

**AC 2008-2265: UNDERGRADUATE RESEARCH CO-OP IN BIOMEDICAL
ENGINEERING**

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Undergraduate Research Co-op in Biomedical Engineering

Abstract

We present our model for expanding a mandatory cooperative education program to include research co-op. We limit the definition of a “research co-op” to an experiential learning opportunity in academic research laboratory. While we recognize that research experiences can occur in industry, we limit the definition in this way for two reasons. First, any effort to strengthen the nation’s professorate must begin by exposing undergraduate students to the environment, responsibilities, culture, and demands of the professorate. Second, from an administrative perspective, the process of developing co-op opportunities in academic research labs differs from the process used for industry. We assessed research co-op with respect to traditional industry co-op in terms of administrative overhead and preconceived notions among participants. We also discuss potential pitfalls that face departments seeking to formalize a research co-op program. We demonstrate that research co-ops present several benefits to the students, the engineering program, the university, and to the nation.

Introduction

Cooperative education at the University of Cincinnati is an academic program. It has its own curriculum and it is faculty driven. The Division of Professional Practice, where the co-op program resides in the University of Cincinnati’s organizational structure, is an academic unit reporting directly to the Vice Provost for Academic Planning. This centralized structure ensures that the co-op program is administered consistently across participating colleges. There are 38 academic programs that participate in co-op. In 2006, 2,916 students participated in cooperative education. The co-op program at the University of Cincinnati is also geographically comprehensive. In 2006, those 2,916 students worked at 1,108 employers in 38 states in the U.S., Washington DC, and Puerto Rico, and in 11 foreign countries.

The College of Engineering is the largest participant in the co-op program. During any given year, approximately 1000 engineering students participate in co-op. Co-op is mandatory for all engineering students, however, the entire freshman and senior years are spent in school. During the middle three years (of a five-year program), each student alternates between work and school assignments. The University of Cincinnati academic calendar is divided into 4 quarters. Most engineering departments have quarter-long rotations. Thus, students rotate between co-op and school 4 times per year. In Biomedical Engineering, all students “double-section” that is, they spend two consecutive quarters in a co-op or school rotation.

Co-op as *raison d’être*

Cooperative education has become so successful within the College of Engineering that it is one of the principal attributes of an education at the institution¹. For several years, surveys of incoming students have found that co-op is the primary reason for students enrolling in the UC College of Engineering (Table 1).

Top Reasons for Selecting UC Engineering*	
Co-op	84
State School	53
Close to Home	43
Guidance of parents or friends of family	26
High Academic Reputation	24
The UC Campus	12
Not Close to Home	8

Table 1. Top Reasons for Selecting UC Engineering. *Students picked their top three reasons for attending the UC College of Engineering, 100 of 260 Spring-quarter graduating seniors responded.

However, the industry-oriented nature of co-op has a significant downside. Students apply to the university because they feel that co-op is an excellent pathway to securing a job upon graduation. In fact, they are correct. Most of our graduating students have job offers in hand, or have already accepted job offers from their co-op employers, before the first day of classes of their senior year. Yet, the very fact that co-op is a successful vehicle for permanent employment, has a negative impact on UC engineering students' approach toward graduate school. Students have associated the UC COE as a vehicle for permanent employment and so, those students whose primary reason for attending college is to "get a job" will rate UC very highly. However, those students that wish to go on to graduate school believe that co-op is a negative attribute to their college experience. In their mind, the requirement to co-op in industry is counterproductive to their immediate goals of entering graduate school. This assessment of attitudes is borne out by the data in Table 2. The COE conducts a survey of its seniors. Of the 260 graduating seniors in the Spring quarter of 2007, 100 returned the Senior Survey. Table 2 reports the results of those students that answered "Yes" to the question: "Do you plan to continue to improve your engineering skills through graduate studies or professional education?"

BME Demographics Drive Research Co-op

In 2002, the College of Engineering established a Biomedical Engineering Department. Very quickly it became apparent that BME students had a significantly different demographic, with respect to career plans, than students in other departments of the college. Many students began

Percentage of Students Planning on Attending Graduate School	%
100 COE 2007 Graduates ¹	30
All 2007 BME Graduates ²	66
All 2007 Freshman BME Students ³	60

Table 2. Percentage of Students Planning on Attending Graduate School. ¹100 of 260 graduating students responding; ²21 of 21; and ³48 of 48 students responding.

petitioning the BME Department to allow research laboratory experiences to count toward their mandatory co-op assignments. An informal assessment of BME students found that they tended to be oriented toward medical or graduate school instead of industry. The first two graduating classes (2004 and 2005) validated the conclusions of the informal assessment as 50% (8 of 16) graduates entered graduate or medical school. Table 2 indicates that the preference for graduate school remains remarkably consistent between BME seniors graduating in 2007 and freshmen students entering the program in 2007. Thus, the BME Department, working closely with the Division of Professional Practice, began the practice of allowing students to fulfill co-op requirement with an assignment in an academic research facility.

The research co-op program has experienced exponential growth and now accounts for over 30% of the total BME co-op placements in the 5-year history of the department. Research co-op is now a formalized component of the overall cooperative education program. The benefits to student recruitment and retention that have resulted from research co-op have led the College of Engineering to formally adopt research co-op as part of its cooperative education model.

Location and Number of Research Co-op Placements	
Cincinnati Children's Hospital & Medical Center	62
UC Genome Research Institute	2
The Cleveland Clinic Foundation	3
The University of Tehran	1
The University of Cincinnati	81
The University of Ulm (Germany)	4
Total	153

Table 3. Location and Number of Research Co-op placements of BME students since 2002.

Managing a Research Co-op Program

The University of Cincinnati has several inherent, but not unique, advantages that allow it to support a research co-op program.

1. The Division of Professional Practice (DPP) manages the cooperative education program for the entire university. Each faculty member (the DPP is an academic unit with faculty and tenure processes) has responsibility for managing the co-op program of one to three academic departments.
2. At the current time, the college of engineering has an NSF grant to supplement the salary of students engaged in research co-op. The supplement serves two purposes. First, it makes research co-op more attractive to the laboratory directors by reducing the salary costs of the students. Second, it brings the research co-op salary closer to the salaries found in industry co-op making research co-op financially feasible to the students. (It also helps to eliminate the perception among students that a research career “doesn’t pay”.)

3. The University of Cincinnati is a major research institution with \$300+ million in research expenditures. The environment is conducive to introducing students, at an early stage in their education, to “learning experiences outside the lecture hall”.
4. Proximity to affiliated research organizations. The University of Cincinnati Medical Center, the Cincinnati Children’s Hospital and Medical Center (CCHMC), a Veteran’s Hospital, and a Shriner’s Burns Institute are all located across the street from the University of Cincinnati’s College of Engineering. The greatest benefit gained by the proximity of these major research organizations is that the students have easy, and low-cost, access during the time they are investigating opportunities for research co-op. The secondary benefit of proximity to major research organizations is that the laboratory directors can interact with the students in multiple ways, such as in the classroom or while the student volunteers as a lab assistant during their freshman year. Finally, the laboratory directors at these research organizations have collaborators located all over the world. In several instances, these collaborations have led to research co-op opportunities outside of the United States (see Table 3).

Lessons Learned

Table 1 indicates a significant preference for graduate and medical school by the 2007 Freshmen BME class. However, that assessment also revealed that these students do not have an appreciation for the role that research co-op can play in helping them achieve their career goals. Each student was asked to rate which of two reasons were more significant in their decision to enroll in the UCBME program. Table 4 clearly indicates that co-op was the most significant reason in their decision process. However, the students were also asked to rate the relative importance of research co-op versus industry co-op in their enrollment decision. Despite their preference for graduate school, only 37.8% of students rated research co-op more important than industry co-op in their decision to enroll in the UCBME program. These results clearly indicate the need to educate not just Freshmen but especially high school seniors on the role that research co-op can play in helping them achieve their career goals.

Percentage of BME Freshmen that choose co-op as having (relatively) more importance in their enrollment decision versus:	%
close to home	84.5
scholarships	61.1
UC has a Medical School	70.0

Table 4. Relative importance of co-op versus other factors in the enrollment decision of 2007 BME freshmen (48 of 48 students responding).

Conclusion

- Co-op is a program with proven success.
 - The same management practices that have been used to build a strong industry co-op program are now being applied to build a strong research co-op program.
- While undergraduate students have research opportunities through REU's and other summer-only programs, the experience they gain through a longer-term, repeatable research co-op is more beneficial to experiencing the environment, responsibilities, culture, and demands of the professorate.
- Not only could research co-op solidify students already considering grad school, but it could also introduce the idea of graduate school to those students who have not previously considering it.

Research co-op may be an excellent vehicle for achieving the goal of improving undergraduate education at research universities².

Bibliography

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2. The Boyer Commission, *Reinventing undergraduate education: a blueprint for America's research universities*, The Carnegie Foundation for the Advancement of Teaching, Stony Brook, NY; 1998.