AC 2007-234: USING CO-OP EMPLOYER SURVEYS TO ASSESS ABET OUTCOMES

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Abstract

Like all colleges of engineering that have ABET accredited degree programs, the Bagley College of Engineering at Mississippi State University (MSU) is always on the look out for direct methods to assess whether or not its students are achieving the outcomes specified by its engineering programs. Each of our engineering programs has some assessment in place, but as we look for ways to simplify and streamline these processes, we are always on the look out for assessments that can be done at the college level to help off load some of the data gathering tasks from the departments. One such opportunity that presents itself at MSU is the cooperative education program. Although co-op experience is not required for our engineering majors, fully 50% of our engineering graduates do participate in this program. In addition, the cooperative education office has a history of extremely high return rates from surveys given to co-op employers to assess the cooperative education experience of its students. In the fall 2005, we undertook a process of developing an additional survey process for our cooperative education employers that would provide additional data for the student achievements of ABET outcomes a-k. Since we did not want to have a negative impact on the return rate of the current surveys, we held a focus group with a small group of employers to find out the best way to present these additional assessment questions without negatively impacting the return on our surveys. This paper will present the feedback from this focus group, the survey developed for this assessment, and the results from the first several semesters of the survey, including the affect on return rates.

Background

Mississippi State University (MSU) is a public, land-grant, doctoral, research university classified as Doctoral/Research-Extensive by the Carnegie Foundation. Enrollment is approximately 16,000 students. The Bagley College of Engineering enrolls approximately 2,300 students, 1,700 of which are undergraduates. The College awards approximately 370 B.S. degrees per year through ten engineering programs (aerospace, biological, chemical, civil, computer, electrical, industrial, mechanical, software, and computer science). Demographically, approximately 12 percent of the Bagley College of Engineering undergraduates are African-American and 18 percent are female. Also, the Bagley College of Engineering ranks in the top 10 percent among U.S. colleges of engineering in research expenditures (~$50M).

MSU's cooperative education program is one of the largest in the nation and recently celebrated its 50th anniversary and its 10,000th co-op student. The program has approximately 584 participating students. The cooperative education program spans all colleges in the university, however, approximately 75% of the students involved in the cooperative education program are engineering students. The co-op office has been using an on-line student evaluation system for the last 10 years for employers to evaluate student participants in the program. Typically the co-op office sees about an 85-90% return rate for these student evaluations. Recent data indicates that 40-50% of the engineering graduates at MSU have participated in the co-op program. This makes the co-op employers a rich source of assessment information on student achievement of program outcomes. In 2006 the co-op office and college of engineering developed and implemented an assessment survey for use in determining student achievement of ABET

outcomes a-k. This paper reports on the development of that survey along with initial experiences in using the survey and the assessment data that it produced.

Survey Development Process

As part of MSU's active involvement in the FIPSE program at the University of Cincinnati[3], we were aware of several other schools who were using cooperative education assessment for measuring student achievement of ABET outcomes. We used surveys provided by Georgia Tech, North Carolina State and University of Cincinnati as a starting point in developing our survey. Of crucial importance to us in the development of our own survey were that we not negatively impact the high response rates for individual student assessment that the cooperative education office was already achieving; that we not have multiple versions of the survey for different departments; and that we get meaningful data that could be used along with other assessments already being conducted within the departments and college on whether or not students were achieving the program outcomes for each engineering program.

In order to insure that we would not have a negative effect on return rates for the surveys, we conducted a focus group with cooperative education employers to get their feedback on the proposed survey and their suggestions for implementation. We selected 6-8 employers with a history of hiring co-op students at MSU and invited them to breakfast on the morning of our career fair when they were planning to be on campus already. We had approximately 15 employers from 6 different companies represented at the breakfast. The main points that the employers stressed in the surveying process were:

- the survey needs to be online and not paper that will get lost on a supervisor's desk;
- the survey needs to take no more than 30 minutes to complete and 5-15 minutes would be optimal;
- the survey needs to stress to the employers that expectations for students may vary depending on the level of the student and their particular co-op semester;
- the survey would provide a vehicle for discussion between supervisor and student about their performance during the co-op rotation.

In order to allow us to have only one form that would be applicable to all majors, we elected to ask questions on the survey related to ABET outcomes a-k rather than the specific program outcomes that are unique to each program. Each of our programs has a matrix that relates the ABET a-k outcomes to their particular program outcomes. This mapping can be used to map the results of the survey questions back to particular program outcomes. In addition, since the college was also preparing to use Educational Benchmarking's Engineering Education Exit Assessment Test[4] beginning in the spring 2006, we wanted the questions on the co-op survey to mirror the student self-evaluation questions for a-k on the EBI survey so that these results could be directly compared. The resulting survey questions and possible responses are covered in the following section.

Survey Instrument

Figure 1 shows the list of questions that employers are asked to answer when entering their assessment. We have kept this survey separate from the one where the individual student's

performance is assessed. We assure the employers that this particular survey is assessing the engineering program and not the student. We do not tie these assessments to a particular employee or student in the program and make sure that the employer knows this prior to completing the survey so that they will answer the questions a freely as possible without fear of its impact on an individual student's co-op grade.

Figure 2 shows a snapshot of the survey results page that is available to co-op office personnel as well as to the ABET assessment personnel in each academic department. The data may be viewed for the college as a whole as well as for individual departments within the college. In addition, for purposes of determining trends in the progression of students, we can select responses for students who are in their first, second or third co-op rotations. In addition, data can be viewed by the classification of a student. This is useful in comparing the effect of classes taken at particular levels in the curriculum on the employer's observation of the student's abilities. The data within {}'s preceding the average response indicates the number of employer responses to a particular question. This allows the person using the data to determine if enough responses are present so that the averages of the responses are meaningful.

Answer choices for each question are: Much more than expected(5), more than expected(4), about what was expected (3), less than expected(2), much less than expected(1), no occasion to observe

<*Student name*> has demonstrated the ability to:

1. Apply knowledge of mathematics
2. Apply knowledge of science
3. Apply knowledge of engineering
4. Design experiments
5. Conduct experiments
6. Analyze and interpret data
7. Design a system, component, or process to meet desired needs
8. Design a system, component, or process which addresses:
    a. Economic constraints
    b. Environmental constraints
    c. Social constraints
    d. Political constraints
    e. Ethical constraints
    f. Health & safety constraints
    g. Manufacturability constraints
    h. Sustainability constraints
9. Function on multidisciplinary teams
10. Identify engineering problems
11. Formulate engineering problems
12. Solve engineering problems
13. Understand professional and ethical responsibilities
14. Communicate effectively in writing
15. Communicate effectively verbally
16. Understand the impact of engineering solutions in a global and societal context
17. Recognize the need to engage in lifelong learning
18. Be knowledgeable about contemporary issues
19. Use techniques, skills, and modern engineering tools necessary for engineering practice

Figure 1 – Survey Questions

Details of Employer Engineering Evaluation of Co-op Students for Spring 2006

Of 129 Possible Responses -- Total Employers Responding with ONE or MORE Evaluation Entries: 89

For a subset of total evaluation responses, select below and press the *Process* button.

Major Department: ALL | MSU Class: ALL | Co-op Course: ALL | Process

Scale from: 5-*Much More Than Expected* , 4-*More Than Expected*, 3-*About What Was Expected*, 2-*Less Than Expected*, 1-*Much Less Than Expected* or 0-*No Occasion to Observe*

Evaluation Characteristic	Employer's Evaluation High-5 to Low-1 or 0=N/A
Numbers below in {} are Total Responses for Question with Mean Response Following.	
1. Apply knowledge of mathematics	{29} - 4.1724
2. Apply knowledge of science	{72} - 3.3889
3. Apply knowledge of engineering	{77} - 3.5325
4. Design experiments	{42} - 3.5476
5. Conduct experiments	{47} - 3.6383
6. Analyze and interpret data	{70} - 3.6571
7. Design a system, component, or process to meet desired needs	{60} - 3.6333
8. Design a system, component, or process which addresses:	
A. Economic constraints	{35} - 3.4000
B. Environmental constraints	{31} - 3.3226
C. Social constraints	{22} - 3.5000
D. Political constraints	{20} - 3.3000
E. Ethical constraints	{24} - 3.5833
F. Health & safety constraints	{37} - 3.4324
G. Manufacturability constraints	{47} - 3.5745
H. Sustainability constraints	{33} - 3.6667
9. Function on multidisciplinary teams	{66} - 3.6818
10. Identify engineering problems	{66} - 3.6667
11. Formulate engineering problems	{59} - 3.5085
12. Solve engineering problems	{65} - 3.6000
13. Understand professional and ethical responsibilities	{71} - 3.6056
14. Communicate effectively in writing	{70} - 3.5429
15. Communicate effectively verbally	{78} - 3.6282
16. Understand the impact of engineering solutions in a global and societal context	{40} - 3.6250
17. Recognize the need to engage in lifelong learning	{60} - 3.8167
18. Be knowledgeable about contemporary issues	{58} - 3.5862
19. Use techniques, skills, and modern engineering tools necessary for engineering practice	{67} - 3.8060

Figure 2 – Survey Results Web Page

Results

We have only been using this survey since the spring 2006 semester. As such, departments have not had an opportunity to use this assessment data in their formal ABET review process. Departments will begin to do this in their assessment/evaluation cycles during the spring 2007 semester. However, we have examined the information being returned by the employers and have noticed some general trends that we report on here.

The professional skills section of the survey (question 8) has a much lower response rate than other sections. This is also true of the question on applying the knowledge of mathematics (question 1). Across all employers and majors, these questions have about half the responses of other questions. This indicates that employers did not feel they had the occasion to observe these behaviors in the co-op students. We do get some feedback on these questions but will need to continue to monitor this to determine if the response rates are high enough to provide meaningful data.

We do get high response rates on questions dealing with applying knowledge of engineering (question 3), communication (questions 14 & 15), professional and ethical responsibilities(question 13), life-long learning(question 17), and teamwork(question 9). Several of these outcomes are ones that many departments struggle to find direct assessments for within the curriculum so we believe that this data will provide much needed information in the evaluation and assessment process.

Not all of the engineering majors at MSU have equal participation in co-op. Biological and aerospace engineering have low participation rates. Software engineering has a participation rate on par with other majors but the total enrollment in that program (approximately 50 majors) means that the number of students participating is fairly low. These programs will obviously not get as much meaningful data as others. In looking at all the other programs, the response rates for employers are consistent across the majors.

One concern that we had in implementing this system was that we did not want it to negatively impact the response rates on the student assessment that co-op employers were already providing. During the four semesters preceding the introduction of this survey, the average response rate for the assessment was 85% (ranging from 80% in the summer to 92% during fall 2004). In the three semesters that we have used the new survey, the initial assessment return rate has averaged 80% (we are not finished with the fall 2006 evaluation period so this number could still go up). Since employers can complete just the evaluation/assessment component without answering the ABET assessment questions, we also compared the response rates on these two components separately. Typically the response rate on the ABET evaluations are about 12% lower than the other portion. This gives us approximately a 68% return rate on the ABET assessment survey. This is still an extremely high return rate and we believe that this will continue to remain high with this audience.

Plans for Future Use

Departments are currently in the process of evaluating this data and comparing against the exit survey data as well as other direct assessments of student outcomes. This data will provide a starting point for discussions with advisory boards on how well students are achieving the program outcomes of the various departments. We hope the data provided will help to confirm that students are achieving the desired outcomes, or, if not, point to particular areas that need to be addressed. Although not all students participate in the cooperative education experience, the high proportion that do helps make the co-op employer survey a valuable tool in assessing program outcomes.

References

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