for exposure to engineering upon entry to college as either low, moderate, or high and the researchers developed a rubric by which to compare exposure. Students with low exposure had no direct, engineering experiences, but may or may not know a family member or friend who is an engineer. Students with moderate exposure had direct, mentored experiences related to engineering activities and may or may not know a family member or friend who is an engineer, and. Students with high exposure are similar to those with moderate exposure, but have had a deeper and/or broader engineering experiences, usually participating in multiple engineering activities before entering college.

It is notable that of the 32 students interviewed, only six (19%) had high levels of exposure to engineering prior to college. The high number of courses and units required for the engineering major forces students to commit to the major early on. As a result, students must commit to the engineering degree before they have had a chance to learn much about engineering as a discipline or as a career. This can affect their level of commitment and may explain some attrition patterns.

Data suggest that the course offerings at both Coleman and Mountain Tech influence the engineering-commitment profile. Students at Coleman have degree program options other than engineering or a technical field, while students at Mountain Tech have only three options in addition to engineering: mathematics and computer science, economics and business, and chemistry. Given this difference, it is reasonable to assume that students enter Mountain Tech more positive about their intention to complete an engineering degree than do many or most students at Coleman.

While Coleman does offer opportunities to explore, students have great financial and institutional pressure to complete a major within four years, requiring careful planning of their lower division engineering-science related coursework in order to be "on track" for a four-year graduation. Students must balance this pre-engineering coursework with the humanities and writing coursework required of all students during their first two years at Coleman. Therefore, although students have opportunities to explore fields other than engineering or even different engineering fields, practical constraints force them to plan their lower division engineering-science related coursework carefully.

Students at Mountain Tech may remain undeclared for their first three semesters, but by the second term of the sophomore year, begin taking courses in their major departments. Almost universally, students at Mountain Tech report that they have chosen to enroll at an engineering institution because they are "good at math and science." Other students choose Mountain Tech because of its strong regional reputation for providing a high-quality education in engineering. The nature of student explorations at Mountain Tech differs from Coleman in part because the options of students are limited by the engineering and technical focus of the institution.

Based on our analysis, it became clear that students at both Mountain Tech and Coleman wrestle

actively with the decision to major in engineering. Despite the constraints at each institution, we discovered that students are anything but highly intent on entering and completing a specific engineering degree. The students' interviews at each school at the end of their first year fell into three groups: unsure, mostly sure, and positive. Over half of the Coleman students were positive about committing to engineering, whereas students were more evenly split between positive and unsure at Mountain Tech. This is surprising in that it might be expected that more of the Mountain Tech students be positive about majoring in engineering than their peers at Coleman. Survey data reveal no statistical difference between students at Coleman and Mountain Tech in terms of their decisiveness about majoring in engineering.

While research literature discusses that students waiver in their decisions about their majors, few have studied what this looks like from ground level, particularly in terms of students considering engineering. Our data suggest that students who look like and act like engineering students may, in fact, not be at all confirmed in their decision.

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