

**A One-Credit First-Year
Introduction to Engineering Seminar Course
at Penn State Fayette Helps Freshman Students in
Choosing an Appropriate Engineering Major: a Student's Perspective**

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Abstract

The purpose of this paper is to address the problems undergraduate engineering students face in choosing their majors and the ways in which first-year engineering courses can help to inform students and aid them in deciding on their major. Emphasis is placed on Penn State Fayette's ENGR 100S, which the lead author took in the fall of 2005. ENGR 100S is an introductory engineering seminar, and the paper provides a student's perspective on the course, based on the experiences of the students in the class. The coauthor of this paper was the instructor of the course, and provides input related to the manner in which the course was taught and information on engineering in general.

An Introduction to the Art of Choosing an Engineering Major

Some of the most common reasons that high school students become interested in the specific field of engineering are numerous, including relatives who are engineers, their math and science skills, engineering's high starting salaries, and the large job opportunities for engineers¹. Students who chose to become engineers for these reasons alone often successfully complete their programs. However without such information it is extremely difficult to make wise decisions about becoming an engineer and selecting a particular discipline. Most students fall into one of two categories: ones who know about engineering through a relative or acquaintance, and those who are not sure what engineers do².

Most first-year engineering students are not sure what field they should choose, and often those who are sure of their choice have chosen it for unacceptable reasons. Some students choose their majors because they are related to somebody in that field, but some because they think it will be an interesting career. Some actually research the various professions available

within engineering; however most students are unfamiliar with the jobs performed by engineers. Most students who research engineering are concerned with which programs have the highest starting salaries for graduates, or which have the most job openings. Engineering literature is full of statistics related to starting salaries for engineers³ and employment data. The relative distribution of various engineering disciplines is also readily available in the literature. For instance, civil engineers make up 16.4% of the engineers in the United States, while less than one percent are biomedical engineers⁴. There are very few students that thoroughly research the different engineering disciplines and even fewer that consult practicing engineers before selecting a major.

When students fail to investigate their fields prior to their first year of undergraduate study, they often have little idea what course they are going to be on for the next four years. Those who chose it because of a relative may not have realized how important math and science are to engineering, while those who chose it because of their math and science interests may find the other aspects of engineering extremely undesirable. Some who chose engineering based on salaries or job opportunities may be discouraged by the intensity of engineering courses. All of this leads to problems for the students, the schools, and the engineering community. For most students who face these problems, there are still several options available, provided they act quickly. They can transfer to engineering technology programs, or switch to other engineering disciplines. They can also transfer to non-engineering disciplines.

Many first-year students have never heard of engineering technology, which is an excellent field for individuals who enjoy the engineering concepts but struggle with advanced mathematics and science courses. Engineering technology places the emphasis on the practical aspects more than theory. For this reason, engineering technology does not require a rigorous math and physics background. Many engineering students transfer to engineering technology programs after encountering difficulties in calculus, physics, or chemistry, but not before their grades are negatively affected by these courses, as well as advanced engineering courses.

Should a student realize that he or she does not wish to become an engineer, it is of most importance that this realization takes place in the first or second semester. This allows the student to switch majors without seriously affecting his or her ability to graduate on schedule. Oftentimes, however, it is not until the third or fourth semester that intensive engineering courses are taken, exposing students to what their chosen field entails. At this point it is often too late to efficiently change to a non-technical field of study, and even many technical fields will be difficult to complete within eight semesters.

If the student still wishes to become an engineer, but would rather specialize in a different field, he or she might not realize this until his or her fifth semester, when most courses taken will be specialized for the intended major. At this point students who feel they are not in the field best suited for them face an imposing dilemma: Do they stay in their current major and graduate on schedule, transfer to another program and overload on courses to graduate on schedule, or take another semester to finish their degree in another field? Too often students choose the first option and enter the workforce in a field with which they are unhappy.

The Science of Choosing an Engineering Major

The above adverse situations can be prevented by a course which exposes fresh engineering students to all of the engineering disciplines and introduces them to the world of engineering. One of the major recommendations of the National Academy of Engineering in their document *Educating the Engineer of 2020: Adapting Engineering Education to the New Century* is to place creative approaches regarding the essence of engineering, among others, in the earliest stages of the engineering curriculum⁵. Accordingly this course should be placed in the first year of undergraduate engineering curriculum. Most first-year students would not be able to list all of the engineering majors offered at their institution and far less would be able to provide an accurate description of each field should they be provided such a list. This reflects more on society's lack of understanding of engineering and less on the individual students. This lack of knowledge can pose many problems for the student later on in his or her education.

Penn State Fayette's ENGR 100S Introduction to Engineering Seminar

Penn State Fayette's ENGR 100S Introduction to Engineering Seminar course remedies this situation by introducing students to the various engineering disciplines early in their postsecondary education through a series of assignments, projects, and presentations. The course aims to familiarize the students with the basic elements of engineering in general. It also acquaints the students with most of the engineering disciplines, including all of the engineering majors offered at their institution. Additionally, the course is used to familiarize the students with the practices and facilities of the university, allowing students to become comfortable with the technology and research materials available to them on campus, as well as help the students learn time management skills necessary for success in their new environment. Among the various assignments in ENGR 100S are some basic technology exercises used to familiarize the students with the campus computing equipment and programs, many of which have a connection to engineering.

Most of the assignments in ENGR 100S emphasize the research done by the students themselves. Undergraduate research is proven to be an important part in the education process itself⁶⁻⁷. Engineering educators have engaged undergraduate students in various aspects of research projects⁸. Many colleges of engineering recognize the importance of engaging their undergraduate students in research and development through their engineering curricula and various programs⁹.

An important assignment in this introductory course, and a personal favorite of the student author, is a simple question: "What is engineering?" Each student is required to answer the question in writing and present it orally to the class. At first it seems simple and easy, but it proves difficult to put into one short sentence a true and complete definition of what engineering is. Some explanations are painfully long yet still incomplete; some are short but glaringly incomplete. Developing a satisfactory definition is secondary to the realization that in most cases not one person in the entire class is able to succinctly and sufficiently answer the question without considerable thought and investigation. This assignment is posed early in the course and beautifully demonstrates the importance of the course.

One of these assignments in the course requests each student to explore and summarize his or her most preferred engineering major. A converse assignment asks students to investigate their least preferred engineering major and write a report on it. These assignments require that each student studies the list of majors and evaluates them based on factual materials and literature rather than their own perceived notions. The students investigate the selected fields to either confirm or refute their ideas through research.

One of the major projects in this course is for each student to prepare and conduct a PowerPoint Presentation on any chosen engineering discipline. This assignment is very valuable and informative, as most students choose their intended major as the subject of their presentation. In doing so they not only thoroughly research their chosen field, they also present the class with pertinent information about the discipline. In doing the research, students have to acquaint themselves with at least one engineering field, and they are able to discover if it is truly the discipline they wish to pursue. Additionally, the presentations of other students introduces everyone to fields they may not have previously considered, all while introducing students to public speaking and a useful presentation tool, often for the first time.

Other assignments include investigating the relationship between science and engineering and the relationship between engineering and engineering technology. This exposes students who may prefer to become scientists, technologists, or technicians to other fields they may not have considered.

Various guest speakers present information to the class about their own engineering disciplines, providing invaluable experience in the engineering profession and helpful advice for those considering a field in their discipline. The engineering speakers often include a mechanical engineer with many years of industrial experience, a practicing architect, a professor with Engineering Science and Engineering Mechanics degrees, among others. There are also guest speakers who introduced the class to other aspects of the campus, such as the registrar's office, course scheduling, and the library facilities.

The Personal Experience of the Student

The student author's experience in his ENGR 100S course was very much analogous to the descriptions provided above. What was taught in the course encouraged him to continue to pursue a degree in engineering, specifically civil engineering. Additionally he was pleased to receive an A in the course.

The course also prompted several other students to continue in their chosen fields, but not all students. Based on communications with his classmates, more than half of the students changed their majors after the first semester. It is highly likely in the opinion of the student author that this took place because of what they learned in ENGR 100S. After completing the course, several students changed to another engineering major. Further, a few students changed to engineering technology, and some even abandoned engineering altogether. In ENGR 100S, the class was introduced to the College of Engineering and the university and learned what it meant to be an engineer. The class explored many engineering majors offered by Penn State, including civil, mechanical, electrical, nuclear, aerospace, chemical, industrial, agricultural, architectural, and computer engineering. The class even discussed other disciplines that are not

currently offered by Penn State, such as paper and sports engineering. Most importantly, the students learned whether or not they wanted to become engineers.

Several students realized that they would rather pursue a degree in a different engineering discipline. For instance two students changed from chemical to industrial engineering and another student switched from architectural to industrial engineering. Some students found engineering technology to be more suitable for them than engineering. A few other students realized they were not suited for a degree in engineering. Of those who changed their mind, it was very convenient to switch intended majors at the end of their first semester of classes, having taken mostly core curriculum classes that will apply to nearly any major, as opposed to switching during his or her fourth or fifth semester after completing many program specific courses.

Conclusion and Recommendation

Penn State Fayette's ENGR 100S is an effective means to educate fledgling undergraduate students about the field of engineering in general. It is also an excellent tool for educating them about various fields in the engineering profession. It is recommended that other universities incorporate principles similar to those outlined above in their own freshman engineering courses.

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Biography

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