A LEARNING-CENTERED APPROACH TO COURSEWORK & TEACHING EVALUATION IN ENGINEERING CLASSES

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Student evaluation of teaching has served as the primary means of evaluating instruction in university classes for some time and considerable controversy has surrounded their use, especially when providing input into reappointment, tenure, promotion and merit pay decisions for individual instructors (d'Apollonia & Abrami, 1997; Marsh; 1987; Sproule, 2000; Starry, Derry, & Wright, 1973). The literature is a mix of arguments, generally not grounded in empirical research, reflecting positive (cf. d'Apollonia & Abrami, 1997; Marsh, 1987) and negative (Haskell, 1997) rhetoric regarding the use of student ratings to evaluate "teaching effectiveness." Studies that have been completed provide considerable support for factors other than student learning influencing evaluations in university courses. More recently, perhaps in response to perceived shortcomings of the current system, a concurrent peer evaluation component based on classroom observations by faculty peers has been added as a supplement to student evaluation at some institutions. All of this has led to a labor intensive and yet a fundamentally subjective process whose relevance as an indicator of the actual knowledge gain by students is yet to established.

This work has focused on a learning-centered approach to the evaluation of teaching. The work was motivated by the concerns over the confusion, inconsistencies and lack of empirical investigation of alternative practices evident in the literature and the genuine belief that there is a better way to evaluate instruction, i.e., one based on the actual knowledge gained by the students judged against a set of established criteria for any given course. Standardized tests were developed suitable for measuring the content knowledge of students in several undergraduate engineering courses. Evaluation of each course was conducted using two systems of assessment: the traditional student questionnaire feedback system and one based on the learning-centered approach using a comprehensive question bank and content knowledge testing. The goal was to critically assess the effectiveness of the learning-centered approach in relation to the current subjective form of student evaluation in a test pool of engineering classes. The following questions were central to the effort:

1. To what extent can measures of content knowledge be developed for use in evaluating the effectiveness of classroom instruction?
2. To what extent do these measures represent valid and reliable growth in content knowledge of students?
3. To what extent student evaluations of teaching relate to learning as measured by growth in content knowledge?

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METHOD

Students in selected engineering classes at a medium-sized state university in the southeast participated in the study. For the most part, students were in their second and third years and for one course in the fourth year of post-secondary education. No selective conditions other than the satisfaction of the prerequisite and co-requisite requirements were imposed on their enrollment in the courses. As is the case with analyses of traditional student evaluation data, no attempt was made to differentiate or describe groups of respondents except by section of course enrollment.

Six courses covering three different disciplinary areas in engineering (Civil, Electrical and Mechanical Engineering) were chosen to test the generality of the approach and to involve faculty from different content areas in the effort. Results for three of these courses for which data analyses have been completed are reported in this paper. Course evaluation was conducted using two systems of assessment: that based on the proposed learning-centered approach (pretest/ posttest of content knowledge) and the traditional student questionnaire feedback system. The first part of the assessment was aimed at measuring growth in student learning using a set of questions from a test bank specially developed for this purpose by a team of faculty members assigned to the course. In preparing the test bank, faculty used course syllabus and topical objectives as the guide and sought information and counsel from various relevant sources including other faculty colleagues and professionals knowledgeable about the subject matter at external institutions, as needed.

The student opinion questionnaire was patterned after the "cafeteria of evaluation" survey tool, which has been widely used in universities across the country since its introduction in the 70's (cf. Starry, Derry, & Wright, 1973, p. 62). The course and instructor appraisal system used in this research was based on a structured method for collecting student opinions about the quality of instruction from their perspective. Ratings on the questionnaire were based on a 5-point Likert-type scale (1=Strongly Agree, 2=Agree, 3=Undecided, 4=Disagree, 5=Strongly Disagree). Twenty-three items were combined for an overall rating. Three cluster ratings were derived from the original items each reflecting a different aspect of the overall rating. These included course (11), instructor (7), and general (5) evaluation items.

RESULTS

The results for the three courses, identified below as Course #1, #2 and #3, respectively, are as follows: For Course #1, the pretest mean was 14.04 ($\underline{SD}$=10.49) and ranged from 0% to 45% correct; the posttest mean was 70.20 ($\underline{SD}$=12.55) with a range of 44% to 89% correct. There was a statistically significant difference between the pretest and posttest ($\underline{t}$=16.90, $\underline{p}$<0.01). The magnitude of difference was large ($\underline{d}$=4.88). For Course #2, the pretest mean was 9.33 ($\underline{SD}$=5.96) and ranged from 0% to 33% correct. The posttest mean was 45.33 ($\underline{SD}$=5.58) with a range of 40% to 53% correct. There was a statistically significant difference between the pretest and posttest ($\underline{t}$=7.96, $\underline{p}$<0.01). The magnitude of difference was large ($\underline{d}$=6.24). For Course #3, twenty-nine students

completed the pretest, posttest, and course evaluation. Pretest performance (M=9.56, SD=7.62) for this group was significantly lower (t=20.48, df=28, p<0.05) than posttest performance (M=68.44, SD=13.69). The magnitude of the improvement (50.88%) was large (d=4.78). The relationship between pretest and posttest scores was very low (r_{xy}=0.03, p>0.05) suggesting that learning changes were not merely reflections of good students improving already high content knowledge scores. Course evaluations represented uniformly positive opinions regarding the course (M=1.98, SD=0.50), instructor (M=1.88, SD=0.58), general (M=2.30, SD=0.78), and overall (M=2.02, SD=0.54) ratings of instruction in Course #3. Low, non-significant correlation was indicated between performance assessments and students' ratings of the course (r_{xy}=-0.31), instructor (r_{xy}=-0.20), and general (r_{xy}=-0.24) item sub-scales and for the overall (r_{xy}=-0.27) ratings.

CONCLUSIONS

Our work supports two views: Current system of evaluation of teaching and, by inference, of course quality are based on questionable premises, and alternative practices grounded in student performance appraisals constitute a practical means of evaluation and offer considerable hope in reforming the system. Sproule (2000) argues that the system of evaluating university teaching is intractable for political, philosophical, and pseudo-scientific reasons; however, the winds of change blow stronger with increasing empirical support for the lack of correspondence between learning as measured by improvement in course content knowledge and student ratings of teaching effectiveness.

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