A Simple and Effective Curriculum Assessment Procedure

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Abstract

This paper describes a curriculum assessment procedure that is easy to use and provides meaningful results. The core of the procedure is a review by a department committee of student work from each civil engineering course. The author proposed the idea of a peer-review assessment procedure to the faculty during a departmental retreat and the faculty developed the implementation plan. Our department has completed two cycles of the assessment and evaluation procedure and successfully passed our ABET accreditation review last fall. The best endorsements of the effectiveness of this procedure, however, are the curriculum changes volunteered by the faculty during the "report-out" phase of the procedure.

Introduction

By now, at least a couple of people in each engineering department in this country have wrestled with curriculum assessment in preparation for ABET accreditation by the Engineering Criteria (EC) 2000[1]. As chair of the department undergraduate curriculum committee, I was willing to do a job no one else in the department wanted to do—develop an assessment plan for our upcoming ABET visit. In exchange, I asked that the assessment plan be meaningful, that is, lead to actual curriculum change. "Of greater value than merely satisfying this [accreditation] requirement, however, is that a good, functional assessment plan can significantly improve the quality of the undergraduate educational experience."[2]

To be functional, I wanted our assessment plan to be a peer review of student work. Peer review because, as University of Alabama Electrical Engineering professor Russ Pimmel puts it, "Who wants to buy gas from a station that calibrates its own pumps?" And student work because, while necessary, student opinions are by no means a sufficient source of information about the quality of a course. Others have used peer review of courses and collection of student work are discussed below.

The Chemical Engineering Department at the University of West Virginia has an outstanding peer review of student learning—the Majors.[2] "The Majors are design projects the students must complete individually and defend in front of at least two faculty members." The Majors, which date back to the 1970s, incur significant faculty time, however. Other examples of peer review of student work include: faculty-colleague check sheet evaluations of project reports[3], reviews of student portfolios and course folders of capstone design work[3], annual evaluation of portfolios of student writing assignments by faculty advisors[4], and before-graduation evaluation of writing assignment portfolios by a faculty/industry committee[4]

Mechanical engineering faculty at Stanford developed an innovative peer-review method in which professors volunteer to be reviewed by their colleagues[5]. The professor being reviewed first writes a reflective memo on the process he or she used to plan and deliver the course. Next, colleagues interview two groups of students from the professor's course. And finally, the colleague reviewers write a summary memo based on information in the reflective memo and student interviews. Focus groups were formed of participants from over a two-year period. The faculty especially liked the reflective memo and many now write these at the end of every semester. The most frequent concern of the faculty was the time commitment for the peer-review procedure. "Several faculty felt that too much time was required for the value added."

Christy and Lima[6] had students develop portfolios for biological engineering courses to initiate student-centered learning. The students found the portfolios useful, especially Meyer's Briggs intuitive types. The authors suggest incorporating portfolios curriculum-wide to enhance student learning and facilitate assessment for ABET review. Other examples of using student portfolios are available in an ASEE publication[7] downloadable on the Internet. According to Beth Panitz[7], "The theory behind such portfolios is that examining a student's work over a period of time provides a holistic assessment that demonstrates whether a student is progressing toward and truly achieving educational goals."

The course notebooks used in the assessment procedure described in this paper, while similar to student portfolios in some respects, do not indicate progression of student work over time. Also, the students do not reflect on the contents. The idea of having the students keep notebooks of all their course work came from the civil engineering faculty during a retreat in response to the question, "How can we peer review student work?"

Assessment and Evaluation Procedure

Students are asked to keep a three-ring notebook containing all course material for every civil engineering course. The notebooks are organized by tabs in a prescribed order (notes, homework, quizzes and projects). At the end of the semester, each civil engineering course instructor selects one notebook from the class to loan to the departmental review committee.

Each instructor prepares a Course Work Summary form (see Figure 1) to give to the review committee along with the student notebook. On the form, the instructor lists the program objectives addressed in his or her course. Next to each program objective, the instructor describes the student activity related to the program objective and references the specific assignments in which students performed that activity. Instructors took from 30 minutes to 2 hours to fill out a Course Work Summary the first time. The next semester instructors took between 30 minutes and an hour to fill out a summary.

Next, the review committee members review the Course Work Summaries and student notebooks. Committee members review the assignment from the instructor, the student work, and the instructor comments made when grading the assignments. The committee meets to evaluate the Course Work Summaries and writes their comments in the last column of the summary.

Results Shared with Faculty

The Course Work Summaries, with comments from the committee, were handed back to the instructors who originally filled them out. Also, the results from the Course Work Summaries were compiled into a "matrix" summarizing the program objectives (suggested by the instructors and evaluated by the committee) for each civil engineering course (see Figure 2).

The Review Committee distributed copies of the Program Objective Matrix and discussed its evaluation with the faculty during a faculty meeting. Professors in the Civil Engineering Department are not accustomed to having their teaching reviewed. Recognizing this, the Review Committee gently made the following points and suggestions.

- Many professors listed the objective "Identify, formulate and solve engineering problems" but most of the student work involved problem solving but not identification and formulation.
- Professors were encouraged to give students assignments for each program objective so that the Review Committee could evaluate student mastery. For example, a writing assignment involving some aspect of engineering ethics was preferable to simply lecturing on engineering ethics.
- Professors were asked to list the name, affiliation and topic of guest speakers.
- Professors were asked to provide documentation of student presentations (for example, have the students include their PowerPoint slides in the notebooks).

Curriculum Changes

The bottom line of the Program Objectives Matrix (Figure 2) is the "bottom line" of the course assessment and evaluation procedure. The last line of the matrix lists the number of civil engineering courses in which the committee found each course objective. Objectives 1d and 3e (ethics and life-long learning, respectively) were each found in only two civil engineering courses. The faculty discussed possible ways to include ethics into departmental courses including guest speakers, books and web sites providing material and assignments.

The discussion on life-long learning did not progress very far when one brave faculty admitted he did not know what is meant by "life-long learning". Several other faculty quickly joined in and agreed. After a 60-minute discussion, the faculty resolved that henceforth, this program objective would be called "Independent Learning". Faculty generally agreed to occasionally give their students assignments that required finding information outside the class notes or textbook by visiting the library, calling on the telephone or searching on the Internet.

A faculty member commented that, although many civil engineering courses appear to give writing assignments (based on the Program Objectives Matrix), the quality of student writing remains very poor. Most faculty agreed with this observation. Further discussion led to the resolution to hire an instructor from the English department to assist with grading writing assignments. An ad hoc committee was also formed to work with the English instructor to develop a grading procedure (or rubric) so that students would receive consistent feedback on their writing assignments as they progressed through the curriculum.

The Program Objectives Matrix shows that program objectives 3a, 3b and 3c are only covered in one course, Construction Methods and Estimating. These objectives relate to professional practice issues and were recommended by the American Society of Civil Engineers. The faculty frankly drew a blank when attempting to answer the question of how to incorporate these objectives into more civil engineering courses. One faculty member proposed dropping these objectives but the other faculty rejected this idea. The final consensus was that we had made good progress in many curricular areas (ethics, life-long learning, and writing) and we would revisit this issue at the next review. Reviews are conducted at the end of every semester.

Conclusions

Our department developed a fairly simple curriculum assessment procedure that has instigated real curriculum reform. At the core of the procedure is a peer review of student activities indicated by course work. Students collect and organize the course work in three-ring binders. At the end of the semester, a small faculty committee (appointed by the department head) reviews the course work and decides which program objectives, if any, are met the by student activities indicated by the student work. The results are compiled and shared with the faculty during a faculty meeting. No one course is singled out during the meeting, and faculty brainstorm as a group to increase the number of student activities related to “under-represented” program objectives.

Demands on faculty time are minimal. Filling out the Course Work Summary form takes from 30 to 60 minutes. Review committee members spend typically 15 to 30 minutes reviewing each notebook, and two to four hours in meetings reviewing comments and formulating recommendations. Review of the results at a department faculty meeting takes two to four hours, depending on the issues raised. Acting on the resulting action items requires the largest time commitment.

Members of the review committee commented on how much they learned from looking at their peers’ course materials. Committee members also commented on the range of quality in the course materials. Discussion started on how to reward professors who taught outstanding but up-till-now unrecognized courses. But this is an issue for another paper!

References

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Figure 1. Example Course Work Summary for Geotechnical Engineering (Lecture &Lab)

CE Undergraduate Program Objective CE students can:	**Student Activity**	**Course Assignment/Exam**	**Committee Comments**
1a. Apply knowledge of math, science and engineering	• Work homework and exam problems • Perform lab experiments	• All Homework • Exams 1, 2 and Final • All lab reports	• OK
1b. Function on teams	• Work in teams in lab	• All lab reports	• OK • Grade for team effectiveness?
1c. Identify, formulate and solve engineering problems	• Work homework and exam problems	• All Homework • Exams 1, 2 and Final	• OK for problem solving, lacks identification and formulation
1d. Understand professional and ethical responsibility	• Emphasize accuracy in data acquisition in lab	• All lab reports	• NG. This activity is too limited to lead to "understanding of professional and ethical responsibility"
1e. Communicate effectively	• Write lab reports • Give project presentation	• All lab reports • Project 1	• OK • OK, but document presentation (PowerPoint slides, grading form)
1f. Contemporary issues	• Listen to guest speaker (local geotechnical engineer)	•	• OK. Provide name, affiliation and topic for guest speaker • Better to give students assignment.
4c. Proficient in geotechnical engineering	• Evaluate soil behavior • Measure soil properties	• All Homework • Exams 1, 2 and Final • Lab reports	• OK

Figure 2. Matrix Summarizing Program Objectives in Syllabi and Course Work Summaries.

s = program objective listed in ABET **syllabus** **c** = objective found in course materials by Review **Committee**	1a) Knowledge of Math, Science & Engineering	1b) Teamwork	1c) Problem Identification, Setup and Solution	1d) Ethics	1e.1) Oral Communication	1e.2) Written Communication	1f) Contemporary Issues	1g) Collect and Analyze Experimental Data	2) Design	3a) Procurement of Work	3b) Bidding vs. Quality-based Selection	3c) Interaction of Design and Construction Professions	3d) Societal Context	3e) Independent Learning	4a) Environmental Engineering	4b) Structural Engineering	4c) Geotechnical Engineering	4d) Water Resources	4e) Transportation		# Competencies in Syllabus	# Competencies in Course Materials
SURVEYING	sc	sc	sc			c	sc	sc					sc						sc		7	8
CE MATERIALS	sc	sc				sc		sc									sc		sc		6	6
STRUC ANALYSIS I	s	s	c		sc	sc			sc							sc					6	5
GEOTECH ENG I	sc						s										sc				3	2
GEOTECH ENG LAB		sc				sc		sc									sc				4	4
STRUC STEEL DESIGN I	sc								sc							sc					3	3
ENVIRONMENTAL ENG	sc			sc		sc	sc						sc	sc	sc			sc			8	8
ENVIOR CHEM LAB		sc						sc							sc						3	3
HIGHWAY DESIGN	sc					sc			sc										sc		4	4
CE FLUID MECHANICS	sc		sc			c			sc					s				sc	c		5	6
REINFORCED CONCRETE	sc				c		sc		sc							sc					4	5
CONSTRUC METH/ESTIM	sc		sc	sc			sc			sc	sc	sc	sc			sc	sc		sc		11	8
CIVIL ENG DESIGN PROJ	sc	sc	sc		sc	sc	sc		sc				sc	sc	c	c	c	c	c		9	14
<u>**Sum of Objectives in Required CE Courses:**</u>																						
Objectives in Syllabus	11	6	4	2	2	6	6	4	6	1	1	1	4	3	2	4	4	2	4			
Objectives in Course Materials	**10**	**5**	**5**	**2**	**3**	**8**	**5**	**4**	**6**	**1**	**1**	**1**	**4**	**2**	**3**	**5**	**5**	**3**	**6**			