Teaching Engineering Students Their Own Discourse

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Abstract - As we are all very aware, effective written communication is one of the ABET 2000 goals, and teachers everywhere are struggling to incorporate more writing into their courses. However, at this point, we should question whether simply adding "writing components" will make engineering students more effective writers. What these students really need is a deeper understanding of the discursive practices of engineering writing. They need to understand how, for example, audience and purpose affect issues such as readability, style, and format. They need to understand the conventions and strategies of professional engineering writing, and assigning students either a memo report, a proposal, or a research paper without a thorough discussion of the rhetoric of these kinds of writing will do little to help them as writers. One way to help students grapple with these more complex issues is to assign a sequence of papers that engage them in research and writing about the discursive practices of their own field. In this paper, we discuss the need for such work, the theoretical underpinnings of such a paper, and a series of assignments that lead students to such an understanding.

Introduction

One concern of many engineering students who are taking composition is how the course will prepare them for their futures after graduation. A valid concern, this issue was the catalyst that lead us to question how we might equip our own students to enter the field of engineering with skills that would enable them to write competently. It was our goal in this effort to present writing as both a process within the larger cognitive structure as well as an instrument of learning and communicating within this discipline. Therefore, we developed an assignment to provide students with an understanding of ways to create, respond to, and manage critical thinking through the medium of writing. In this paper, we discuss an assignment in which students are asked to research the writing performed in their field. Their research leads to an annotated bibliography of their sources upon which the students base a report focusing on the discursive (writing) practices of engineering. This assignment is written in a simulated situation to an audience of newly hired employees who typically know very

little about workplace writing. The goal of this assignment is to help engineering students to understand the cultural values and conventions held by their discipline, to examine the various types of writing and skills needed to write them, and to analyze the audiences to whom they will write and purposes which their writing will fulfill.

Background

To understand the need for this assignment, it is important to examine the way communication skills are presently emphasized in the field of engineering. For example, the American Society for Engineering Education conducted a survey to determine which academic subjects are most needed for engineering careers in industry. Out of the 4057 responses by engineers who responded to the survey, communication skills ranked above any other type of skill, with technical writing ranking second [1]. Further findings in a University of California, Berkeley survey of 595 engineering alumni indicate that writing ability is considered a high priority in making hiring or promotion decisions[2]). The time spent writing has also been the focus of various studies; for example, a recent unpublished survey of nearly 1,500 Cornell University engineering graduates reveals that engineers spend about 25-30% of their time (about ten to twelve hours per week) in the activity of writing [3]. These studies clearly show that writing skills are critical tools for success in the "real world" of work in engineering.

Rhetoric and Engineering

Further, to grasp the significance and practical application of this assignment, we must examine the role rhetoric plays in producing technical knowledge. Our cultural beliefs about technology may lead us to believe that technical communication is "object-bound and data-determined," [4] with objects and data speaking for themselves. However, these objects and data require a spokesperson who will fill in the gaps and interpret for the reader. This suggests that to be effective as a communicator, the engineer must be a skilled user of rhetoric. One only has to remember the

Challenger disaster to recognize that poor communication and miscommunication was a leading cause of the failure. Understanding how to interpret data and knowing exactly to whom this interpretation should be addressed are crucial to the success of any project. Moreover, even though the goal of engineering may be to produce functional objects, engineers do not always construct these objects themselves. Rather, they generate knowledge that allows such objects to be built. Thus, the use of rhetorical strategies and the understanding of rhetorical terms are essential to engineers because their writing and use of language will affect both the quality of the product and profitability of the company, as well as the safety of workers and consumers [5].

Because of these far-reaching effects that can result from effective or ineffective writing, novice engineers must be equipped with certain rhetorical strategies that can be used to prepare the important documents in the workplace. They must know how to use appropriate language in the appropriate genre and properly identify the purpose and audience for each piece of writing that they do. Since the late 1980s, rhetoricians have recognized the notion that members of a given discipline use language in ways unique to them [6]). In engineering, these underlying commonalties include use of common terminology, or shared use of language. A number of studies, such as Hass' in 1994 and Geisler's in 1994 have found that novice writers must be socialized into what is considered appropriate language [7].

Further, these novice engineers must be able to write in genres particular to their discipline and customary in form, recognizing the situations, purposes, and audiences for these documents. Winsor refers to this as the "rhetorical view of writing," in which writers negotiate knowledge between themselves and the readers, rather than simply passing on information. This view prevents writers from seeing the members of an audience as passive receptors of finished information rather than as active interpreters of the text who negotiate the text's meaning [8]. Once novice engineers can define these basic elements of purpose and audience, they can better decide on the appropriate type of writing, its content, and its form.

The Assignment

With these rhetorical issues in mind, we developed a two-part assignment in which the engineering student performs research of the discursive practices of engineering to prepare an annotated bibliography and an informal report addressed to newly hired engineers who need more training in writing. This assignment is currently taught at Arizona State University by instructors in the English Department in Writing for the Professions, an upper-division undergraduate course offered to all majors to fulfil their literacy requirements. A variety of majors require this course; engineering does not require this course, but some engineering students opt to take the course.

The Annotated Bibliography

In this assignment, students collect at least 8-10 sources (including an interview with a specialist in the field) that will give them a sense of the discursive practices in their specific field. Leading to the informal report, this annotated bibliography fulfills three objectives: 1) to give the students a notion of the literature in the field, what is available and how it is written, 2) to inform the students of the priority that engineering places on communication, and 3) to acquaint students with the specific discursive practices in the field of engineering. This process of inquiry and exploration provides students with more clarity about the specific types of writings that they will be expected to do, the strategies needed to write them, and the critical nature of analyzing audience and purpose for the writing.

This research requires a thorough search of academic and professional/trade journals and books that focus on the following issues:

- specific kinds of writing performed in engineering, which may include the following: a) *letters and memos* which might include responses to requests or inquiries about something, test report cover letters, thank yous, proposals for improvements, or information on procedures and b) *reports and proposals* which might include status reports, test reports, proposals for original research, inspection reports, or equipment reports;
- situations in which these kinds of writing are called for;
- identification of the audiences for these types of writings (including specialist and nonspecialist readers);
- readers' needs and readers' reading behaviors;
- the purposes for the types of writings;
- language use in engineering writing (the need for common terminology and conventions);
- the need for purpose statements;
- the need for executive summaries;
- style issues, such as clarity, conciseness, coherence (transitional strategies), the need for active/passive voice; and
- integration of text and graphics.

We allow enough time for students to perform a thorough search of these topics, and although we encourage research in the engineering field, we permit students to search in other fields, such as technical writing, the sciences, and business. Another vital aspect of their

research is the requirement to conduct an interview with an engineer in the world of work, and specifically in the area of specialization the student plans to enter. In this activity, students prepare their own interview questions, asking any question which might inform of the field of work they are planning to enter but focusing on writing practices.

After this research, students write the annotated bibliography that begins with an introduction of at least two paragraphs providing the reader with a rationale, or reasoning, for writing the bibliography. In this rationale, students indicate their method of organization (either alphabetical, topical, or other), the scope and range of sources (time frame), and some type of overall conclusions about the writing practices in the engineering field that they draw from their sources. Then, in each of the 8-10 annotations, the students provide the bibliographic citation in the style appropriate to engineering, an accurate description of the source, and a critical evaluation of the source to determine its usefulness to a novice engineering writer.

The Informal Report

In the next phase of the two-fold assignment, students are provided a simulated writing situation in which they are working in an engineering organization/company. In this simulated position, they assume the role of a project leader whose job is to mentor new hires. Because these new hires traditionally have a difficult time transitioning from academic to professional writing, they need training in the writing practices on the job. As part of their responsibilities in this simulated position, students write a report to the new hires to inform them of the types of writing they will be required to do as well as various rhetorical strategies needed to write them.

In this report, students must consider a primary audience of the new hires, who have specific needs that must be met to get the most from the report. Students must consider what they did not know themselves about workplace writing in general and writing specifically in the profession prior to entering the class. Therefore, to meet the readers' needs, students must explain things carefully. For example, they cannot expect that their readers' will understand the terms "purpose statement" or "rhetorical situation," so they must provide definitions of terms, explanations of concepts, and use analogies appropriately.

To help students with readers' needs, we provide students with Thomas Huckin's "A Cognitive Approach to Readability," an article which defines readability as the quality that "makes writing readable to the extent that its meaning can be easily and quickly comprehended for an intended purpose by an intended reader operating under

normal conditions" [9]. A fundamental tool to help these students gain insight into the importance of readers' needs and strategies for meeting them, this text addresses analyzing the schema, or background, of the reader; various reader variables, such as familiarity with subject matter, reading styles, or behaviors; and textual features. This text actually lays the groundwork for this assignment and provides students with their own "schema" of rhetorical terms and strategies which appropriately serves them in the assignment.

Further, students are called to organize the paper with good coherence strategies: a clear purpose paragraph which includes a problem statement, investigation statement, and purpose statement; a good executive summary that sums up the entire report and accurately forecasts it with appropriate language choices to meet the needs of the secondary audience (the supervisor who asked for the report); good, strong topic sentences that forecast entire paragraphs; similar information chunked together and separated by headings and subheadings; and sentences and paragraphs that follow each other logically and are connected with good transitional strategies that cue the reader.

In the assignment, students must explain each writing practice in a discussion section and must support each explanation with a detailed example and support from an expert source. Therefore, students must use quotations, paraphrases, and summaries from sources targeted in the annotated bibliography to provide credibility and to help their readers understand these practices better. In this section, students are required to discuss the kinds of writing that engineers do, including a description of each, the essential elements, situations that call for this specific type of writing, and the kinds of readers who would read them, whether non-specialists or specialists. Further, students must identify the needs of these readers based on these readers' schemas and reading behaviors (scanning, skimming, searching, receptive reading, or critical reading). Involved in this analysis of audience is the attention to appropriate language use, conventions that particular audiences expect from a document, and other readability issues that might affect an audience. Other important issues that students might discuss in this section are the importance of purpose statements and strategies for such style issues as clarity, conciseness, and coherence.

The students might close the paper with an impacting conclusion that draws together the key ideas for their readers and suggest the rewards of knowing this information, such as promotion and individual growth and/or benefits for the company/organization. Further, they might suggest ways to make the shift to this kind of writing from academic writing more easily. The conclusion provides an opportunity for these students to confirm for

themselves the priority that effective writing must be given, a priority that will ensure more success, if not survival, for their own professional lives.

Although a time-consuming assignment, this exercise provides students with a knowledge of methodology and application of the discursive practices in the field of engineering. Because an engineer's responsibility to use technical knowledge is carried out by communicating ideas, issues, and policies to specialist and non-specialist audiences, this assignment's emphasis on both product and process is invaluable. The assignment affords students the opportunity to learn the conventional forms of engineering writing, the analysis of audience and purpose, and appropriate and useful strategies for constructing the text. Because an engineer's success at work depends directly on their abilities to communicate what they know, what they propose to do, and what they have done already, it is imperative that he/she has the tools to convey that knowledge accurately and convincingly to others. This assignment is just one of many that might focus on the value of solid communication skills and the practices that develop these skills further.

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