ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Paper ID #32060

First-Year Engineering - Deciding on a Major

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Full Paper: First-Year Engineering - Deciding on a Major

Abstract

At SUNY Binghamton, first-year engineering students have a shared year as Watson School of Engineering and Applied Science majors and do not declare their specific engineering major until later. In order to track interest and assess program impacts, the students are given a survey in the first week of their fall classes. This survey asks just two questions: 1) What is your intended engineering major and 2) How certain are you of your intended major. Typically, about one-half of first-year students indicate that they are very sure of their intended engineering major and the other half is only somewhat sure or not at all sure.

Along with an introduction to general engineering concepts, one of the primary objectives of the introduction to engineering course that the students take in their first semester at SUNY Binghamton is to familiarize them with the engineering majors offered at the university: biomedical, computer, electrical, mechanical, and industrial and systems engineering. Throughout the course students are given lectures, assignments, and laboratories that are representative of the engineering majors offered. The majors are also introduced in many other forms, including: departmental visits, student organization presentations, visits from industry representatives, and visits from engineering based student service offices on campus. The laboratory classes are also instructed by graduate teaching assistants from the different engineering departments.

During the last week of the fall semester, students are required to declare their majors although they are free to change their decision up to the start of their second year. Since the 2014-2015 academic year, the percentage of students who declare an engineering major has ranged between 90.3% and 94.5% (meaning 5.5% - 9.7% of students leave our engineering programs for non-engineering degrees at SUNY Binghamton or leave the university). Of those that declare an engineering major, it is found that some number of students go on to declare a major different from the one they initially indicated.

This paper will present detailed data of the intended major given in the first week of class, the strength of their intention, and their final major declaration. An in-depth description of the methods used to introduce the engineering majors will also be provided. Finally, the authors will provide their insight into the reasons for any changes in intended major from the first week to final week of the semester.

Introduction

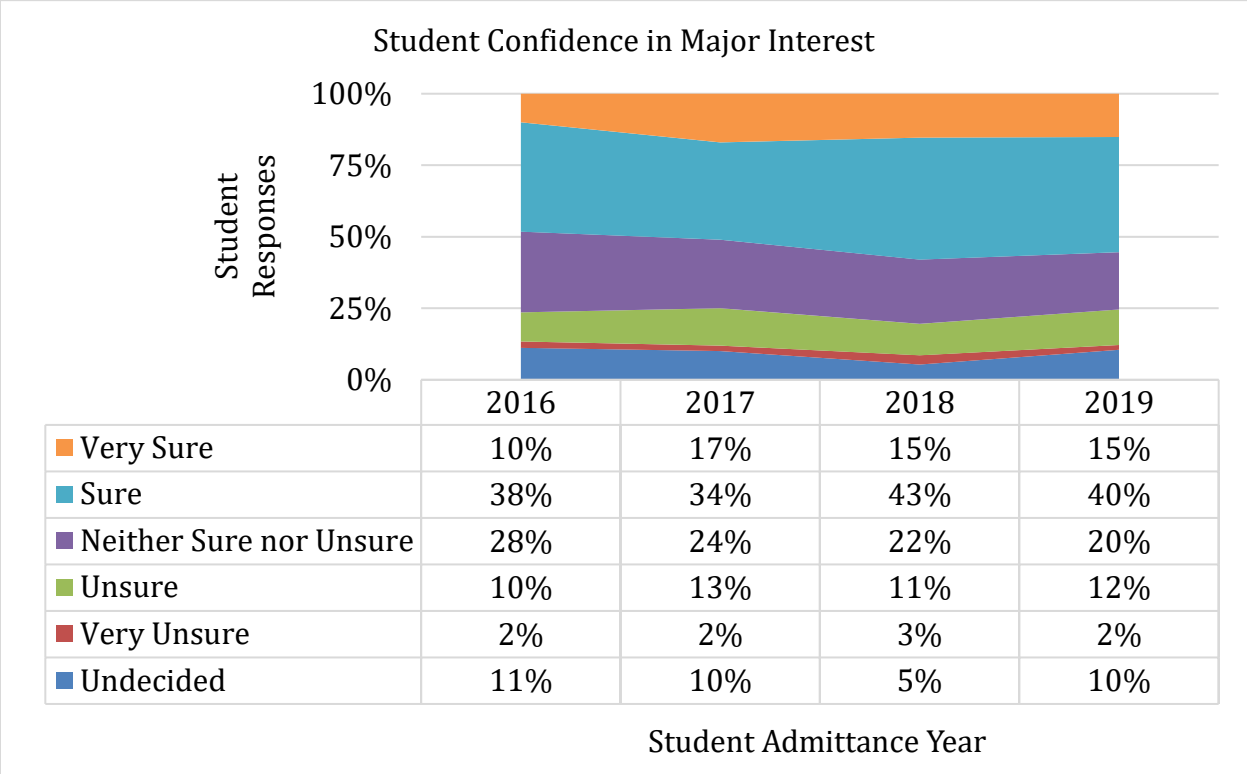
Choosing a future career can be a daunting task, whether this is as a young adult or later in life. Everyone chooses which career to pursue for their own reasons. For those who choose to study engineering these reasons can be personal, familial, economical, based on teacher or counselor recommendations, or other [1] [2]. For decades, the reasons that individuals choose engineering and why they stay in the majors has been studied [3] [4] [5]. One aspect that makes the choice of an engineering major so difficult is that before starting in an engineering program, the

knowledge of the major is often superficial or limited. [6] This would indicate that the best way to help students pick and stay with a major is to provide them with the needed experiences and materials so that they can make a well-informed choice of major.

At SUNY Binghamton, first-year engineering students have a shared year as Watson School of Engineering and Applied Science majors and do not declare their specific engineering major until later. This is to help the students make as informed a decision as possible. Throughout the course of the first-year engineering program, the students are not only introduced to general engineering design and analysis topics, but there is a considerable effort made to provide students with the information they need to determine what major would fit them best.

The First Semester Experience

During their first week, students in the first-year engineering program at SUNY Binghamton are asked what their intended engineering major is and how confident they are in that choice. From the responses summarized below in Figure 1, all students seem to fall into one of three categories. About 50% of students know what engineering major they would like to pursue and are confident of that choice. Another 40% think they know what engineering major they would like to pursue, but are not confident of that choice. The remaining 10% are undecided on their intended major.



	2016	2017	2018	2019
Very Sure	10%	17%	15%	15%
Sure	38%	34%	43%	40%
Neither Sure nor Unsure	28%	24%	22%	20%
Unsure	10%	13%	11%	12%
Very Unsure	2%	2%	3%	2%
Undecided	11%	10%	5%	10%

Figure 1. Student Confidence: Summary of student responses indicating the confidence they feel in their choice of engineering major

Throughout their first semester in the program, along with an introduction to general engineering concepts, one of the primary objectives of the program is to familiarize the students with the engineering majors offered at the university: biomedical (BME), computer (CE), electrical (EE), mechanical (ME), and industrial and systems engineering (ISE). This is done throughout the three components of the program, shown in Figure 2; a faculty-led introduction to engineering lecture, a faculty/graduate teaching assistant led laboratory, and a faculty-led communications class.

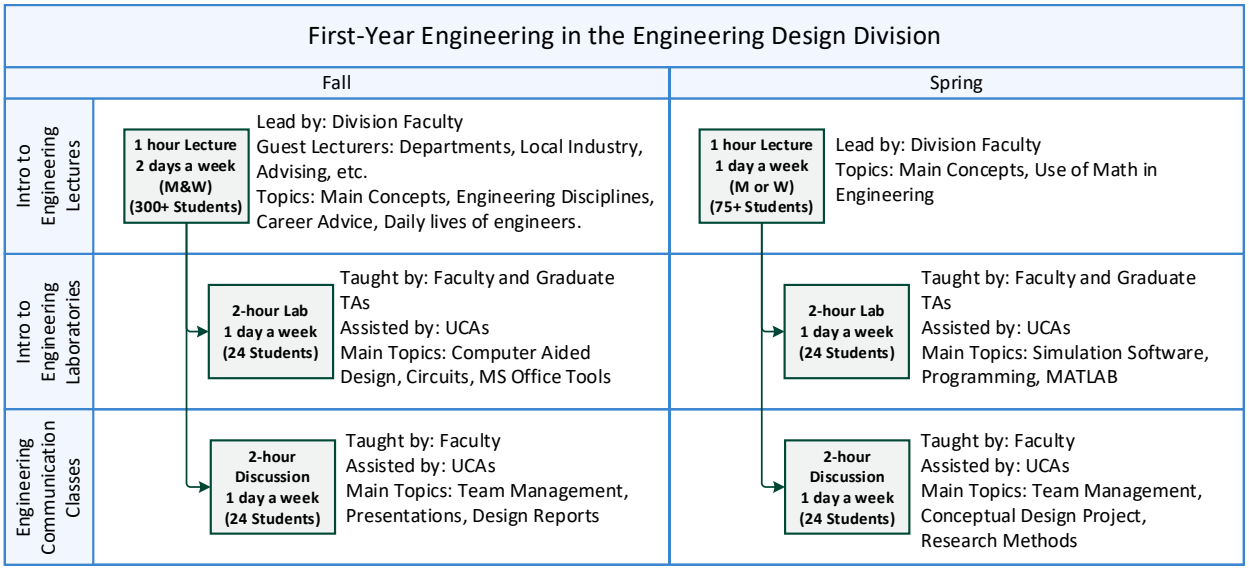


Figure 2 - First-Year Engineering at SUNY Binghamton: A summary of the components of the first-year engineering program

Lectures

In the program's main lecture which meets twice a week with all students in attendance, there are many instances where the different engineering majors are introduced and discussed. One of the main ways this is done is through the Department Lectures. These are days where representatives from one of the engineering departments come in to present to the students. These sessions introduce the students to the department's curriculum, the career opportunities, and research done within that department. While this is information that our program's faculty could also present, department representatives are asked to present as they are going to be more passionate about the material. (e.g. ISE faculty will be more passionate talking about ISE research than someone with an ME background). Each department treats this opportunity in a different way. Some departments have a single representative give a presentation, others have a faculty member and a student present, and one department even puts on a full event where many faculty, undergraduate and graduate students, and student organizations all are available to discuss their experiences and answer questions.

In some other sessions, more general engineering career information is presented by student organizations, the career and alumni office, and by the Watson school's advising office. These presentations cover many aspects of the academic and professional lives of engineers.

In the weeks prior to the declaration of their major, the program puts on two special panel sessions for the students. The first of these is one where we ask representatives from local industry to visit and following a brief introduction, students are given a chance to ask about their day-to-day life as engineers. The representatives are chosen to present a diverse set of viewpoints, coming from different backgrounds and at different points in their engineering careers. The second panel session is one where the department representatives all return at once to allow students to have any last minute questions answered.

Laboratory Classes

In the 2-hour laboratory classes, that meet once a week in sessions of 24 students, students are introduced to the different engineering majors in two primary ways. The first of these is through the material covered in the sessions. During the lab classes, students complete hands-on examples of work done in each of the departments. The second way is through the lab instructors (graduate teaching assistants (GTAs) and undergraduate course assistants (UCAs). These include representatives from each of the engineering departments and are available both in class and during office hours to help answer questions students may have about their programs.

Communication Classes

The 2-hour weekly communications classes, comprised of the same 24-student cohorts as the laboratory sessions, incorporate the introduction of the different engineering majors in two primary ways. The first is that while the faculty are not necessarily engineers, the UCAs in each session are engineering students. The second is through the assignments and projects in the class. These are chosen to include examples and applications that are representative of the different majors.

Declaring a Major

At the end of the fall semester, the first-year engineering students in the program are asked to declare what major they choose to pursue at the start of the second year. Students can still and do change their mind throughout the spring semester but are asked to declare in the fall of their first-year for planning purposes. As is indicated in the summary of declarations shown in Table 1, throughout the last 4 years, over 92.5% of students declared majors within the engineering departments at SUNY Binghamton. The remaining 7.5% of students include those who decide to pursue non-engineering majors at SUNY Binghamton and those that decide to leave the university (including those who pursue engineering majors at other universities).

Table 1 - Major Declarations: A 4-year summary of the engineering major declarations for first-year engineering students at SUNY Binghamton

	2016/2017	2017/2018	2018/2019	2019/2020
1st Year	304	311	326	321
2nd Year				
BME	53	64	67	55
CE	44	45	49	49
EE	44	26	30	40
ISE	55	52	52	47
ME	86	101	110	106
Retention (%)	92.8[1]	92.6	94.5	92.5

[1]Declaration of majors was completed in February rather than December

The majors that students declared in December were often different from those that they indicated as their intended major at the start of the semester. This includes those students who initially indicated that they had not yet decided on a major. A summary of the change in intended majors is shown below in Figure 3 which shows a comparison of the multi-year average responses to the survey completed in September and the majors chosen during declaration in December.

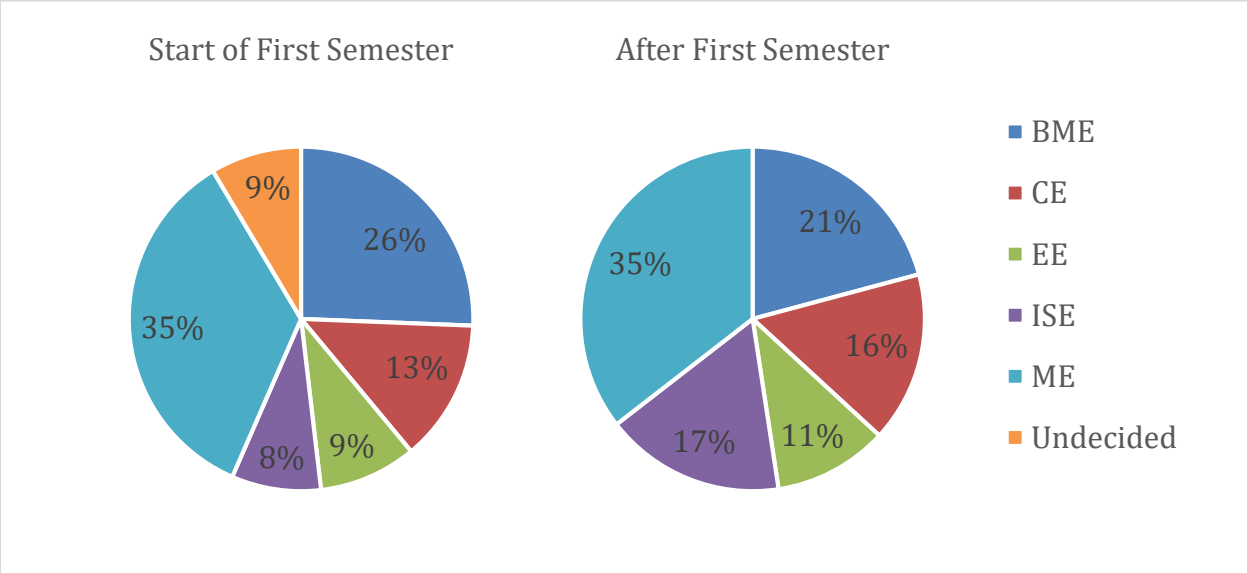


Figure 3. Student Majors: Summary of student intended engineering majors at the start and end of the first semester

Discussion

Students entering the first-year engineering program at SUNY Binghamton come from many, diverse, backgrounds. Some of the students have had years of engineering-specific instruction as

a part of their secondary education experience or through attending engineering camps, others have not taken any type of engineering class. Some students come from families of engineering professionals and others are first-generation college students. This spread of backgrounds can lead to much variation in how much the student knows about what the daily lives of engineers are like and how the engineering majors differ from each other.

With this difference in backgrounds, students enter a first-year engineering program with their own ideas about what it means to be an engineer and have made the choice to pursue that career with different levels of confidence. As the students learn about the field of engineering, we have found that it will lead to one of four outcomes. The first of these is that it can help confirm their existing views and lead the students to become more confident in their choice of major. In the second case, students who had a general idea about engineering, but hadn't decided on a major, learn about the field and find a major they choose to pursue. Third, students learn about a new major they had not previously considered or learn new information about a major that they find suits them better than their initial choice. In the last case are the students who find out an engineering major is not as attractive to them as they had first thought and opt to pursue a different career all together.

Conclusions and Future Work

For students entering an engineering program, the choice of which engineering major to pursue can be a daunting task. In shared first-year engineering programs, this choice can be made less stressful through both giving more time to make a decision as well as by providing the student with an introduction to the different engineering majors. With this in mind it is the responsibility of first-year engineering programs to provide the students with an experience that is both engaging and productive no matter what major (engineering or not) the student ends up choosing.

While the current study was driven from anonymous student surveys in the course and did not track individual student responses, of interest to the authors is a follow-up study tracking individual students over the course of the program to track their responses to the material presented throughout the courses.

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