

## **Impact of Departmental Sovereignty and Faculty Autonomy on Service Classes for Engineering Majors**

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**Abstract:** In the context of a study in which we used a semi-structured protocol to interview engineering majors, we discovered issues related to technical courses that are taught by departments outside of a student's major department. We have categorized these courses into three broad areas: shared core classes, pure service classes, and quasi-service classes. Our analysis shows that student satisfaction with these courses across categories depends on the perceived quality of the instructor and the perceived match between the course content and the student major. We also found student dissatisfaction with courses in the quasi-service category, where a course enrolls both major and non-major students.

### a. objectives or purposes

In the context of a larger study, we have discovered issues related to courses required for undergraduate majors that are not taught by the major department. For convenience, we refer to these courses as "service courses". The specific venue for our discussion of these issues is the College of Engineering (COE) at Our University (OU). One set of courses we consider here is required of most undergraduates in COE: "core engineering" courses (e.g., "Rigid Body Mechanics") whose descriptions are written by a COE-wide committee, but whose specific implementations tend to be at the discretion of each instructor. In general, these courses are taken by students from multiple disciplines within COE. Another set of such service courses includes pure service courses under the primary control of one department but taken predominantly by students in another department(s) (e.g., "General Physics for Engineering and Science Majors"). A third set consists of quasi-service courses under the primary control of one department for students majoring in that area, but which are also required of students in other departments ("Introduction to Computer Programming", "Calculus & Analytic Geometry"). The purpose of this portion of the study is to examine how service courses in these categories impact students.

### b. perspective(s) or theoretical framework

With funding from the National Science Foundation we have been studying the striking and puzzling trend of gender parity among undergraduate majors in a particular degree program within COE. To study this trend, we have been interviewing COE majors at OU. We believe that the trend is not the result of any one factor, but is instead the result of a combination of factors. Thus, our interviews have tended to be broad as well as deep. This open-ended approach to our data collection process is driven by assumptions about the complexity of socio-cultural realities and multiple dimensions of student decision-making. Socio-cultural factors can include department cultures, subjective student experience/background, and interactions between students and faculty as well as characteristics about the discipline domains. It is this approach that has led us to the findings on student satisfaction in service classes.

### c. methods, techniques, or modes of inquiry

We used a semi-structured interview protocol based around five factor categories: student profile, institution profile, discipline profile, pedagogy/curriculum, and department profile. These categories were based on the literature as well as on the experiences of the researchers. This paper focuses on the pedagogy/curriculum factor category. Among the questions that we asked participants were: "What has been your best/worst class? In your major? Outside your major? Outside of COE?" Each interview lasted 60-120 minutes and was audiotaped. Verbatim transcripts were analyzed for patterns and themes by a multi-disciplinary team (chemistry, computer science, industrial engineering, mathematics education, meteorology, and women's studies). Most of the student comments included in this paper were responses to these questions, although a few came up in response to other questions.

d. data sources or evidence

Between Spring 2002 and Summer 2003 we conducted 37 interviews. Three students were interviewed twice (subsequent terms), giving a total of 34 distinct participants. The participants self-identified their class standings.

	sophomores	juniors	seniors	alumni
women	7	8	6	2
men	4	4	4	2

e. results and/or conclusions/point of view

COE undergraduates take three kinds of courses that are not taught by their home departments: courses not controlled by a specific department (i.e., shared core classes), department-controlled courses populated by non-majors (i.e., pure service courses), and department-controlled courses populated both by majors and by non-majors (i.e., quasi-service courses). In these last two categories, "majors" refers to students majoring in the department that controls the course. We discuss each of these three types of courses, illustrating key points with sample student comments. (Excerpts from transcripts have been edited for readability and to mask the identities of students, faculty, and staff.)

Shared Core Courses

The COE at OU has 11 schools and 13 degree programs. With the exception of two programs, all undergraduate majors in COE take a core of classes including Rigid Body Mechanics, Strengths of Materials, and Structures and Properties of Materials, among others. Course descriptions are determined by a college-wide committee, but each instantiation is the purview of the assigned instructor. The variety of possible experiences was reflected in the comments made by our participants:

Several students named Rigid Body Mechanics as a favorite class, in large part because they appreciated the instructor's apparent attitude:

(female, sophomore) As far as engineering classes, I liked was Rigid Body Mechanics. I like that class. And a lot of it had to do with the teacher ... He cares about his students ... he wants to know what he can do to help you.

Other students disliked Rigid Body Mechanics, referring to the content as irrelevant for their particular branch of engineering:

(female, junior) I really hated my project for Rigid Body Mechanics. ... We had to design a bridge, and um, and they, he gave us the length of the, how long it had to be and stuff like that, and I've, I had never taken any classes where I needed to design a bridge, or needed any information about bridges at all. So I knew nothing about bridges, and I never am going to have to do that ever in life, and so it really was frustrating. ... [I told the professor that] I don't feel like this project is very pertinent towards, you know, the rest of our major, you know, 'cause there was a bunch of different types of majors in there.

Several participants named the Strength of Materials class as a favorite. Here we noticed a possible, but predictable from the literature (e.g., Seymour & Hewitt, 1997), gender difference: the male students referred to liking the content while the female students referred to liking the professor.

(male, sophomore) I like Strength of Materials primarily because of the content.

(female, junior) I liked my professor a lot. ... It seems like he really wants us to learn.

The Structure & Properties of Materials course was less well-liked by our participants, men and women alike. Although the tendency to like the content seemed gender dependent, it was not clear, to them or to us, what it was they did not enjoy:

(female, senior) I just didn't like that class. ... I know part of it is just the material itself. ... The teacher was great. He was awesome. He helped me, his lectures were good, I just couldn't grasp it or something.

(male, sophomore) I liked the content, the professor was nice, but for some reason, it just wasn't clicking with me until the very end, so I unfortunately I did poorly in that class.

### Pure Service Courses

The Physics sequence required by COE degree programs is controlled by the Department of Physics & Astronomy but is intended for students not majoring in physics. That is, physics majors complete a separate sequence designed specifically and exclusively for them. Individual instructors have a considerable degree of freedom with these courses, but in this arena very few students commented on specific instructors. A few commented on specific content that they

disliked or did not see the relevance of to their major. Others commented on the profit to grief ratio (Seymour & Hewitt):

(female, sophomore) I think the most rewarding class I've had was Physics II. It was the hardest class I've ever had, but I felt so extremely satisfied. ... I made a 14[%] on my first test. Coming back from that, I had to work so hard and I had to set out an exact schedule. But coming to the end where I actually understood stuff and I could explain it to others ... just being able to look back and see how far you've come, I really liked that.

(male, sophomore) With my Econ classes it's always been like the easy A, you know, so you're kind of like, yeah I got an A but it didn't feel as good as getting that B in Physics.

### Quasi-Service Courses

The Calculus & Analytic Geometry sequence required of every COE major is controlled by the Department of Mathematics. This sequence is also required of students majoring in geosciences, physics, chemistry, and mathematics. The sequence has a department-determined list of topics and a common textbook. Otherwise, the emphasis of the class – e.g., proofs, problem-solving, computations – is at the discretion of the instructor. The variety of experiences possible was again reflected in the experiences our participants shared with us. For example, one student named one semester of calculus as one of her least favorite classes and another semester as a favorite. Both of these views were based on her perception of the particular instructor's responsiveness to the perspectives of engineering majors (as opposed to mathematics majors).

General Chemistry is taught in the Department of Chemistry & Biochemistry. The course is required for chemistry majors as well as many engineering majors, and can be used to satisfy a lab science general education requirement for non-science majors. The course has both a (large) lecture component and a lab component. The course is designed and controlled by a single faculty member, although individual sections are taught by different instructors. Chemistry majors have the option of this general education course for which university admission is the only true prerequisite or of a separately run honors course, if they qualify. Several COE students replied “chemistry” when queried about their least favorite class, but the most specific comment offered so far focused on the class size and organization and the impersonal nature of the interactions with faculty.

The School of Computer Science controls the introductory programming classes that are required of COE students. The course follows a department-determined list of topics, but the textbook, pedagogy, and emphasis of the class are at the discretion of the instructor, and tend to be aimed at computer science majors. When computer science courses were mentioned, they were universally disliked by these students on every front: content, structure, and instructors (in line with Margolis and Fisher, 2002):

(male, junior) I noticed [that Java is] the first course they teach as far as computer science goes to a lot of the engineers and it's, it's not a beginning class really. ... I had no clue what was going on. A lot of the juniors would leave engineering

because of that course. I hate to say this, but 90% of students who take Java cheat just to pass the class. I mean, they're not like that, they're not cheaters, they don't do that in other classes, but they're doing what they have to do. They can't take any more. ... I think they [professors] do it [fail students] to minimize the number of engineering students. I heard that before. They wanna filter out students so it doesn't become that big. But I think that's unfair that one student has the potential to do so well in these courses is held back because of this.

One might predict that students would be disgruntled because courses are "hard" and some students did mention this. More striking, though, the students talked much more about their relationships – or rather, lack thereof – with the faculty. Other issues were related to large class sizes and structural matters. One might also expect students to complain that the content in calculus and physics courses, which are not taught by COE, is not sufficiently relevant to their perception of an engineering major. However, our participants actually complained much more about the content in courses taught within COE. As such, service courses tend to fill up the majority of a schedule for freshmen and sophomores, they are particularly critical in efforts to retain students in engineering majors.

f. educational or scientific importance of the study

Other professional degree programs face similar issues. For example, calculus for business and social science majors tends to be taught in departments of mathematics, with varying degrees of collaboration with the departments whose students are required to complete the course(s). Similarly, courses in the life sciences, as well as in chemistry, mathematics, and physics, are populated by students intending to go into medicine and other health professions. The balance among departmental sovereignty, instructor autonomy, and collaboration among invested players has the potential to impact a wide range of issues including prevalence of academic misconduct, students' ability to approach problems from multiple perspectives, and retention within a major.

## References

- Seymour, E. and N.M. Hewitt (1997). *Talking About Leaving: Why Undergraduates Leave the Sciences*. Oxford: Westview Press.
- Margolis, J. and A. Fisher (2002). *Unlocking the Clubhouse: Women in Computing*. Cambridge, Massachusetts: The MIT Press.