

AC 2009-1610: COMMUNICATION PEDAGOGY IN THE ENGINEERING CLASSROOM: A REPORT ON FACULTY PRACTICES AND PERCEPTIONS

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Communication Pedagogy in the Engineering Classroom: A Report on Faculty Practices and Perceptions

Abstract

The purpose of this project was to analyze engineering faculty's communication pedagogy in the engineering classroom. We have surveyed engineering faculty at a variety of institutions to determine to what degree they incorporate communication into their technical classes. The project included the development of an electronic survey instrument that collected responses from engineering faculty at programs and departments in the United States. In addition to the survey results, we conducted focus groups with small groups of faculty, both at our institution and at the site of the 2008 Frontiers in Education Conference, in order to dig deeper into the data collected. The conclusions we draw from analysis of the survey and focus group results indicate that engineering faculty have incorporated communication more frequently into their technical courses but that they are motivated to do so primarily from motivations having to do with helping their students model professional practice.

Project Rationale: EC 2000 and Professional Skills

Adopted in 1996, ABET, Inc. Engineering Criteria 2000 promised to transform engineering education in two fundamental ways. First, EC 2000 expanded the definition of engineering competencies to place much greater emphasis on “professional skills, such as solving unstructured problems, communicating effectively, and working in teams.”¹ Second, the new criteria “shifted the basis for accreditation from inputs, such as what is taught, to outputs—what is learned.”¹ These two changes were expected to be transformative: “program changes would reshape students’ educational experiences inside and outside the classroom, which would in turn enhance student learning.”¹

Engineering communication was positioned to receive particular benefit from the replacement of the old ABET criteria, which had largely evaluated engineering curricula by the total course hours devoted to distinct subject areas. That system had enforced a firm distinction between technical curriculum and instruction in the humanities and social sciences—offering no particular credit for instruction that successfully bridged the divide between liberal education and professional engineering practice. ABET’s system did recognize the existence of professionally relevant non-technical subjects—naming “ethical, social, economic, and safety considerations in engineering practice”—but marginalized them in a system devised around the division of the curricular pie. “Course work may be provided for this purpose,” the criteria specified, “but as a minimum it should be the responsibility of the engineering faculty to infuse professional

concepts into all engineering course work.” Commentators suggest that this “responsibility” was seldom monitored during ABET site visits.²

The Engineering Criteria changed the situation. Assessment now targets students’ *acquisition* of skills, rather than the curriculum’s *coverage* of them. Professional skills, now elevated to a position akin to that of technical bodies of knowledge, could be developed either in technical or Humanities and Social Sciences departments and courses; for accreditation, all that matters is the quality of student skill outcomes that engineering educators can demonstrate.

The EC 2000 approach has now become sufficiently mature to support studies of program achievement under its auspices. ABET, Inc.’s own commissioned review, conducted in 2006 in the Penn State Department of Education, summarized its key findings in two succinct bullet points:

- “2004 graduates better prepared than their 1994 counterparts.”
- “Professional skills gained; technical skills maintained.”¹

Our course in technical and professional communication, required by all of Rose-Hulman’s engineering programs, provides documentation of achievement of student learning outcomes in communication for the purpose of accreditation. We also work closely with colleagues in engineering departments who regard communication skills as central to their own courses—helping to develop assignments and supporting activities such as peer review workshops. These interactions led us to formulate a few central questions:

- How and to what extent did the Engineering Criteria change the role of communication in courses taught by engineering faculty?
- How do engineering faculty define their priorities and goals when they teach communication?
- How do engineering faculty approach communication pedagogy?

To investigate these and related questions, we developed a survey instrument designed to measure the perceptions of faculty regarding the degree to which program accreditation have influenced the teaching of communication in engineering programs. We conducted the survey at Rose-Hulman in the early fall of 2007 and extended the reach of the study across the nation during the fall of 2008.

Survey Design

The survey was designed to be completed online. Participants were solicited through the ASEE Educational Research Methods listserv and through a database of participants in ABET’s annual

Best Assessment Processes Symposium. A screenshot of the first page of the survey is provided in Figure 1.

Figure 1. Screenshot of the first page of the online survey

Mapping the Future of Engineering Communication 2008 Survey
Funded by the Engineering Information Foundation

This survey collects information about how communication **assignments** (written and oral, formal and informal) are incorporated into engineering courses. The survey consists of 17 main questions, most of which are checkboxes. Estimated completion time is about 8-10 minutes.

The aggregate results of the survey will be shared with engineering faculty members who complete the survey and with engineering communication faculty who support them. In addition, this information may be used as part of a study on the ways in which engineering faculty incorporate communication assignments into their courses. Your individual information will not be reported.

Thank you very much for your participation!

Course Selection

Q1. Please provide the title and a brief description of a course you teach in which communication assignments play a substantial role.

Course Title:

Description:

Course Background

Q2. For the course selected above, please provide the general background information below:

Engineering/Discipline/Department:

Course Level: Lower-Division (1st/2nd Yr) Upper-Division (3rd/4th Yr) Graduate

Student Mix: FR SO JR SR GR
(Est. Total=100%; e.g., 25 FR; 25 SO; 25 JR; 25 SR; 0 GR)

Size (Typical Enrollment in This Course):

Type(s) of Teaching Staff Involved: (Mark all that apply)

Tenured or tenure-track professor

Adjunct professor or instructor

Graduate instructor or teaching assistant

Typical Number of Teaching Staff Involved:

Grading: (Who grades most of the student work?)

Tenured or tenure-track professor

Adjunct professor or instructor

Graduate instructor or teaching assistant

Respondents were asked to use one of their engineering courses as the example on which their responses should be based. 17 survey questions sought, among other information, the following: the types of communication assignments the faculty member made in his or her engineering course; the motivations for adding these assignments; the greatest challenges faculty face when they assign communication tasks in technical courses; the feedback faculty provide to students on their writing; the methods they use to evaluate student writing; and the degree to which they collaborate with writing faculty outside of their department, whether in creating writing assignments or evaluating student writing.

In this report, we focus chiefly on interpreting the results as they pertain to communication *pedagogy* as practiced by engineers in their home departments' courses. Other publications will address related questions—especially those pertaining to the traits and practices that engineers identify as constituting effective professional communication.

Results: A Snapshot of Survey Respondents' Courses and Communication Pedagogy

137 responses were determined to be valid (unique, unduplicated responses from a faculty member in an engineering department). Each respondent answered questions about a specific “course you teach in which communication assignments play a substantial role.”

The central findings of the survey—based on preliminary analysis in which “other” responses have not yet been completely interpreted and categorized—include the following:

The average course profile abstracted from the responses was an upper-division course, enrolling between 12 and 30 students, taught by a tenured or tenure-track instructor.

- 64% were upper-division (3rd or 4th year) courses; 32% were lower-division; 4% were graduate courses.
- 42% of these courses enrolled between 12 and 30 students; 22% enrolled 30-60 students; 14% enrolled fewer than 12.
- 52% were taught by a single instructor.
- 88% involved a tenured or tenure-track instructor; 29% involved adjunct faculty; 29% involved a graduate instructor or teaching assistant.
- About half of the courses reported an associated lab.

Courses most frequently target multiple communication tasks.

- 85% of courses included an oral presentation.
- 73% design proposal or report
- 67% visual communication
- 54% project documentation (progress, requirements, specification, etc.)

- 53% office communication (correspondence, email, memos, etc.)
- 40% essay responses on exams or homework
- 39% lab report
- 22% poster presentation

Accreditation requirements motivate most faculty but are reported as subordinate to the belief in communication assignments' practical benefits for student learning.

- 93% of respondents include communication assignments “to prepare students for professional practice”
- 77% to assess student learning of course concepts
- 73% to encourage critical thinking
- 71% to help students learn course concepts
- 58% to fulfill accreditation requirements

42% of respondents included student peer review as part of a communication assignment.

Content Analysis

Survey respondents' written comments quickly proved immensely enlightening, not only clarifying the intent behind many responses but also illuminating the limitations of the questions themselves. While analyzing the results of the survey, we were able to follow-up with further questions of our Frontiers in Education 2008 focus group. The content of some of the responses are reported and analyzed below.

Motivations: Self and Other, Intrinsic and Extrinsic

One of the most complex sets of responses concerned the influence of the Engineering Criteria—the initial factor which had motivated the design of our study. Multiple-choice responses place accreditation requirements a distant fifth in motivating factors behind communication assignments. This seems to suggest a relatively peripheral role for ABET, evident in the moderate agreement that recent years have seen changes in engineering courses' incorporation of communication assignments. (33% agreed and 19% strongly agreed that they had observed such changes, while 33% responded neutrally.) Yet written comments on this question create an intriguing counter-narrative: respondents who *did* perceive changes in the EC 2000 era express near-universal consensus that there is *more* communication content in engineering courses. “More” is expressed in several distinct ways:

- Assignments are more frequent. (This was the most common observation.)

- Communication skills are perceived as more central to engineering. (“Students, faculty, and our industrial advisory board have made it clear that...this is a critically important area of education.”)
- Accordingly, writing instruction is in some cases being moved from the periphery to the core of engineering courses. (“At our school, the move has been from add-on assignments...to fully integrated team-taught courses.”)

These comments yielded no clear consensus on whether student communication skills had improved as a result of these trends. Many reported positive trends in student achievement, while others posited that change had been needed precisely because of a long-term decline in student communication skills. (Faculty who made this argument frequently tied the skill decline to the increase in electronic communication and the decline in print readership.)

Perhaps the most important finding here is that engineering faculty attribute their *own* teaching of communication to the intrinsic motivation of personal or departmental conviction. Many would likely agree with a respondent who reported teaching communication “because it’s the right thing to do.” The stated reasons for this imperative vary, with some respondents citing competitive advantage for graduating job-seekers, while others report that they want to encourage reflection or critical thinking. One view is compatible with a distinction between “soft skills” and core engineering competencies; the other implies what one respondent termed a “symbiotic relationship” in which engineering and its communication practices are inextricable from one another.

The account changes appreciably, though, when respondents describe motivations beyond their own courses or departments. More general accounts of communication in engineering courses—campuswide or national rather than personal or departmental—are much more likely to invoke *extrinsic* motivations: requirements of ABET, deans, or university commitments to writing across the curriculum (WAC). One faculty member asserted that “even the most reluctant faculty can be persuaded to include communication assignments in their courses using ABET”—implicitly placing the respondent among those who need no such persuasion.

Placing ABET

Perceptions are just as variable when it comes to ABET’s role in prompting increased teaching of communication. Some respondents describe that role as absolutely decisive. (“They made the change happen. Without this external pressure, things would have remained as they were for almost all campuses.”) Others cast EC 2000 in a supporting role: for instance, pointing out that the new criteria “set a tone,” “increased awareness,” and “led to conversations with constituents,” which then led to the implementation of changes.

An apparent middle ground appeared in the comments of respondents who didn’t credit the upswing in communication teaching *exclusively* to ABET, but saw it as much more than a mere supplement: on this view—characterized by respondents’ strong, coercive verbs—ABET has

“spurred” or “forced” or “is driving” change (in one case, by “light[ing] a fire” under administrators).

What Techniques Make It Work?

Few respondents commented directly on their comfort or proficiency as teachers of communication. However, reports about collaboration with colleagues reveal much about the expertise that engineering faculty sought to acquire or to employ as they integrated communication tasks into their courses. A slight majority approach this work without much input from outside of their home departments: 34% reported that they never collaborate with colleagues outside of their departments; another 24% seldom do so, and only 19% report “regularly” engaging in such collaboration.

Written comments on the survey provide valuable accounts of such collaboration. By far the most frequent result of collaboration between engineering and writing faculty is a grading rubric—whether for a specific assignment, a genre (such as presentations), or for technical communication more generally. Other techniques for evaluation and feedback are mentioned often as well, perhaps related to the fact that engineering faculty report being challenged by the time commitment required for such feedback. Other collaborative tasks include the creation or selection of sample documents, identification of other resources for student support and guidance, and training of tutors or teaching assistants.

One interpretation of this pattern is that engineering faculty are most confident in their own convictions about the substance and stylistic features that define effective communication within engineering. They simultaneously recognize, though, that helping students to become better writers may require different supporting behaviors, different feedback styles, and resources that may not always coincide with the best practices that they use in other types of assignments, such as problem sets.

It appears to be somewhat less common for engineering and writing faculty to create writing assignments together, and writing faculty seem most often to be consulted after the assignment has already been developed. Clear exceptions exist, though, and are most frequent when institutions or departments have created more formal systems for cross-departmental collaboration, such as initiatives for Writing Across the Curriculum (WAC) or Writing in the Disciplines (WID). The most extensive collaboration, of course, occurs within team-taught courses. Faculty in such situations were most likely to report collaboration at the outset, with communication and technical objectives considered and combined in the initial design of an assignment.

However formal, collaboration sometimes reflects a clear hierarchy in which engineering faculty occupy the dominant position. “We work with staff from our tech comm department. We tell them what the assignment will be, and they work with the students...” Other respondents report

a more equal and reciprocal relationship: one faculty member in a team taught course asserts that “no differentiation is made between comm and design faculty.”

Enmity and the English Department

In its questions about collaboration and support, our survey mentioned both Communication and English Departments, but treated them as equivalent. (This may reflect our own role in a multidisciplinary department in which all English faculty teach required writing courses as well as other courses in literature and rhetoric.) We weren't surprised to see responses that discussed writing specialists from many institutional sites: writing centers, Communication or Technical Communication departments, and within engineering colleges and departments themselves. Apart from occasional mentions in conjunction with writing centers, though, English departments appeared to provoke a noteworthy reaction from our respondents:

- “I specifically do NOT want English department involvement in this because the goals are professional not literary.”
- “To be honest...having to communicate with our English Department (or equivalent) would likely drive me away from these communication assignments.”
- “In engineering, we definitely do not need a bunch of pie-in-the-sky educational theorists and pot-stirrers trying to tell us how to do things. However, the assistance of English faculty in actually grading certain assignments solely for grammar, spelling, etc. would be helpful.”

These remarks are just frequent enough to require some mention. Some of these reactions have at least some practical grounding apart from interdepartmental politics. “Strong standards from campus departments in the humanities,” one respondent wrote, “result in inappropriate writing for engineering and science. (e.g. students tend to give lots of attention to ‘MLA style,’ little attention to ‘introduction, methods, analysis, conclusion.’)” The sentences seem also, to reflect an emotional investment in the separation that safeguards these respondents from the stereotypical liberal arts. (To be fair, the last respondent appears to find English professors more useful than theorists of engineering education—provided that they're willing to serve as copy editors.)

To be sure, cross-campus antagonisms are nothing new, and many faculty members are likely to rally around purposes, principles, and knowledges that define their discipline against its opposite number. Moreover, the Engineering Criteria may actually have reinforced that instinct. If the focus on professional skills has blurred the line between technical and interpersonal skill sets, it may seem more important to restore some other disciplinary boundaries. However, at least some contemporary engineering educators seem willing to see engineering as, among other things, a system of professional genres; a set of beliefs about evidence, reasoning, and persuasion; and shared expectations for communication practices, views that most English and Technical Communication faculty would share. The comments quoted above may reflect an anxiety that

emphasizing these parts of the profession might subject them unduly to the influence of the academic disciplines that have traditionally been able to define what constitutes “good writing.”

Intrigued by the evidence of this evolving dynamic that we saw in the survey responses, we followed up with questions about collaboration in our focus group of nine engineering educators conducted at the 2008 Frontiers in Education Conference. The members of the focus group (all engineers, from various disciplines) were drawn from those respondents to the earlier survey who indicated that they were planning to attend the conference and would be interested in participating in a focus group. The facilitator introduced the topic as follows (taken from the focus group transcript):

“To start with I wanted to probe a little more deeply on the notion of collaboration. That was an area that on the survey was a pretty interesting set of responses. The question we asked you was do you ever collaborate with someone outside of your department on engineering communication tasks? Or assignments or rubrics. So, I thought I’d ask you a little bit more. If you had been outside your department, who have you gone to and how has it worked for you?”

One participant responded as follows:

“We have a rubric that we use for our projects. And we . . . came up with a technical writing rubric for the campus. And it’s not bad, it’s pretty good. The problem is that nobody’s really using it. And we don’t use it in our [engineering] department, not because we don’t think it’s a good rubric for writing, but we grade more for the technical content. And that’s where we run into the disconnect [between] what we see and what we do. At least in my case, I don’t always know how to give the students the best feedback on how to write better. But I know when I see the meat and potatoes [engineering content]. Where my technical writing faculty know when they’re getting the idea across but they have no idea when there’s meat and potatoes and substance to the project. I think there is considerable room for improvement. We need to figure out how to bring them together a little better.”

This engineering faculty member points to efforts at collaboration at his or her institution, and indicates a desire for them to be more successful, but also expresses some uneasiness about the relative areas of expertise between the engineer and the technical writing faculty, breaking down along a traditional divide between content and form or process.

Conclusion

At this point, we believe we have only skimmed the surface of the rich data collected through both the survey and the focus groups. Our plan is to continue to mine the data for additional insights on the subject that will be treated in future papers and presentations.

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