Survey of Teaching Assessments

at Engineering Educational Institutions

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Abstract – Every academic institution has systematic assessments of curricula for accreditation organizations, and a method for review of faculty achievements for salary considerations. Despite these review and assessment instruments, it is not clear the how individual teaching is truly evaluated, assessed, improved, and kept modern in the use of technology. It is the goal of this manuscript to provide a sampling of current practices for assessment of teaching for engineering professors at peer and leading academic institutions.

This paper discusses some current trends in course evaluations and teaching assessment, including student surveys and peer reviews. Educational institutions have long implemented evaluation surveys to improve the quality of instruction, especially in the areas of instructor performance and course content. While the data provided by these student surveys are perceived by some faculty to be of limited value as an effective assessment and improvement tool, these surveys remain the primary means of teaching and course feedback to the instructor and the administration. As such the best survey methods, content, and format are required to extract accurate student information for any meaningful interpretation.

Techniques for improving survey response quality, completion rates, and a review of a limited sampling of course evaluations at peer and leading institutions of higher education are offered. Data presented in this paper were gathered from the public domain. Benchmarking the approaches at these institutions is a critical step in the development of an effective means of assessing faculty teaching and providing resources for continuous improvement. The survey content data indicated that many questions, not directly relate to teaching or course content are present on student surveys. Appropriate length, incentives, and information on the use of the data are required to motivate students and to provide higher quality data.

Keywords: Course Evaluation, Assessment

BACKGROUND

A primary goal of engineering educators must be to provide the best classroom experiences, using modern and effective techniques for educating students. While teaching methods may vary by individual, dependent upon technical skill, talent, and personality, it is necessary to have honest, fair, and expert feedback to improve teaching by the faculty. By improving the actual, as well as the perceived, quality of teaching other significant goals may be achieved, such as increasing enrollments and retention of engineering students, especially those in the under-represented demographic populations. Thus, the benefit of increasing the quality of teaching extends to the student, teacher, and the institution of learning.

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There appears to be two main avenues of teaching evaluation: observation with critique by a skilled expert, and a survey of the students who have taken the course. While the methods are not exclusive, and owing to the cost and time associated with the observational methods, surveys have been the primary, if not the singular, means of evaluating teaching at institutions of higher education. The first uses of teaching evaluations at universities in America were cited as occurring between 1915 [1] and the early 1920s [2]. However, wide usage of evaluations did not begin until the 1960s and later. Today, virtually all educational institutions have students complete course surveys each semester to provide feedback on their instructor's performance and course content. The data provided by these surveys may have significant or limited use as an effective assessment and improvement tool, dependent on survey attributes, student engagement, and administration of the survey.

Evaluation or guarantee of professional performance in many areas (medicine, engineering, surveying, law, education, etc.) has always been somewhat lacking, with an exception to minimum standards in most of the professions. Quite often an official assessment only occurs at the beginning of a career, as professional certification. Tenure for university professors might be viewed in the same way, assuring only minimum standards. Quality assurance concepts for continuous improvement typically practiced in manufacturing or critical safety areas such as transportation have not been applied to many professions, including engineering professors. Assessing teaching effectiveness and as well as course content has been primarily left to the course surveys. Other methods used in K-12 education, such as peer or supervisory review of actual teaching are also starting to be integrated into post-secondary education. While the primary focus of this paper centers current sampling of course evaluation surveys, the following section details a recent pilot project for peer review as an evaluation means.

Peer Review Evaluation of Teaching

Brent and Felder [4] have described a pilot study at the North Carolina State University, Department of Chemical Engineering using a peer review component in the evaluation of teaching along with input from students, administrators, self-ratings, and learning outcomes assessment that address all aspects of teaching. They point out that students are not qualified to evaluate many aspects of teaching such as the content, the appropriateness of the level of difficulty of the course, necessity of pre-requisites, and whether the course content and learning objectives are consistent with the course's intended role in the curriculum of their specific program. It was judged that only faculty colleagues who are sufficiently skilled and educated should assess and evaluate an instructor's teaching. Not all faculty members in a college or department are qualified or interested enough to review the teaching of another faculty member, and those who are qualified may be over utilized. There were also other concerns for the peer review process such as no universal agreement among faculty members about what comprises good teaching, with slim odds of achieving consensus on all aspects in most academic departments.

The review process was based on research focused on teaching effectiveness, consistent with accepted best practices in evaluation, and was deemed that it does not impose undue time demands (7 hours) on the faculty reviewers. While the initial results provided useful feedback to reviewed faculty members, it is important to note that the protocol developed only used peer review as only a component of the teaching assessment, not as a replacement for student evaluation surveys. In fact, it should be noted that the use of course evaluation survey results remained an integral part of the teaching review process in the pilot study. Thus, it appears than modern teaching evaluation must have some element of student feedback through surveys.

EVALUATION SURVEYS

The content, length, type of questions in course surveys will be shown to vary significantly between institutions, from the sample presented. As the surveys are often the only instrument for teaching evaluations, the design and administration of the surveys must focus on keeping students interested and engaged in the process.

Reference [1] sheds some light on the student motivation issues in surveys. The paper recommends some simple things to increase student motivation and interest. First: Inform the students of the uses of the evaluation results. Students were most likely to complete the survey and provide thoughtful comments, if they believed the professor will take their feedback seriously. The second highest motivation for students was the desire to improve the course (content, format, etc.). Suggestions on the way to accomplish this included that faculty demonstrate the use of evaluation results in their courses. (e.g., an example should be included on each syllabus stating how student

feedback has improved a course, or caused a change in teaching methods). Clearly, motivating students to thoughtfully complete a survey for each course is a challenge.

Survey Length

Surveys with good participation and valid results are critically important to all organizations planning to use the survey results to make decisions, especially business decisions. The length of a survey has been found to affect the response rate and quality of responses. Increasing the length of a survey negatively impacts the number of respondents and detailed information provided. The shorter a survey is, the more likely a survey participant is to complete it. Market Research Tech, a commercial information source for market research has indicated that there are four primary factors in determining the maximum length of a survey. These fours factors are (1) incentive, (2) interest, (3) fun and ease of completion, and (4) impact for respondent.[7]

The survey length is a trade-off between the number of relevant questions asked, and the optimal length that will entice students (or customers) to respond. Effective marketing surveys typically do not use supplemental questions, but only questions that are pertinent to the target areas of the research. It will be shown that many, if not most, course evaluation surveys have excess questions, even including some that are unrelated to teaching.

Incentives for Respondents

As course evaluations move to on-line surveys, typically outside the classroom, student completion rates have decreased. The incentive for a survey responder is typically monetary for commercial surveys. Payments, rebates, prize drawings are all useful to increase respondent completion. However, it has been found that larger incentives are required for longer surveys. [7] In a similar fashion, incentives for students to complete course evaluation surveys have been instituted at some colleges and universities. A good example of using incentives for student course evaluations may be found at Columbia University's Fu Foundation School of Engineering and Applied Science, which began using the web for course assessment in 2000. Completed student evaluations enter a student in random prize drawings for small consumer electronics such as an iPod. Since implementing the incentive, student response rates have steadily increased to 85%. [8] Other positive effects include more detail in student written comments in course assessments. Supplemental questions (for ABET EC2000 assessment and those customized for faculty interests) were limited to a small fraction (15%) of the survey, as the additional questions were deemed a disincentive.

Building on the Interests of the Respondents in the Survey

Advanced online survey techniques, not currently used in course evaluations may also yield some benefits in terms of data and completion rates. These streamlined surveys techniques have yielded the highest response rates on commercial surveys. Techniques include branching, intelligent looping which skips or enters a series of questions depending on the participant's previous responses (implied interest). Skip-logic "branching" allows respondents to skip certain questions in surveys based on how they answered previous questions. Similarly, "intelligent looping" adds questions based on respondent interest. By only answering questions logical to the respondent's interest or situation, the survey length can be made shorter and yields higher completion rates. These techniques segment the respondents and are not presently used in course evaluation surveys.

EVALUATION SURVEY DATA

A small sampling of current teaching evaluations from primarily educational institutions with engineering programs were gathered from the public domain. Student course evaluation surveys from peer institutions for Mercer University and top engineering schools as listed by *US News and World Report* for 2008 were sought for review and comparison. Benchmarking the approaches at peer institutions is a critical step in the development of an effective means of assessing faculty teaching and course content, providing a basis for continuous improvement. Mercer University School of Engineering is presently reviewing and revising its course evaluation and assessment of teaching effectiveness.

Both public and private universities were represented in this survey. Educational institutions whose public information on course evaluations was surveyed in this paper included: MIT, Stanford University, Georgia Tech, Bucknell, UIUC, Cal Tech, University of Texas at Austin, Drexel University, Carnegie Mellon University, Smith

College, Towson University, Yale University, Rose-Hulman Tech, and University of WI-Milwaukee. Data were only gathered from the public domain [9-24], so no confidential data were sought or are presented.

Summary data for the course evaluation questionnaires for the given sampling of university and colleges are presented in Table 1. Data characterization of survey questions were broken down in to categories. Where several options existed on a particular survey, questions were limited to a lecture course without a teaching assistant. In some instances older (before 2008) data were used, if current data were unavailable at the time of data collection. Each question was assigned to a particular category; judgments were made about the category of each question, irrespective to the category that may have been assigned in the actual questionnaire. For example a question on teaching methods may have been in the 'course content' section of a survey form, but actually relates to the instructor.

Table 1. Base Data for Course Evaluations: Multiple Choice

School	Olin	MIT	Bucknell	Cal Tech	GA Tech	UIUC	Rose Hulman	Towson	Stanford	UT-Austin	Drexel	Mercer	Smith College	WI-Milwaukee	Yale
Format	online	paper	paper	online	online	paper	online	online	online	paper	online	online	online	paper	online
Year	2008	2004	2004	2008	2008	2008	2006	2008	2008	unknown	2008	2008	2008	2008	2008
Use of Data Explained	YES	NO	NO	NO	unknown	NO	unknown	YES	YES	YES	unknown	YES	Yes	YES	NO
Likert-type scale questions-actual	7	24	11	23	13	23	21	23	23	22	11	26	13	18	10
Comments for Likert-type scale questions	NO	NO	NO	NO	YES	NO	unknown	NO	NO	NO	unknown	YES	YES	NO	NO
Comment questions actual		3		3		6	unknown	4	4	1	unknown			2	3
Likert Scale	5	7	5	7	5	5	5	5	5	5	5	5	5	5	5
Instructor /Teaching															
Methods, effectiveness		4	3	2	2	7	4	5	6	6	2	7	3	5	
Grading		2		1	3		2	2	2	2	1	2	1		
Person skills		3	2	3	2	3	2	1	3	3	1	4	1		
Availability out of class		1	1				1	1		1		1	1	1	
Competence						1			1	1		1		1	
Overall rating		1	1	1			1	1	1	1	1			1	1
Course Content															
Assignments/Workload/ Difficulty	2	2		2	2	1	3	3	1	2		2	1	4	1
Interest/Challenge	2	1	1	2		4		1				1	2	1	
Learning Objectives	5			1			1	1		1		1	1		
Specific learning objectives															
Application of Knowledge	1	1					1								
Other/General/overall	1	3	1	1	3	2	2	1	2			3			1
Learned a great deal/skills/etc		1			1			1							
Valuable/developed new skills			1	1		2	1		1	1				1	
ABET											3				
Overall Course rating		1	1	1		2	1	1		1	2	1		1	2
Time spent	1	1		1											1
Textbook/materials		2		1			2			1		2		2	1
Grade expected				1				1		1	1		1		
Good understanding		1													
Student info				5		1		4	6	1		1	2	1	3

Survey Format

From the data it can be seen that the majority of institutions are using online formats for data collection. Note: Some of the data may not be current (MIT, Bucknell) as many institutions have their current online course evaluation survey information and access secured. From the data presented in Table 1, an average of nearly 18 multiple choice questions were asked, on average, along with approximately 2 comment/essay questions.

Many schools have recently changed over to online survey methods. For example MIT, a preeminent technology institution, only recently changed from paper surveys to online surveys. A problem arising with online surveys is that students generally are required to complete the survey on their own time. Assuming that a student reads, contemplates and responds to a survey question in 20 seconds, a student with 5 courses, each with 20 questions per survey would take over 30 minutes to complete all survey questions. As has been observed and noted earlier, student interest in survey completion decreased with survey length and personal time intrusion. The use of paper surveys, during class time, did not intrude on student personal time and yielded higher completion rates.

The design of the surveys also varied substantially across the sample. Some surveys intentionally interwove questions on multiple areas [12, 13], and asked a question in both a positive and negative context, possibly for evaluating responder consistency. These redundant tended to increase the length of the survey. Other surveys clearly grouped questions under general headings (e.g., quality of teaching, factors in learning, assessment of learning,

course materials, and subject [8]). Font, font size, spacing of questions, and other formatting and layout schemes were varied to ease viewing in some survey designs.

It is also interesting to observe that only half of the surveys fully explained the use of the surveys, possibly reducing respondent interest.

General Areas of Questions

It should be note that many types of comparisons about the format and content of the surveys may be drawn from this data. A first categorization is that the questions can be separated into multiple-choice (Likert scale) answers and comment/essay questions. The comment/essay questions were very limited in number and area for the institutions surveyed. Only about half of the surveys asked comment/essay type questions. In fact there were only two areas (Instructor/Teaching and Overall Course) where more than two institutions had even asked a comment-only question. Thus, the focus of this sampling summary is on the multiple-choice questions of the surveys. The most common scale was a 5-point Likert scale, with only two schools using a 7-point scale.

Table 2 lists the summary counts of survey questions by general area for the multiple-choice questions. While the area and purpose of the questions varied greatly and even included ABET assessment questions, the primary focus of the questions centered on teaching and content. Instructor and Course Content areas dominated the types of questions on the surveys with an average of more than 8 questions (47%) relating to the instructor and 5 (30%) relating to course content. The (distant) third, most-asked category was questions relating to student information (year in school, major, studying hours per week, time spent on course per week, percent of homework completed, percent of class attended). Instructor and Course Content areas are broken down in further review.

Table 2. Questions by General Area for Course Evaluations: Multiple Choice

General Area	Count	Total	Average	avg. %
Instructor	15	125	8.3	46.6%
Course Content	15	81	5.4	30.2%
Student info	9	24	1.6	9.0%
Overall Course rating	11	14	0.9	5.2%
Textbook/materials	7	11	0.7	4.1%
Grade expected	5	5	0.3	1.9%
Time spent	4	4	0.3	1.5%
ABET	1	3	0.2	1.1%
Good understanding	1	1	0.1	0.4%

Questions Relating to Teaching and the Instructor

Questions concerning the evaluation areas relating to the instructor have been subcategorized and summarized in Table 3. The most asked questions related to instructor behaviors were effectiveness and methods of instruction, followed by questions relating to person skills. Technical competence was the least evaluated. Clearly, the competence of the instructor on the subject was of least concern to survey designers. Whether the students have the ability to correctly judge instructor subject competence is unclear. Students may consider other instructor subject competence as instructor attributes. While difficult to articulate, the 'person skills' of a professor were second in the frequency of questions asked.

Questions Relating to Course Content

Table 4 provides a categorization of questions relating to course content. Note: all questions were considered to be in distinct areas and were only counted once. In the course content area questions relating to assignments, workload, and difficulty of the course were the most asked with an average of nearly 2 questions per survey (Table 4). While overall course content was second, the questions varied substantially from 'learning applications', 'interest in the subject', to 'learned something valuable'. A close third was questions relating to interest in the subject and challenge of the course. It should be noted that much of a course challenge may be the instructor.

Table 3. Instructor Evaluation Areas for Course Evaluations: Multiple Choice.

Instructor Evaluation Areas	Count	Total	Average	avg. %
Methods, effectiveness	13	56	3.7	44.8%
Person skills	12	28	1.9	22.4%
Grading	10	18	1.2	14.4%
Overall rating	10	10	0.7	8.0%
Availability out of class	8	8	0.5	6.4%
Competence	5	5	0.3	4.0%

Table 4. Course Content Areas for Course Evaluations: Multiple Choice.

Course Content Areas	Count	Total	Average	avg. %
Assignments/Workload/ Difficulty	13	26	1.7	32.1%
Other/General/overall	11	20	1.3	24.7%
Interest/Challenge	9	15	1.0	18.5%
Valuable/developed new skills	7	8	0.5	9.9%
Learning Objectives	6	6	0.4	7.4%
Application of Knowledge	3	3	0.2	3.7%
Learned a great deal/skills/etc	3	3	0.2	3.7%
Specific learning objectives	0	0	0.0	0.0%

SUMMARY

The current methods of evaluation for course content and teaching focus on the student responses of surveys. It is apparent from the sampling in this paper that the current preferred method of student surveys using online approaches will only continue and grow. Other methods of teaching evaluation such as use of peer review appear limited. The initiatives into peer review for teaching assessment may grow, dependent on the real and perceived costs and effort of reviewers and the results achieved by this method. It should be further noted that the use of peer reviews does not eliminate the need or use of student surveys [4].

The collection and assessment of meaningful survey data require both a high quality instrument and the strong support and engagement of the student responder. From the data presented here, an average of about 20 questions per survey is asked per each course (18 multiple choice and 2 comments-only). From the variation of questions and the data indicating longer surveys have poorer responses, it is apparent that unnecessary, supplemental questions have been asked. Shorter surveys with fewer, but critical questions should be implemented. More detailed descriptions of the use of the survey data also need to more broadly implemented, than the current 50% of surveys.

It is also interesting to note that most surveys had a limited number of comment-only questions or none. Futhermore, in the majority of the sampled surveys there were no opportunities for additional comments to be entered. It must be concluded that most surveys were designed for primarily numerical data. Unfortunately, it is the written comments from students that faculty find most constructive for making changes.

When shorter surveys are combined with a completion incentive (monetary or a prize), results should yield better quality responses with higher completion rates. It is also suggested that time be allocated in the classroom for completion of the surveys, further reducing the time cost of students to complete these surveys. As educational computer systems administration competence in wireless technologies increases, use of personal electronics (phones, etc.) might be used to further increase the student response rate.

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