

WHAT STUDENTS SAY ABOUT LEARNING PHYSICS, MATH, AND ENGINEERING

Ann McKenna¹, Flora McMartin and Alice Agogino²

Abstract: Faculty from the mathematics, physics, and engineering departments at the University of California have collaborated over the past three years to restructure first year and lower division courses. Specific courses have been restructured in order to improve students' integrative understanding of calculus and the physical sciences, and their applications to engineering. The purpose of this project is to examine the impact that the reforms had on student learning, as well as to gain insight into students' experiences during their undergraduate engineering career. One-on-one interviews with Engineering students have been conducted in order to identify and understand differences, if any, between the "traditionally" taught physics and calculus courses and the "reformed" courses.

OVERVIEW

The ability to effectively integrate physics and calculus knowledge and skills into engineering is essential for engineering students. Many engineering faculty report that students do not adequately transfer knowledge from required physics and math courses and are not able to successfully integrate and use these skills in their courses. Faculty at the University of California at Berkeley implemented two reform projects aimed at improving the integration between physics, math, and engineering courses. These projects focus on using technology as a mechanism to integrate these curricula and to emphasize collaborative learning, small group work, and solving "real life" problems.

Currently, these reform efforts are being assessed. The assessment focuses on examining the impact on student learning and investigating specific connections between the physics and calculus target courses, their innovations, and their articulation with engineering courses. One-on-one interviews with Engineering students have been conducted to identify and understand differences, if any, between the "traditionally" taught physics and calculus courses and the "reformed" courses. Several of the questions driving this research include:

1. What does integration of math, physics and engineering mean to engineering students?
2. In what ways does integration take place within the curriculum, as well as in student understanding?
3. What are the factors that promote, as well as hinder, integration?
4. What physics and math concepts and skills do students use and/or apply in their engineering courses?
5. In what ways do students think they need to be better prepared for engineering courses?

METHODS AND CURRENT DATA

Approximately seventy-five interviews have been conducted between the spring 1999 and spring 2000 semesters. The interviews were conducted by a team of graduate and undergraduate researchers from the education, sociology, physics and engineering departments. Initial and on-going training sessions were conducted with the team to review the protocol, to learn and practice interviewing skills, and to discuss the results of the interviews. The team consisted of three male and three female interviewers. Participants in the study were obtained by contacting all undergraduate mechanical engineering students by email and inviting them to participate in the project. Participation was voluntary and based on total number of students contacted we had a response rate of about 22%.

Of the students who have been interviewed, 51% were seniors, 23% juniors, 21% sophomores, and 5% freshman. Approximately 67% of the students interviewed were male and 33% female. The participants were 48% Asian-American, 31% Caucasian, 10% East Indian, 6% Filipino-American, and a few international students. This diversity reflects the demographic makeup of the university. The students also covered a range of ability as measured by their GPAs with 1.7 being the lowest and 3.9 the highest. The students interviewed for the current project represent a diverse population with respect to gender, ethnicity, and GPA.

¹ Graduate Group in Engineering, Science, and Mathematics Education, University of California at Berkeley, Berkeley, CA 94720, amck@socrates.berkeley.edu

² Department of Mechanical Engineering, University of California at Berkeley, Berkeley, CA 94720