Feedback From Co-op Students: What Does It Tell Us About Our Curricula?

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Students who go out on co-op jobs are challenged in many ways. Some of the ways are deeply technical: writing software, designing analog or digital circuits, analyzing semiconductor process parameters, testing complex systems. Others tend to demand more personal growth, non-technical skills or technical skills that are not part of the students' academic backgrounds. Interviews with several cohorts of co-op students returning to school reveals that not all of them perceive strong correlations between what they had studied and what they were challenged to do on their jobs. This paper summarizes and evaluates a year's worth of feedback from ECE students about the relevance of their courses to their co-op job needs. A surprising number of students found no course work useful in their jobs. Those students tended to be either in the first group to go out to work after one semester of their sophomore year or to have the lowest academic averages.

Numerous studies have established that experiential education is of value to engineering students (Blair and Millea 2004; Rogers and Westin 1987; Pittenger 1993). The practice of "cooperative education" is 100 years old in the United States; the first program was initiated in 1906 at the University of Cincinnati. Northeastern University began its program in 1909 and today provides alternate six-month work and school periods for approximately 600 students in various engineering majors. Students complete their freshman year and either one or two semesters of their sophomore year before "going on co-op". Half the sophomore class, designated as Division N, completes one semester and goes out to work. The other half, Division A, completes the second semester and then goes out to work while Division N returns to school. This pattern continues for a total of three work periods and three school periods. Each period is six months long with the school period being made up of a conventional 4-month semester followed by a "mini-mester" of 7 weeks in which students take two courses, intensively.

The creation and administration of the job pool is the responsibility of faculty members in the Division of Cooperative Education. Each academic department has one or more assigned Co-op Faculty who prepare the students for their first work term, develop jobs for students, deal with any problems or issues that arise for students during their work term, and review job experiences with returning students.

The job placement process used in the College of Engineering mimics that of the labor market. Jobs are available for review by the students in a database. Students may designate a limited number of jobs for which they wish to be considered. Their co-op faculty advisors review the

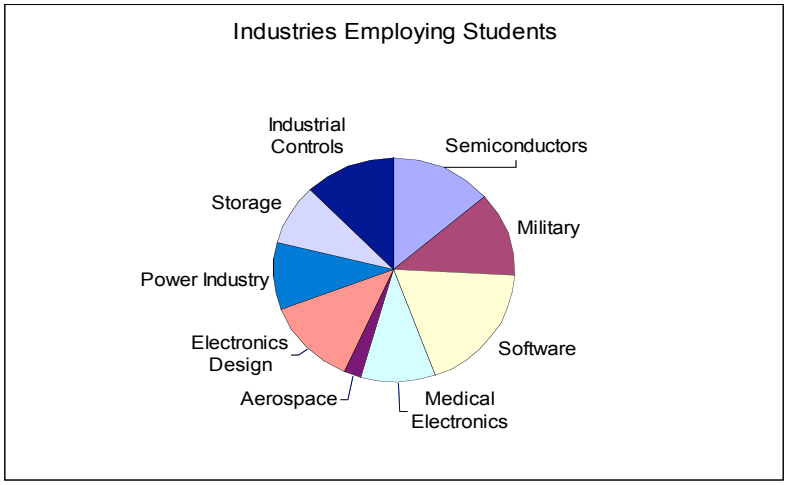
selections and approve those that meet the employers' criteria (citizenship, transportation, skills…) and send the selected resumes to the employers. The employers interview the students that interest them and make offers. Students have the option of accepting or declining offers. Typical jobs range from software quality assurance testing to circuit board design and debug to systems test of advanced military communications to power distribution planning.

Naturally, some jobs relate to the students' interests and academic preparation better than others. The goal is to have each job match the student's interests, challenge them to utilize and extend their course work and give them insight into their future career possibilities. Given the diversity of personalities, interests, aptitudes and work ethic of our students, the match is not always ideal. The same job at different times can be exciting or boring and predicting which it is apt to be is certainly not science and only barely art.

One of the assumptions that we have traditionally made is that there are several learning mechanisms inherent in industrial experience: extension of and application of classroom subjects to develop students' abilities to apply theory, assumption of responsibility for meeting commitments and deadlines, development of teamwork skills, and generally improvement in the students' abilities to connect the dots of academic theories. Our assumption of learning relevance frames the job development process and our view of which jobs are suitable for students based on their majors, their academic standings and their personalities and interests. We operate in the belief that the classroom subjects are useful to the students in their co-op jobs at some level and to some degree.

Jobs in the high-tech industries in and around the Metropolitan Boston area comprise the majority of co-op opportunities. A small number of jobs are in Florida, Texas, California, New York, and North Carolina. Figure 1 shows the relative numbers of jobs in nine different classifications that students whose experiences are included in this paper were employed in. The total number of students included was 92 in three majors: Electrical Engineering, Computer Engineering, and the dual major, Electrical and Computer Engineering.

Figure 1: Industries Employing Co-op Students, 2005.



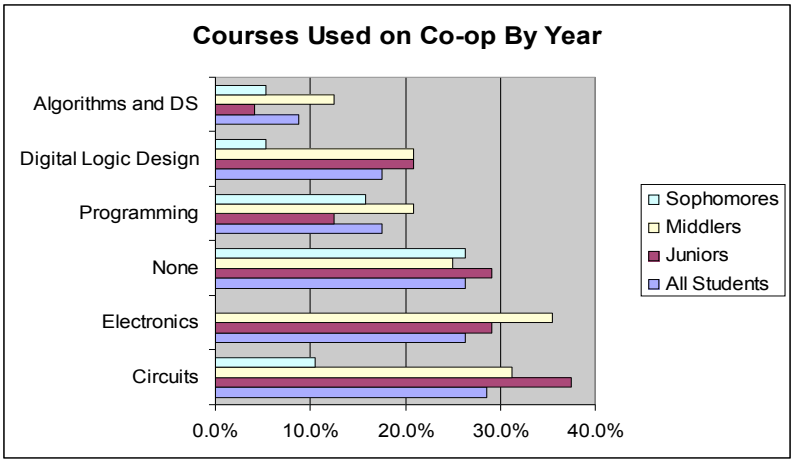
The jobs were relatively evenly distributed with Software being slightly larger than the others.

The student population included all three majors and all three years: Sophomore, Middler, and Junior. Middler is the middle year of a five-year program. Seniors have completed their co-op experiences.

At the conclusion of each work term, students returning to school are required to meet with their co-op faculty advisor and review their experience. They will have been given a performance review by their employers before they left work and that review forms part of the discussion with their advisor. Another part of the discussion is their thoughts on the job, what they learned, what challenges were in the job, and what impact it had on their academic or career plans. During 2005, each of the author's students was asked to relate their academic preparation to their job requirements by listing the courses they found useful or relevant for their work assignments. The summary of responses from students is shown in Figures 2-6. The students found that Circuits, Electronics, Digital Logic Design, Algorithms and Data Structures and a variety of programming-intensive courses were useful along with small numbers of other courses. The third most frequent response was "none." Roughly a quarter of the students did not perceive that any of their course work was useful for their job requirements. This large a fraction was surprising given the generally sophisticated nature of the companies the students worked for and the descriptions of the jobs they filled. A similar result was found in the literature. Nasr, Pennington and Andres (2004) surveyed students at Kettering University and found that only 79% answered positively to the survey question "the work experience made use of my technical background to complete assigned projects" (p16).

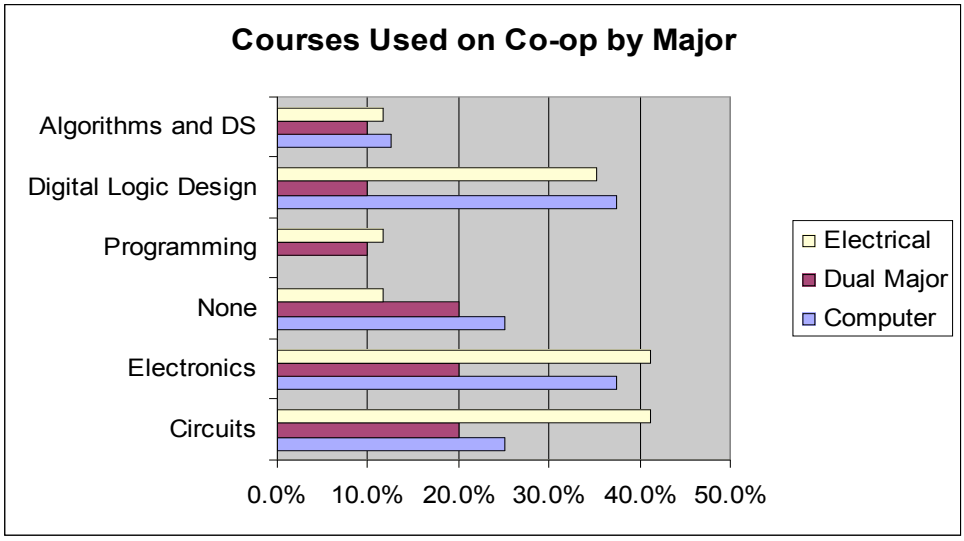
The data were examined against several factors: class year, cumulative grade point average, division, and major. In Figure 2 we show the responses by class year. While clustered around 26% average, it is interesting that the Juniors' responses that no courses were of use were slightly higher than the other two classes'. Whether this reflects objective reality or increased expectations on the part of the students in their final work term is unclear and a potential area for further investigation.

Figure 2: Responses by class year



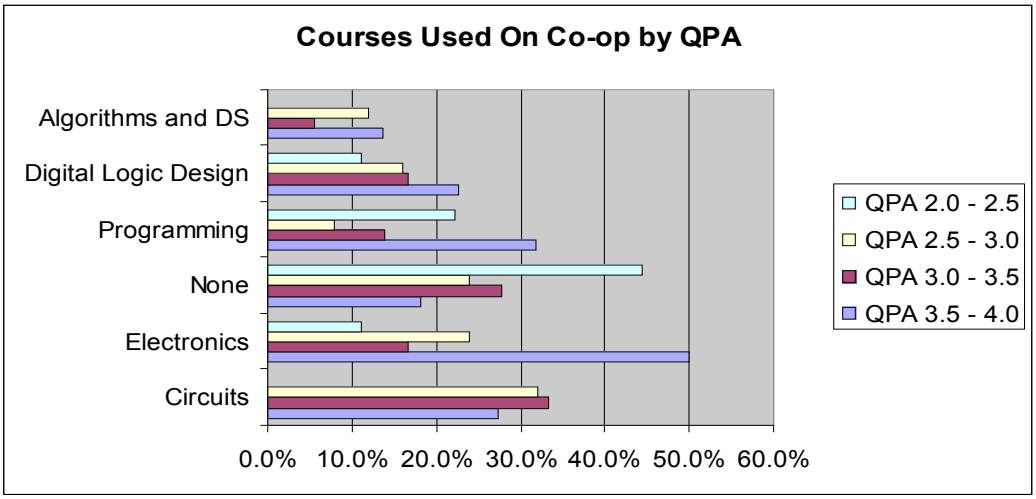
In Figure 3 we examine the responses sorted by academic major. The Electrical Engineering majors were less apt to choose "none" than dual majors or Computer Engineering majors. They were also apt to choose Circuits and Electronics in nearly half the cases. Interestingly, nearly as many Computer Engineering majors chose Electronics as being useful as did the Electrical Engineering majors. This could indicate a preference among students majoring in Computer Engineering for the hardware side of the field rather than the software side.

Figure 3: Responses by Major



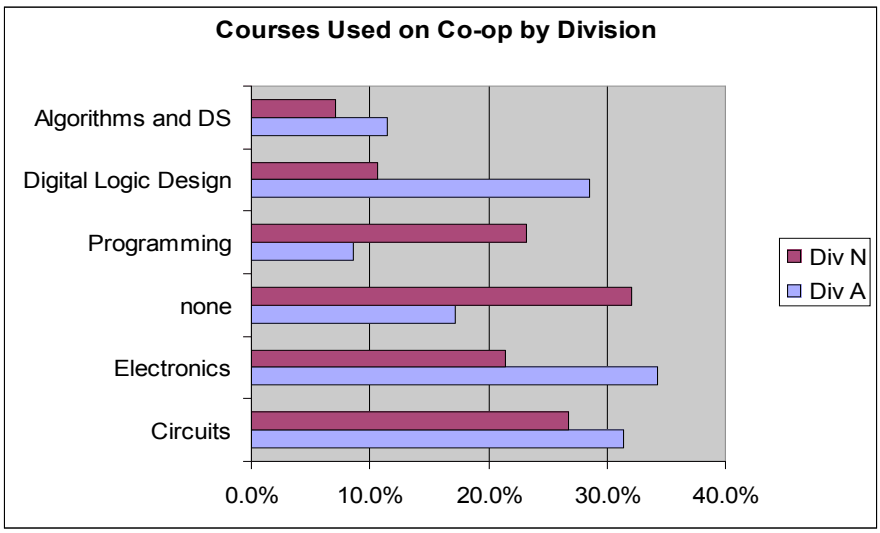
Another cut at the data was taken according to QPA (a weighted version of cumulative Grade Point Average). Here the students in the lower segment of the range chose "none" as their response much more than the other students did. This could represent a bias in the jobs they were in since the more challenging jobs are either by employer choice or de facto reserved for more academically distinguished students or it could mean that students with lower grades are less apt to be able to apply classroom subjects to their work. Perhaps it is some combination of the two and we should certainly look into the question further.

Figure 4: Responses by QPA



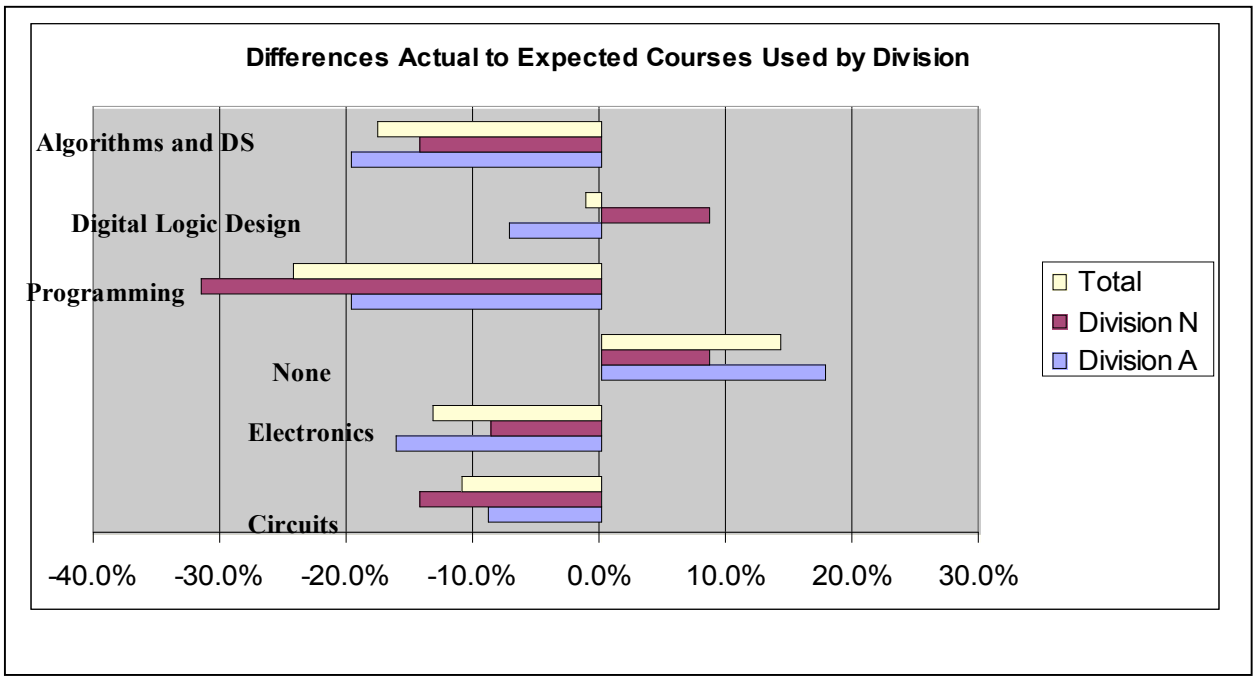
The final sort was by which division the students were assigned to. Division N is in school during the latter half of the summer and all the fall; Division A is at work then. Sophomores in Division N go to work with only one semester of course work in their major. That may be related to the number of "none" responses being so high. Division N sophomores would not have had, for example, either Electronics or Digital Logic Design.

Figure 5: Responses by Division



The job descriptions for each of the respondents were examined and a hypothetical course requirement list was created. This list was compared against the actual responses of the students. The differences in what was actually required, as reported by the students, and what the coordinator thought was required is shown in Figure 6.

Figure 6: Actual vs. Expected Courses Required



Interpreting this result is problematic and demonstrates the need for more thorough analysis. One hypothesis is that some students are not using or are not aware of using most of their coursework. Another is that the courses they have had are not easily related to real-world problems. Or, it may just be that certain jobs or kinds of jobs do not require knowledge that is readily identified with specific academic subjects.

In summary, we have analyzed responses from 92 students returning from cooperative education assignments who were asked which academic courses they found useful with emphasis on the 26% who answered that none of them were. The only clear differentiations in the responses correlate with the students' Division – students who go to work in the first cohort are academically behind their classmates who go in the second and see less opportunity to apply classroom knowledge – and in academic achievement with students with the lowest grades expressing significantly more negative answers. Further investigation is needed to understand if, for example, there are better ways of matching students in those two categories with challenging assignments. There may also be better ways to ask the question.

There remains the question of what this feedback could be telling us about our curriculum. The smaller-then-expected associations of technical courses with job needs are surprising and warrant further investigation. Clearly, there is reason for concern that the first class of sophomores to go out to work is under prepared. We need to look further into the question of how to improve their preparation in ways that are complementary to their academic progress. There also seems to be

an area needing attention in students with below-average grades and this area is possibly much more challenging. Aside from these two salient results, further study is indicated with more of a data sample to see what other trends appear and to confirm the validity of these results.

References

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Author's Biography

David Potter is a member of the Cooperative Education Faculty at Northeastern University in Boston, MA. He works with Electrical and Computer Engineering students. As a faculty coordinator, his responsibilities include preparing students for their cooperative work assignments, supporting them while they are working and guiding them in reflecting on their experiences when they return to school. He develops jobs for students in a broad range of companies. His industrial experience spans more than 30 years in the computer, networking, and research industries. He is a graduate of Northeastern University with BSEE and MSEE and currently serves, in addition to his co-op coordinator position, as adjunct instructor in the ECE department and as a part time faculty member in the School of Professional and Continuing Studies.