

# Making the Grade with Students: The Case for Accessibility

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## ABSTRACT

Student-based teaching evaluations are one critical component of instructor and course evaluation in most universities. The purpose of this study is to critically examine several factors that drive student-based ratings of instructors and courses in an undergraduate mechanical engineering program. The findings are based on a statistical study of student ratings in 181 mechanical engineering courses during a three and one-half year period, two mid-semester classroom interviews, and anecdotal evidence garnered from personal experience. A key rating that appears strongly linked with the overall instructor and course rating is the “accessibility of the instructor.” The instructor accessibility factor outweighs others often cited by conventional wisdom, such as perceived course workload or expected grade in the course. Rationale for the strong correlation between instructor rating and perceived instructor accessibility is discussed. Several suggestions for how to improve instructor accessibility and resulting student-based teaching evaluations are provided.

## I. INTRODUCTION

As students, we spent countless hours studying in the hope of achieving exceptional grades and embarking on a satisfying career. As we approached graduation, we naively believed that the grading process would end. We were wrong. Now, as faculty members, the tables are turned and we are once again graded—this time by the students we teach. The evaluation of faculty by students is one

critical and necessary part of assessment in engineering education. Although some instructors consistently obtain high teaching marks from their students, others are routinely marked down for their teaching efforts. In this paper we explore potential driving forces for high teaching evaluations, with the overarching goal being to guide all faculty to new levels of teaching excellence and subsequently higher student evaluation.

In 1986, the four-campus University of Colorado (CU) system implemented mandatory student-based faculty/course evaluations called Faculty Course Questionnaires (FCQs) [1]. The purpose of FCQs is to elicit and publish information for students, faculty, and university administration on students’ perceptions of teaching quality in individual courses. The FCQ “grades” are one of several tools considered in course evaluation in the CU system. The FCQ forms are administered at the end of each semester during the final week of classes, prior to final exams and formal grade distribution. After semester-end, the FCQ data are summarized and posted on the Internet for students and university administrators. The course instructor receives the original student feedback forms, which contain valuable qualitative comments in addition to quantitative rankings. In the CU system, like many universities, FCQ scores are integrated into faculty promotion/tenure and merit review processes. In addition, students consult Web-based FCQ ratings on courses and instructors prior to course registration.

Most, if not all, engineering faculty agree that student learning is the desired outcome of effective teaching. A large body of evidence indicates a positive correlation between student learning and overall faculty/course ratings in student-completed questionnaires [2–5]. In the early 1980s, a study by Cohen revealed that one critical measure of teaching effectiveness—student achievement—correlated with overall student ratings of the instructor ( $r = 0.43$ ) and course ( $r = 0.47$ ) [2]. More recent studies have corroborated the positive link between student learning and overall student evaluations of teaching effectiveness [3–5]. One critical finding has been the stability of student rankings several years after student graduation [3]. Cashin found that the correlation between alumni and student rankings ranged from  $r = 0.40$  to  $r = 0.75$ , which helps to diminish the suggestion that students come to “appreciate” poor teaching after gaining “real” work experience [1, 3].

Although most statistical evidence supports a positive correlation between teaching effectiveness and student-based faculty/course ratings, several studies have pointed out the need to account for student bias in ratings [6–8]. Such studies indicate that student characteristics and perceptions can sometimes have a significant effect on ratings. It is recommended that multiple measures of teaching effectiveness be employed to achieve the most accurate measure of student learning. One of these measures is a student-based rating system, such as the FCQ.

The purpose of this paper is to explore several factors that lead to high FCQ scores in engineering education and help engineering faculty gain insights into how they might improve student perceptions of teaching effectiveness. We base our findings on a combination of student FCQ rating analysis, two classroom interviews, and anecdotal evidence derived from the teaching experience of the authors. The paper utilizes the mechanical engineering FCQ database from CU-Boulder, although the recommendations are expected to have more widespread application to other fields. Results from a statistical study of 181 undergraduate mechanical engineering courses covering a three and one-half year period are presented. A statistical analysis is employed to determine which variables correlate on student FCQ results. Following the presentation of the statistical data, selected results of two mid-semester classroom interviews are presented. The paper concludes with a discussion of the findings and a summary of key recommendations based on personal teaching experience for optimizing student learning, student perceptions of teaching, and subsequent instructor FCQ ratings.

## II. STUDENT PERCEPTIONS OF TEACHING: THE FCQ DATA

A statistical analysis was performed on the FCQ results from all required and elective undergraduate courses in the mechanical engineering curriculum taught from spring 1999 through spring 2002 (seven semesters). This analysis included a required general engineering first-year projects design/build course, but did not include required core courses outside the mechanical engineering course structure such as chemistry, physics, or calculus. A total of 181 courses was analyzed; small courses with fewer than five FCQ responses were discarded from the analysis.

The FCQ forms contain twelve factors for the students to rank. The following subset of items was selected for this analysis:

- Course rating (compared to all other university courses)
- Instructor rating (compared to all other university instructors)
- Fairness of grading policies
- Accessibility of instructor
- Workload relative to the credit given
- How the course addressed issues and information about women and ethnic minorities
- Expected grade in the course

On most FCQ items, students assign one of five letter grades—A (very good), B, C, D, or F (very poor)—which, for averaging purposes, correspond to numbers four, three, two, one, and zero. The course workload rating ranges from zero to ten, spanning a

spectrum from “too light” to “too heavy,” with the value five representing “ok.” The overall course and instructor ratings are perhaps the most important factors for administrative decisions; the latter five categories listed above are also commonly perceived as important by students and/or faculty and are required on the FCQ form for all courses. The forms also request that students rate other dimensions such as “presentation of course material” or “knowledge of subject matter.” Although these variables are critical to effective teaching, for this study we will focus on the above seven factors since they seem to be the center of most controversy among faculty.

Table 1 and Table 2 present the correlation coefficient,  $r$ , as well as means and standard deviations for the seven above-mentioned variables. The strongest positive correlation (0.85) exists between the overall course and the instructor ratings. Based on the data in Table 1, it would be extremely unlikely to find a high course rating coupled with a low instructor rating, or vice versa. Interestingly, this could imply that a difficult-to-teach course, with an inevitably low rating, could serve to bring a usually strong instructor’s rating down. Viewed another way, the strong correlation between instructor and course ratings could indicate that the instructor rating is the primary driving force for the course rating, as has been suggested by Cashin [3]. In either case, based on the near interchangeability of the course and instructor ratings, for our analysis we will focus on the correlations between the instructor rating and the other five variables.

Strong correlations exist between the instructor rating and both the accessibility of the instructor (0.74) and the perceived fairness in his or her grading policies (0.76). Grading fairness and instructor accessibility also correlate strongly to each other (0.64), which may indicate an inherent link between the two variables. For example, students may be more satisfied with an instructor’s grading policy if they feel more comfortable with the instructor. A significant positive correlation exists between the instructor rating and the instructor’s treatment of diversity issues (0.54). A mild correlation exists between the instructor rating and the expected grade of the students (0.36), while a weak negative correlation is found between the instructor rating and the course workload (−0.21).

Figures 1 through 3 present more detailed representations of the full data sets relating instructor rating to three selected variables that will be explored further: accessibility, expected grades, and workload. Figure 1 plots instructor rating versus workload for all 181 courses, and reveals two noteworthy trends. First, the average of the workload data is well above the “ok” workload rating of five. Secondly, as indicated by the weak correlation coefficient (−0.21), the data are scattered, with mild clustering in the upper center of the plot.

FCQ Variable	Course	Instructor	Fairness	Accessibility	Workload	Diversity	Expected Grade
Course	1						
Instructor	0.85*	1					
Fairness	0.68*	0.76*	1				
Accessibility	0.69*	0.74*	0.64*	1			
Workload	-0.15	-0.21*	-0.22*	-0.15	1		
Diversity	0.34*	0.54*	0.64*	0.29	-0.14	1	
Expected Grade	0.52*	0.36*	0.37*	0.39*	0.15	0.00	1
* $p < .01$		$n = 181$					

Table 1. Correlation coefficient,  $r$ , for seven selected variables from the end-of-semester student feedback Faculty Course Questionnaire (FCQ) forms.

FCQ Variable	Mean	SD
Course	2.85	0.65
Instructor	2.94	0.75
Fairness	3.06	0.58
Accessibility	2.95	0.55
Workload	5.99	0.93
Diversity	3.72	0.39
Expected Grade	3.39	0.35

Table 2. Mean and standard deviation for seven selected FCQ variables.

Figure 2 plots instructor rating versus expected grade, showing a trend for higher expected grades to be coupled with higher instructor ratings. Notably, at a given expected grade level, considerable scatter exists in the instructor rating. On average, the students also appear to expect high grades. Figure 3 plots instructor rating versus accessibility, and the strong correlation (0.74) between the variables is evident. With higher accessibility ratings, the instructor rating is quite predictable. However, as the accessibility rating decreases to average, uncertainty in the instructor rating arises. In Figure 3, the dashed boxes mark two different sets of four data points whose course workloads were averaged to obtain the values noted on the

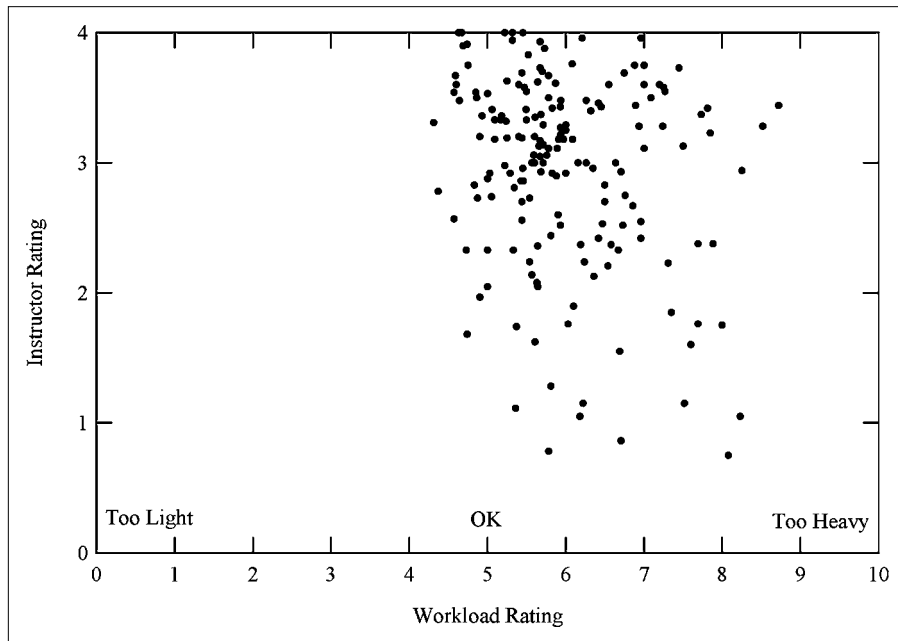


Figure 1. Data for instructor rating versus workload. The correlation between these variables is weak, with  $r = -0.21$ .

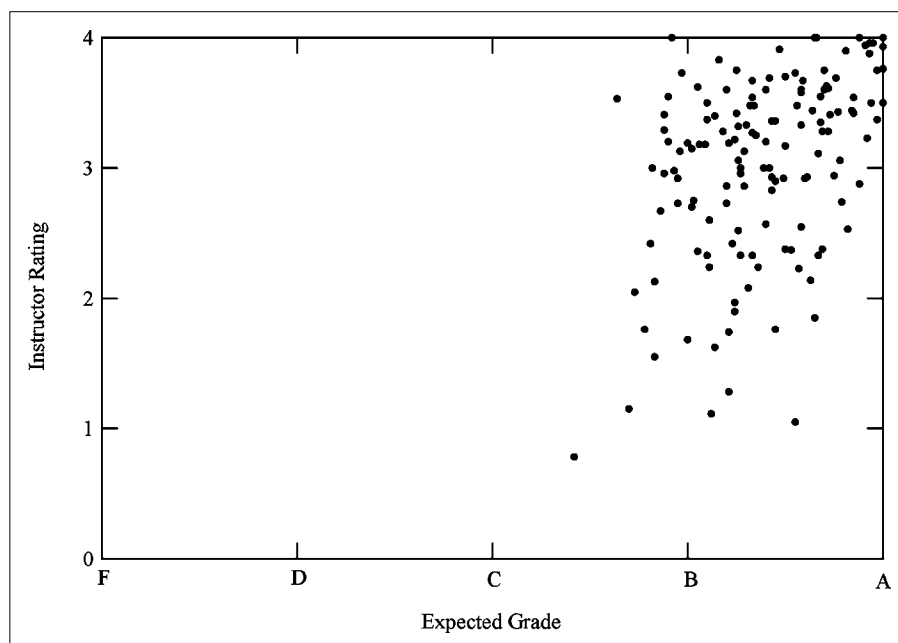


Figure 2. Data for instructor rating versus expected grade. The correlation between these variables is mild, with  $r = 0.36$ .

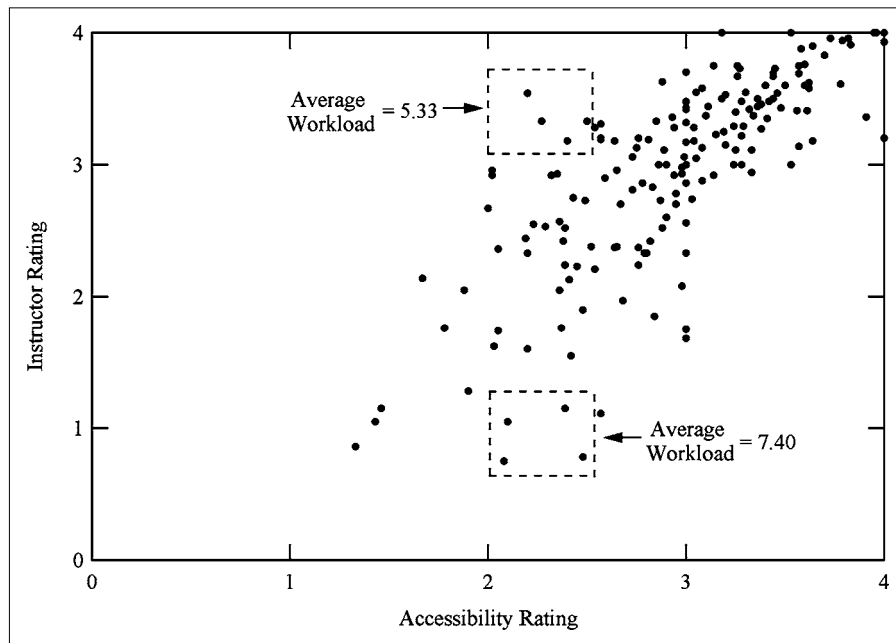


Figure 3. Data for instructor rating versus accessibility. The correlation between these variables is strong, with  $r = 0.74$ . The average workload values cited in the graph are the average values for the four data points enclosed within the dashed boxes.

graph. A difference in average course workloads is apparent between courses rated high and low at the same poor accessibility rating.

### III. MID-SEMESTER CLASSROOM INTERVIEWS

As a complement to the statistical FCQ analysis, two mid-semester classroom interviews were conducted. In the classroom interview process, the students were not given a form with pre-described questions, but instead were asked to generate a list of the strengths and ways to improve the course. Small groups first reached consensus on the strengths and potential improvements, and a consolidated list was put on the front board. Next, students voted individually, indicating the degree to which they agreed or disagreed with each listed strength and suggested improvement. For this assessment process, the interview facilitators were CU staff not affiliated with the courses, the instructor and any TAs were not present, and all feedback was captured anonymously. Results were withheld from instructors until after grades were distributed.

Two specific courses were targeted for the classroom interview process. Course 1 is a senior-level class with approximately 80 students taught by an instructor with consistently high FCQ ratings. Course 2 is a junior-level class with approximately 80 students taught by an instructor with relatively lower FCQ ratings. At the end of the semester, the overall instructor rating of Course 1 was A+ while the overall rating of Course 2 was F. These ratings span the high and low values of potential course ratings, and thus the feedback from these courses provides a valuable comparative tool.

Below, we present selected issues with high significance from the classroom interviews of the two courses. We focus on comparing the student-volunteered strengths of the highly rated course to the improvements of the poorly rated course. We present feedback directly related to the interaction between the class and the instructor. We have not selected “technical” issues from the course feedback sessions since the courses cover different subject areas.

Selected Strengths of Course 1 (A+ overall instructor rating):

- Instructor connects personally with the students (98 percent student agreement).
- Instructor is responsive to student feedback (92 percent).
- Instructor is available to answer questions in and out of class (90 percent).

Selected Improvements of Course 2 (F overall instructor rating):

- Instructor should encourage in-class questions (97 percent).
- Instructor should treat students with more respect (94 percent)

It is important to note that while the students independently formulated these course strengths, they are related to the “accessibility of the instructor” question on the FCQ. The classroom interview results, therefore, corroborate the findings of the statistical analysis on the importance of perceived accessibility of the instructor.

### IV. DISCUSSION

The FCQ data analysis and the classroom interview indicate that one key factor in students’ perception of an effective instructor is her or his accessibility. Although fairness of grading was also strongly correlated with instructor ratings, this dimension was not corroborated in the mid-semester classroom interviews and, therefore, will not be discussed. Recent studies in other fields have reached a similar conclusion on the importance of instructor “accessibility” for effective teaching. Das *et al.* determined the factors critical to ideal teaching as viewed by *both faculty and students* [9]. The students and faculty agreed that the “most important” factor is a “willingness to help students,” which can be interpreted as a component of instructor accessibility. A complementary study of a large number of business students used a statistical analysis to determine the factors that are predictors of effective teaching [10]. Among the twelve factors found significant were “the instructor answers students’ questions” and “the instructor treats students in a courteous and/or professional manner,” both of which are a manifestation of

perceived faculty accessibility. Although other factors can certainly contribute to effective teaching and high teaching evaluation by students, our results and the literature indicate that instructor accessibility is one of the key factors. Furthermore, accessibility is a factor that instructors can readily control.

Detailed examination of the data in Figure 3 reveals additional insight into the correlation between accessibility and instructor rating. For high accessibility ratings (above 3.0), instructor ratings rarely fell below 3.0 for all classes analyzed. This implies that it is unlikely for one to receive a low teaching rating from students if the students perceive the instructor as accessible. This does not hold true of other variables, such as expected grade (Figure 2). An average expected grade between a B and an A would not statistically assure that an instructor would obtain a high teaching rating. Interestingly, as the instructor's accessibility rating goes down, the spread in the instructor rating becomes large. In other words, if an instructor is not accessible to students, he or she may or may not receive a high teaching rating. Looking at the data more carefully reveals a trend in the data spread. Courses with poor accessibility marks and *relatively* high instructor marks had low workloads, on average (Figure 3). Courses with the same poor accessibility marks and low instructor marks had relatively high workloads, on average (Figure 3). These average workload ratings for the selected four data points are close to the extreme values for workload presented in Figure 1. It appears that extremely low instructor ratings are achieved from a deadly combination: load the students with a lot of difficult work and limit the accessibility of the instructor to provide student assistance. However, high workload by itself *does not* diminish overall instructor rating (Figure 1).

A natural question arises—what does “accessibility of instructor” mean to the students and why is it so important? At first glance it may be assumed that accessibility simply reflects the number of out-of-class office hours committed to the class. It is common for instructors to state that students never come to office hours, but then complain that they were not perceived as accessible to students. We suggest that perhaps accessibility is perceived by the students as a combination of availability and *approachability*—practical measures of an instructor's willingness to help them. As found in previous studies, as well as the classroom interviews, it is important for students to perceive a genuine effort to help them learn, both in and out of the classroom. This does not imply giving the students answers, but it does mean mentoring them. Mentoring a student requires a personal connection with the student [11], which goes beyond the transference of technical information. If students perceive an instructor as a good mentor, they may also feel that the instructor is approachable, which is a key component of accessibility. Personality factors may also play a role in the student perception of approachability, as previous studies have shown that instructor expressiveness correlates positively with overall ratings [3]. Furthermore, avoiding the “office hours” syndrome is critical to conveying availability. Office hours are convenient for instructors, but they do not always create a comfortable or convenient help environment for students. Scheduling targeted help sessions when the students need them or having an open-door help policy better contribute to accessibility, as defined from a student point-of-view.

By emphasizing the importance of instructor accessibility, we do not imply that other factors are not important in determining teaching effectiveness and FCQ ratings. As shown in other studies [9, 10], traditional factors such as the clarity of presentation of

course material, instructors' knowledge of the course material, and subject matter organization are critical for optimizing student learning levels and subsequent teaching ratings. As important as these traditional variables are, they can be linked to instructor accessibility. For example, if an instructor does not want to commit an inordinate amount of time to teach material to a class of 100 students, it is advisable to present the material clearly in class the first time. If the instructor does a poor job presenting the material, he or she should be ready to handle the resulting barrage of students who need better explanations. If the instructor does not subsequently help these confused students, then his or her perceived accessibility will go down, and we assert that the student perception of overall instructor effectiveness will likewise be diminished.

## V. SUMMARY AND RECOMMENDATIONS

In this paper, we have examined numerous variables that correlate with student-based overall instructor and course ratings. Among the variables analyzed on 181 courses and two classroom interviews, instructor accessibility emerged as a dominant variable. Previous studies in non-engineering fields have also noted the importance of “instructor accessibility” or “willingness to help” in driving student course/instructor ratings. *We assert that the accessibility of the instructor is derived from the availability of the instructor coupled with his or her approachability.* Based on personal teaching performance with high accessibility and instructor rankings, we believe that improving an instructor's accessibility enhances the student learning experience and likewise increases the student perception of overall instructor effectiveness.

Methods used by the authors in their personal teaching experience to maintain a high level of accessibility, without excessive time commitment, include the following.

- Have lunch with individual students to build a personal connection outside of the classroom, making one more approachable.
- Obtain in-class feedback from students every other week to determine what topics they did not follow in lecture, providing an opportunity to revisit the topic with the entire class.
- Establish an open-door policy and meet with students at any time; most often the students have brief questions.
- Conduct an evening help session just before the due date for homework, projects, or exams. Students who do not come to office hours will often come to this group help session.
- Run communication and team building activities in class in which the instructor participates actively.
- Learn the students' names at the beginning of class, and address them by their name inside and outside of class.
- Offer to intervene on behalf of students who are struggling in areas outside of class.
- Communicate that you consider it a privilege to teach the class.
- Communicate that you value the students, and their questions, comments, and feedback.

## VI. EPILOGUE

In this paper, we have attempted to gather information supporting the importance of accessibility in the teaching process and subsequent student perception of teaching effectiveness. However,

many times a message is most clear when it comes directly from the source. A faculty member in mechanical engineering received the following anonymous note from an engineering student in fall 2002.

"I appreciate the time and effort you gave me every time I came to ask questions for advice. Your approachability makes it easy for me to ask questions, where as with other professors it's a different story. I want you to know that you have really taught me a lot, and I hope to learn more. I wish all of my professors gave as much effort as you do and I hope my graduate school advisor is as good as you are, because you have played a major role in shaping my career ambitions."

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