"Engineering" Better Writing for Undergraduate Students

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Abstract

ABET 2000 has caused American undergraduate engineering programs to look for ways to document that they are graduating engineering with effective communication skills. Yet although most engineering students take at least one English composition course, engineering professors often are dissatisfied with their students' ability to write and speak. Given this situation, a communications specialist in an electrical and computer engineering school at a large Midwestern public research university devised a thirty-minute writing sample which is administered every semester to all students enrolled in the sophomore and senior seminars, both required large lecture courses. This paper describes how the writing topics are selected, how the student papers are rated, and how the communications specialist works individually with the students who receive low scores. The paper suggests that once this program is well-established, comparing the same students' performances on the writing samples as sophomores and seniors will help document the students' improvement in their written communication skills.

I.   Introduction

With ABET 2000 influencing curricular decisions in American undergraduate engineering programs, engineering educators are trying to decide how to satisfy the program outcome specified in Criterion 3 (g)…"Engineering programs must demonstrate that their graduates have:…an ability to communicate effectively"[1]. The ability to communicate effectively is vitally important for engineers. Over fifty percent of an engineer's time is spent writing, and that percentage increases with job seniority[2]; more recently, the figure has been put at anywhere from thirty percent to ninety-five percent [3]. Those students who say that they chose engineering as a major so they "wouldn't have to write" tend to be shocked when they hear the role of writing in their future careers.

Even though engineering students typically take one or more courses in English composition early in their college careers, many engineering professors still complain about the quality of written work their undergraduate students turn in. An informal in-house survey administered in the fall of 1999 to the faculty of the School of Electrical and Computer Engineering (ECE) at Purdue University revealed that professors commonly found the following problems in their students' writing, in order of decreasing frequency: cohesion, organization, grammar, punctuation, content, vocabulary, and spelling.

As engineering programs struggle to find a way to help improve their students' writing, they have turned to a variety of solutions. ABET's outcomes-based assessment allows for individualized responses from engineering programs[4]. Over the past decade, some universities have integrated writing into existing engineering courses[5], established engineering writing centers[6], among other alternatives. In July of 1999, the School of Electrical and Computer Engineering at Purdue University hired me as a communications specialist; among my initial duties, I was asked to develop an institutional response to documenting communications outcomes in the undergraduate students. This paper will describe one aspect of the process by which this engineering program is dealing with the issue of documenting outcomes for ABET, as well as monitoring the evolving written communication skills of its undergraduate students.

II.   The context

Purdue University has offered courses in engineering since the land-grant institution opened its doors in 1874. One of the largest undergraduate engineering programs in the United States, Purdue enrolls nearly six thousand undergraduates and over 1,900 graduate students in ten major areas: aeronautics and astronautics, agricultural and biological engineering, chemical engineering, civil engineering, electrical and computer engineering, food process engineering, industrial engineering, materials engineering, mechanical engineering, and nuclear engineering. The School of Electrical and Computer Engineering, on which this article focuses, was started in 1888 and in the fall of 2000 had 1144 undergraduate students (enrolled in the sophomore through senior years) and 482 graduate students, making it the largest engineering program at Purdue University.

At Purdue, all freshman engineering students spend their first year on campus in the Freshmen Engineering Program, which has a core curriculum that includes at least one semester of English composition. At the end of their first year, these students apply to one of the ten professional engineering programs on campus. In the School of Electrical and Computer Engineering, all incoming sophomores take EE 200, a seminar that provides an orientation to areas and problems in electrical engineering. The course enrollment averages 350 students in the fall semester and 160 in the spring.

III.   The writing sample

In order to assess the writing proficiency of the incoming sophomores, a writing sample was elicited from the EE 200 class in the fall of 1999. In addition, the same writing prompt was used in EE 400, the required senior-level Electrical Engineering Undergraduate Seminar. The purpose of giving the test in a senior-level class is to provide a baseline against which improvement in writing skills on the part of the current sophomores can later be judged.

The initial writing sample consisted of a single prompt ("Describe a light bulb and analyze how it works.") which was developed in conjunction with the input of several faculty members. The writing prompt is deliberately simplistic so that a lack of prior knowledge does not affect the students' ability to address the topic. Yet the prompt is, to some extent, discipline-specific, and

involves the use of description and analysis, two rhetorical modes considered important in the engineering writing genres. The prompt is changed every semester to another topic of similar difficulty.

The test format—a thirty-minute timed writing sample—is modeled on the Test of Written English (TWE), the Graduate Management Admissions Test (GMAT), and the new Graduate Record Examinations Writing Assessment, all developed by Educational Testing Service (ETS). Although timed writing samples have been criticized as inauthentic, they tend to be a more valid and direct measure of writing proficiency than multiple choice or fill-in-the-blank test items. In addition, a case can be made for timed writings having authenticity in the university class context.

Similar to the previously mentioned ETS tests, the engineering writing sample is rated holistically, although according to a unique, four-point scoring rubric (for example, a top score of "4" is given to a paper which "clearly demonstrates competence in writing on both the rhetorical and syntactic levels, though it may have occasional errors."). After administering the test during a regularly scheduled class period, I hire advanced Ph.D. students from Purdue University's Department of English to help me do the ratings. I was already familiar with holistic rating from my experience as a reader for the ETS GMAT and TWE programs. The graduate students also have had previous experience doing holistic scoring of writing, either for ETS or the Department of English.

To ensure that holistic evaluation produces high interrater reliability, the raters need to be normed successfully. Thus, at the beginning of the first rating session, I conduct a norming session and repeat this procedure at the beginning of each subsequent rating session. We raters first read the papers to get a sense of their scope. After about twenty minutes, each of us takes a new stack of ten papers and assigns each a number from one to four, according to the holistic rating scale. Scores of "0" are assigned to papers which are written off-topic, in other languages, or are left blank.

Once all the raters have achieved consensus as to the characteristics of the different level papers, the rating sessions begin in earnest. Each writing sample is read by two raters; in the case where the difference between the scores is more than one point, another rating is done by a third rater.

Finally, those writing samples with scores of "1" and "1.5" are then evaluated by an analytic scoring rubric consisting of content, organization, language, mechanics, and punctuation. Essentially, the analytic rubric uses the descriptors from the holistic evaluation but rearranges them according to the above descriptive categories.

IV.   Results

Typically, about ten percent of the writing samples fall into the bottom quarter of the range, receiving scores of "1" or 1.5." The decision was made to do an analytic evaluation of these bottom-quarter sophomore-level essays. The comparable senior-level papers are not re-

evaluated analytically for logistical reasons; the school decided to collect more thorough information to help guide intervention efforts which would be done only at the sophomore level.

As the faculty writing survey mentioned earlier indicated, organization and cohesion have turned out to be major problems in the lowest-scoring writing samples. The writers of these papers demonstrate little or no control over the direction of their prose, producing writing that rambles from sentence to sentence, usually without any cohesive devices linking sentences or paragraphs. Another common characteristic of the low-scoring papers is the omission or short-shrifting of one part of the writing prompt (e.g. "describe…and analyze"). An insufficient use of detail is another typical situation in these writing samples. Finally, there tends to be an abundance of surface-level sentence errors, especially among the non-native speakers of English in the class, who have constituted about 27 percent of the school's undergraduate enrollment over the past couple of years.

V.   Discussion

From the start, I wondered how to require students to take the writing sample or to seek help for their writing. Because EE 200 is a zero-credit class, the first semester that the writing sample was administered there was no way to require the students to attend the class session in which it was administered (although a majority did) or to enforce the recommendation that the students get help for their writing problems (none did). However, after the first semester, the EE 200 professor decided to make receiving a passing score on the writing sample mandatory for passing the class, so that students who missed the in-class writing sample now have to attend a make-up session. More importantly, under this new policy, students earning "1.5" or lower on the writing sample are required to attend a half-hour writing tutorial with me. During the individual tutorials, I explain the raters' comments on the analytic evaluation forms and give the students instructional handouts from the Purdue University Writing Lab to supplement our discussion. Usually when the student leaves my office, s/he has an appointment to return to do another writing sample. However, when students have problems which cannot be dealt with in one session, I often ask them to write a practice paper for me to review in a second help session before having them return again to write an "official" writing sample.

I see these on-going tutorials as an unique opportunity to help some of ECE's neediest writers—most of whom happen to be non-native speakers of English—at an early stage in their engineering program. Also, I hope that these students are beginning to develop a working relationship with me so that they can return to my office with writing-related concerns throughout their undergraduate years.

        In addition to their diagnostic function, the scored writing samples from the sophomores are the first piece of documentation in ECE student portfolios devoted to written communication. ABET has encouraged the use of student portfolios as a means of evaluating the work of engineering students[7,8]; likewise, portfolios are a popular form of evaluation in the field of college composition studies for reasons that make sense in the engineering writing context as well[9,10]. First, portfolios contain examples of authentic writing[11]. In addition, for two of the

three years students spend in ECE, a representative writing assignment will be collected, so the portfolios can document any changes in writing over time. In the sophomore year, the writing sample comes from EE 208, Electronic Devices and Design Laboratory; in the senior year the paper comes from EE 402, Design Projects, or EPICS ("Engineering Projects in Community Service"). Also in the senior year, a post-test writing sample will be collected in order to document the students' anticipated improvement in written communication.

By means of the writing samples, the portfolios, and the on-site availability of a communications specialist, who also gives guest lectures on communications topics in various engineering classes, the School of Electrical and Computer Engineering is sending students a strong message about the importance of cultivating effective communication skills. Hopefully, all of this new activity also will remind faculty of the importance of having their students write whenever possible, so that in a few years I will not have seniors annotating their writing samples with the words, "I haven't written anything in three years."

Since ABET is due to visit the School of Electrical and Computer Engineering in the fall of 2001, it will be too soon for any student portfolios to be complete. However, Purdue University's School of Electrical and Computer Engineering will be well on its way to documenting an improvement in the ability of its students to communicate in writing.

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