Addressing Multiple Goals for Engineering Writing: The Role of Course-Specific Websites

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Abstract.

Writing instruction for engineering students involves differing perspectives and in some cases conflicting goals of many stakeholders including future employers, accrediting associations, writing center staff, and faculty in engineering, English, composition, and technical writing programs. These perspectives and conflicts can be addressed through a bottom-up approach to WAC and WID: course- specific websites, in which instructional materials that focus on writing tasks for a particular engineering course are both conceptually and electronically linked to other perspectives. By addressing specific tasks from multiple perspectives, course-oriented websites may help to build the consensus among disparate stakeholders necessary for more extensive efforts.

Many engineering students need instruction about writing. However, addressing this need may involve conflicting goals among several interest groups—conflicts that must be ameliorated by any approach to Writing Across the Curriculum (WAC) or Writing In the Disciplines (WID). While these two terms refer to ideas and practices that can be mutually supportive (Maimon 1982; Kirscht, Levine, and Reiff 1994), the acronyms provide a convenient shorthand for distinguishing between two seminal concepts: WAC connotes *writing to learn*—i.e., writing as a means of acquiring information, understanding concepts, and appreciating significance in any discipline (Martin *et al.* 1976; McLeod 1989); WID implies *learning to write*—i.e., acquiring the socially-mediated communication skills and genre knowledge appropriate to a specific discipline (Bazerman 1988; Swales 1990).

Some of the conflicts about writing instruction in engineering can be addressed by course-specific instructional websites. To see how,

we first need to review the goals of the interested parties in greater detail, for their differences comprise a messy tangle of educational theories, disciplinary cultures, curricular goals, institutional lines of authority and allegiance, and funding policies and practices. We may then turn to a description of the course-specific website, and finally to a discussion of the website's potential role in addressing the concerns of the various groups interested in the instruction of engineering students.

Groups with Potentially Conflicting Interests about Engineering Writing

At least four academic or professional groups have overlapping and potentially conflicting interests in college writing instruction for engineering students: (1) prospective employers and professional/academic accrediting organizations, (2) engineering faculty, (3) English Department faculty, including composition instructors and writing-center staff, and (4) technical writing faculty.

1. Employers and Accrediting Agencies

Employers have long complained about poor communication skills among engineers. At the entry level, the complaints may involve a rookie employee's lack of familiarity with the company's institutional culture (Lutz, 1989; LaRoche and Pearson, 1985). Or they may point to an inability to address nonspecialist readers effectively (Braham 1992); as Bernard McKenna (1997) notes, "the engineering report. . .crosses a discourse boundary to (presumably) non-engineering clients (such as construction and fabrication managers and government authorities)" (193). At a more senior level, engineers may have difficulty with administrative and client-centered tasks and genres (Tadmor *et al.* 1987; Graham 1998). In many cases, however, complaints focus on a lack of general communication skills—a failing that seems inappropriate for a college graduate (Spears 1986; Gates 1989). Targets of concern range from sentence structure and usage (Bly 1998; Lanciani 1998; Goldwasser 1998) to cohesion and organization (Rhinehart 1991).

The employer's point of view is shared by the main accrediting agency for engineering programs: the Accreditation Board for Engineering and Technology (ABET). By emphasizing outcomes in assessing programs, ABET promotes the workplace skills required of professional engineers, including their need to communicate well in writing and speech. Both in its current guidelines (ABET 1997a) and in its goals for the next century (ABET 1997b), the accrediting organization expects programs to produce engineers who can communicate well with fellow workers, supervisors, and clients. In doing so, ABET appears to respond to "a significant change in the way many of the most successful firms manage their

human resources and organize their work," moving from a "skills components model" with "limited and passive roles of workers in traditional hierarchical organizations" to a "professional model" in which "technical and foundation skills are the. . .enablers for more complex general functions such as problem solving, reasoning, and the exercise of judgment" (Bailey and Merritt 1997, pp. 405-11). ABET's focus on workplace skills is nowhere more evident than in its sample case study of "Coastal State College" (ABET 1998), which models how an institution might document improvement in an outcomes-oriented assessment program: ". . .after instituting a requirement of a technical writing course for all engineering programs, employer complaints about the writing performance of graduates decreased" (p. 13). Indeed, ABET includes "the ability to communicate effectively" among its eleven principal criteria of evaluation; and for advanced level programs, ABET specifies that students must complete "an engineering project or research activity resulting in a report that demonstrates both mastery of the subject matter and a high level of communication skills" (ABET 1997b)—a goal earlier voiced by Michael Rabins (1986) in his call for a pedagogy leading to "productive communication among the members of a design team" (25). In the older language of the 1998-99 criteria, too, a composition requirement or even a technical writing course is not sufficient: "Although specific course work requirements serve as a foundation for such competence, the development and enhancement of writing skills must be demonstrated through student work in engineering work and other courses." Similar concerns for competency in communication skills are voiced (though certainly not stressed) in the National Research Council's *Engineering Undergraduate Education* (1986, pp. 10, 81) and its more recent *Engineering Education: Designing an Adaptive System* (1995, p.8).

By focusing on assessment through a design project requiring a written report, and by insisting that communication skills must be exhibited in work within engineering courses, the ABET criteria appear to encourage the *writing to learn* goals of WAC (Held *et al.* 1994; Hendriks and Pappas 1995; Sharp 1995), reflecting similar efforts in computer science (Walker 1998) and accounting (O'Connor and Ruchala 1998). Though the notion of *writing to learn* as a universally desirable pedagogy has been challenged (Smagorinsky 1995), skill in writing is clearly relevant to a student's preparation for the workplace activities of an engineer, which in most cases involve the production of discourse. For example, "writing" is listed or implied as a professional task in nearly every job description for engineers in the U.S. Department of Labor's *Dictionary of Job Titles* (1991), as one would expect from studies of the workplace writing of engineers (Allen 1987; Selzer 1983; Paradis, Dobrin, and Miller 1985; Broadhead and Freed 1986; Winsor 1990, 1998). Of course, the ABET guidelines do not

always result in an engineering curriculum that is thoroughly imbued with written and oral tasks to facilitate the development of disciplinary knowledge—a goal outlined by Mathes, Stevenson, and Klaver (1979), and partly implemented in the Professional Liaison Program (Wilson 1995) and in other efforts (Pauschke and Ingraffea 1996). More often than not, engineering departments require a capstone, senior-year design course that calls for a fairly lengthy written report (e.g., Yannitell and Cundy 1988). While such a course illustrates a programmatic concern with writing, it does not necessarily ensure that significant writing instruction will occur.

2. Engineering Faculty

The concerns of employers and accrediting agencies are often shared by engineering faculty, since as teachers they care about the career potential of their graduates. On the other hand, they may sometimes be more worried about a student's ability to perform writing tasks in their courses. For many engineering faculty members, a workplace-oriented writing course in the senior year may be much less desirable than a lower-division course that focuses on writing tasks appropriate to specific upper-division engineering classes, with enrollment limited to students in that field. However, the stringent course-hour demands of engineering curricula (which engineering faculty design in response to ABET criteria) make it very difficult for students to take two semesters of first-year composition, a field-specific writing course in the sophomore year, and a workplace-oriented course in the senior year. Indeed, the general tendency among engineering faculty is to encourage fewer rather than more credit hours in courses devoted solely to writing instruction. For example, at Oklahoma State University, engineering students who earn a B or an A in a first-semester composition course can skip the second-semester composition course, replacing it with an upper-division service course in technical writing. Since that upper-division course is often not taken until the student's final semester in college, many students have only one first-semester composition course to prepare for college-level writing in engineering. For some students who enter college as good writers, this may not be a problem; but for many other students, it is. Despite this paucity of requirements for writing instruction, engineering faculty still want to see students who can (a) write like specialists in a particular field of engineering or (b) at least write clearly and succinctly, with a minimum of "grammar" or usage errors.

A complicating factor is that many American academics (including many engineering faculty) hold relatively unsophisticated notions about rhetoric, language, and writing. This at least is the testimony of dozens of frustrated, alarmed, or ticked-off essays in professional journals

(e.g., *Mechanical Engineering, Civil Engineering, IRE Transactions on Engineering Writing & Speech, STWP Review*) and trade magazines (e.g., *Quality*) for the last fifty years (Broadhead 1983, 1985). In article after article, "technical writing" is reduced to sterile notions of traditional grammar, to appeals to the authority of conservative warhorses such as Strunk & White, to promotion of quick-trick readability formulas, or to inculcation of reductionist and wildly misleading precepts like KISS—i.e., "Keep It Simple, Stupid" (e.g., Crawford 1945; Miller 1948; Shurter 1952; J. Baker 1955; Feistman 1959; Fielden 1959; Racker 1959; Weisman 1959; Clauser 1961; Keith 1967; Schindler 1975; Heldt 1976; Bush 1980; Mitchell 1980; Mueller 1980; Vervalin 1980; Marder and Guinn 1982). As David Russell has noted (1992; see also Russell 1991), American faculty (including engineers) are often committed more to "upholding disciplinary standards" than to addressing the writing needs of less well-prepared students. Indeed, because the American education system is founded on the principle of "disciplinary specialization," there has generally been no "integral role" for writing:

> Instead of viewing writing as a complex and continuously developing response to a specialized, text-based, discourse community, highly embedded in the differentiated practices of that community, educators. . .see it as a set of generalizable, mechanical 'skills' independent of disciplinary knowledge, learned once and for all at an early age. . . .Thus, writing instruction past the elementary school [has been] viewed as mere remediation of deficiencies in skill rather than as a means of fostering a continuously developing intellectual and social attainment intimately tied to disciplinary learning. (25)

As a result,

> . . .All but a handful of the many cross-curricular efforts to improve student writing launched over the last hundred years merely asked general faculty members to correct students' mechanical grammatical errors or, more commonly, to refer "deficient" students to a "remedial" program run by composition instructors. (26)

For all of these reasons, faculty in engineering are likely to prize the academic research paper based on Introduction-Methods-Results-and-Discussion (IMRAD) rather than genres commonly found in industry (proposals, recommendation reports). Like many professionals, they are apt to describe/prescribe the writing process as they believe it ought to

be, rather than as they actually practice it; as Dorothy Winsor (1996) notes, "particularly in science and technology, effective rhetoric involves the denial that one is using rhetoric" (7). And they are prone to view writing as a simple transcription of experience into prose, rather than the generation of a document that creates meaning by mediating between the author's wishes, the reader's expectations, the user's needs, and the task's constraints. In this respect, Charles Bazerman (1992) has warned that, in focusing on the characteristics of an existing technical genre, one may come to think of it as a static and unchanging recipe, rather than a continually adaptive response to changing rhetorical exigencies.

3. English Department Faculty (Literature, Composition, and Writing Center Staff)

In most cases, writing programs are housed in English departments, where faculty with a fulltime commitment to rhetoric in their research and teaching may be substantially outnumbered by literature faculty with little if any professional interest in non-literary discourse. Like many of their colleagues in engineering, some literature faculty may focus on the goals of their academic discipline, and may similarly consider courses in composition, technical writing, or any other application of rhetoric as being essentially remedial. Though they may take little professional interest in engineering writing, they may negatively affect the environment for WAC and WID simply because they and their engineering colleagues both believe that a literary essay is the polar opposite of an empirical research report in terms of writing quality. To some extent, this polarity has a basis in fact: the scholarly writing of literature teachers differs markedly from that of engineering teachers for many characteristics of style, cohesion, organization, and argumentation (Broadhead, Berlin, and Broadhead 1982). While most of these differences are matters more of degree than of kind, they invite stereotyping of engineering and literary writing by their stylistic extremes, rather than by their shared characteristics and values. Thus, for some engineers, writing about literature seems flowery, vague, and impractical—while for some literary scholars, engineering writing seems crude, mechanical, and unimaginative. With such negative opinions of the writing of their fellow university teachers, both English and engineering faculty may feel they have nothing in common and nothing to learn from one another.

Just as literature and engineering faculty may differ markedly in their concepts of writing and their rhetorical practices, teachers in composition courses and tutors in writing centers may view writing from yet another perspective. At the first-year level, a composition curriculum may focus on expressive writing or the genre of the personal essay (a form prized more highly in the humanities than in schools of engineering),

especially if composition instructors are TAs working toward advanced degrees in literature or creative writing. Like some WAC promoters, composition faculty may be more interested in writing to discover and explore ideas than in writing to convey information or to offer technical advice (Spears 1986; Connors 1987; Woolever 1989; Foster 1994). For example, in defending a quasi-ethnographic "field sequence" assignment in which first-year composition students explore a possible discipline for a major, Miriam Dempsey Page (1987) takes pains to note that "the academic prose becomes an extension of the personal experience of writing in [a] journal, as well [as] other writing earlier in the course. In short, the student's voice is not lost in the transition to the more academic writing" (141). For this reason, the pedagogical goals and practices of composition faculty may draw the contempt of both literature and engineering faculty.

Like first-year composition teachers, writing center staff may promote goals of social equity or self-realization, and thus may outright oppose the status quo of discipline-oriented education (Warnock & Warnock 1984). In seeking to do so, they may pursue independent pedagogical strategies and seek different or even antagonistic goals than faculty in engineering and technical writing—or even in composition (for example, at institutions where writing centers are located outside of the English department). They may have little interaction with the other interest groups, and in some cases may promote expressive writing to the detriment of either academic or workplace writing (Grimm 1996). In some cases, they may have strained relations with faculty in engineering, literature, and other disciplines who believe that writing centers provide unethical assistance to students (Sullivan 1984; Clark & Healy 1996). Of course, such generalizations may not apply to specialized writing centers at technical universities such as Rensselaer Polytechnic Institute (Skerl 1980), and they certainly do not apply equally to all writing center staff at all institutions of higher education.

4. Technical Writing Faculty

Like first-year composition staff and writing-center tutors, technical writing (TW) faculty are often housed in English departments or humanities divisions, where their emphasis on workplace practices and non-academic careers may make them an awkward minority (Seitz 1986). Even among TW faculty themselves, curricular goals may adversely affect attitudes toward engineering students. The problem is not with the curriculum itself. That is, though researchers may still not have settled on a final definition of technical communication, TW faculty now generally view their discipline as the study of a socially constructed rhetoric (Bazerman 1988; Markel 1993). Thus, a debate between "non-rhetorical" and "rhetorical" views of technical writing (such as the exchange of views

by John H. Mitchell and Marion K. Smith, 1989) would now seem highly improbable—although the idea that science and technology are thoroughly rhetorical has been challenged by researchers who seek a narrower meaning for the term "rhetoric" (Fleming 1998; Selzer 1998). Rather, the problem results from the potentially competing interests of students in service courses (including engineering students) and students majoring in technical communication. Because of the growth of technical communication as an attractive career field, TW faculty are increasingly sensitive to conflicts in allocating relatively scarce financial and programmatic resources (and personal research time). Despite years of second-class academic citizenship due to their instructional focus on technical writing or composition, TW faculty may yet be tempted to allocate precious institutional resources to their "own" students, neglecting the larger population of students in service courses. An institutional check on such temptation is the fact that many technical writing programs rely on graduate students in technical writing to teach the service courses—certainly at the sophomore level, but sometimes at the upper-division level as well. That is, multiple sections of an undergraduate service course may constitute an important source of financial aid for graduate students seeking a degree in technical writing. For this reason, TW faculty may resist WAC efforts that appear to bolster writing instruction in other disciplines, since such courses threaten to lower enrollments in TW service courses, and since fewer sections of those courses may endanger the economic viability of a TW graduate program.

Even where such fiscal conflicts do not exist (or are transcended), technical writing faculty may resist WAC or even WID initiatives on the grounds that a course that prepares a student for writing in a particular discipline may not prepare a student for writing on the job. That is, for many teachers, the primary goal of technical writing courses is to develop a student's ability to design documents that meet the needs of a wide range of potential readers and users—a goal that is obvious in the audience-centered textbooks of Mathes and Stevenson (1976) and Anderson (1987, 1999). Thus, a course restricted to enrollment by students in a single sub-discipline of engineering (or even to the wider discipline of engineering) may seem to offer too limited a range of potential in-class audiences, so that students cannot learn to analyze multiple audiences and to design, write, and revise documents in accordance with such analyses.

Finally, even when technical-writing faculty are committed to the preparation of engineers for workplace writing, they may at the same time be highly suspicious of the ethos of both academic and workplace engineers. As a pre-eminent example, Charles Bazerman rejects any "rhetoric of the disciplines" that would "indoctrinate [students] unreflectively into

forms that will oppress them and others, although such oppressions do happen often enough, as power and system become their own ends, and practice becomes habit and then rule. Such oppression of the self and others is more likely to occur when individuals learn communication patterns implicitly as a matter of getting along" (64). Bazerman therefore favors "explicit teaching of discourse [that] holds what is taught up for inspection. It provides the students with means to rethink the ends of the discourse and offers a wide array of means to carry the discourse in new directions" (64-5), and thus is directed toward the goal of creating "empowered speakers" rather than "conventional followers of accepted practice, running as hard as they can just to keep up appearances" (67). For Bazerman, the goal is to understand disciplinary rhetoric in order to control and transcend it. A similar, more recent version of this view is offered by Segal *et al.* (1998), who fear that teaching effective rhetoric in a discipline implies complicity in whatever the members of the discipline think or do with their rhetorical skills. In contrast, F. Robert Baker (1994) proposes that technical writing pedagogy should "supplement the existing composition-based framework with pedagogical practices derived from engineering theory" (24)—though in fact he appears to accomplish the more modest goal of showing the points in the design process at which argumentation and document production occur. Like Baker, Beverly Sauer (1998) demonstrates how specific engineering knowledge can shed light on the rhetorical decision-making of engineers.

This brief survey of four major interest groups may oversimplify the situation on many campuses. For example, several other disciplines frequently share an intellectual interest in (and develop proprietary notions about) the communication skills of engineering students. These include departments and/or programs such as journalism, speech, linguistics, and especially the teaching of English as a second language (TESL), where scholars have made exceptional contributions to the study of engineering and scientific writing (e.g., Selinker and Trimble 1974; Swales 1990). Interaction between any and all of these groups may be enhanced or discouraged by yet another university faction: administrators with an eye on the bottom line—either financial income through credit-hour production, or else financial outgo through salary, equipment, and software costs. Finally, beyond these entrenched faculty and administrators are the students whose welfare they argue about—students who may have developed strong feelings about writing instruction, depending largely on their need for help and on their success in current and previous venues for writing instruction. Often ignorant of workplace communication practices and values (Betz 1996-97), whipsawed between the conflicting goals of the various faculty and professional groups that exert power over their careers, students somehow must learn to write—must undergo what Winsor

(1996) calls the "rhetorical education" that results in "writing like an engineer."

Clearly, to meet the needs of engineering students, universities must balance the often conflicting goals and attitudes of these various interest groups. One way of achieving such coordination would be a top-down program that finds a theoretical common ground and then coordinates activities among the various groups (Fulwiler and Young 1982; Kuhn and Vaught-Alexander 1994). Besides WAC schemes to promote the use of writing assignments in every discipline, such efforts may also include linked courses, formal interest-groups of students who enroll in common courses, or coordinated multidisciplinary programs of study (Gabelnick *et al.* 1990). A second approach works from the bottom up: initially meeting specific, practical needs of one group, then attempting to establish working relationships with as many other groups as possible, and thus finally helping to create the institutional and collegial ties necessary to achieve a satisfactory theoretical consensus. Rather than addressing instructors through seminars on introducing writing components into their courses, bottom-up approaches are student-oriented (Haring-Smith 1987). For example, a WAC effort at Colorado State University addresses student needs by turning its writing center into an online resource, offering consultations and modular tutorials on topics such as "writing summaries," "writing and presenting informative speeches," and "writing electrical engineering lab reports" (Palmquist *et al.* 1995).

In an alternative bottom-up approach at Oklahoma State University, a course-specific website provides help for the main writing task in a specific engineering course, using instructional materials that incorporate the goals and techniques taught in the lower-division and upper-division service courses of the technical writing program. To understand how this website is designed to encourage multidisciplinary interaction, we need to see what kinds of assistance the website provides, and then see how it serves different interest groups in different ways.

A Course-Specific Instructional Website for a Civil Engineering Course

The course-specific instructional website provides help for students writing a term paper assignment for a junior-year Civil Engineering course: CIVEN 3813, "Environmental Engineering Science." The website, located at http://www.okstate.edu/artsci/techwr/CIVEN_3813, is a collaborative effort of faculty in technical writing and engineering (Broadhead and McTernan, 1998). It is designed to enhance a set of written instructions previously used in CIVEN 3813:

CIVEN 3813: Term Paper Assignment

Please recall that you are to complete a term paper assignment which will count approximately 18% of your semester grade. The paper will be 10 double spaced, typed pages or less using either size 10 or 12 font with standard margins. You are to utilize the available literature, citing references and developing quotations in a manner consistent with scientific and engineering journals. It is suggested that you consult with a journal from your field such as ASCE's *Journal of Environmental Engineering* to determine their instructions to authors relative to citation and bibliographic format.

The subject matter of your paper is relatively flexible. Within one week please submit a title with sufficient text to allow an evaluation of your topic. Some topics you may wish to consider include:

1. A history of water borne diseases in the United States. The Role of the Engineer in addressing these problems.
2. An overview of critical environmental legislation in the United States.
3. Available models, with descriptions and evaluation, to address _____ problems.
4. Near ground ozone problems with emphasis on Tulsa and OKC.
5. Agricultural impacts on Oklahoma's receiving waters.
6. An overview of Risk Assessment in addressing environmental problems.
7. An overview of microbial physiology and its application to waste water treatment.
8. Tulsa's trash to energy program.
9. Advantages and disadvantages of chlorine as a primary disinfectant.
10. Nuclear wastes—options for final disposal.
11. Etc.

These topics are only intended to help you focus on a topic of interest to you.

As interviews with students and discussions between the collaborators revealed, several features of these printed instructions called for enhancement. First, the guidelines began with issues of format (which arise late in the composing process), and thus gave a misleading focus to the instructions. Second, the guidance on genre or intention was quite limited: "You are to utilize the available literature, citing references and developing quotations in a manner consistent with scientific and engineering journals." This language implied but did not explicitly state that the paper should be based on a literature review, rather than lab work or original research. Third, the same sentence appeared to assume that the student-writer was familiar with (a) developing topics appropriate to environmental engineering and (b) discovering and using sources of relevant information—perhaps questionable assumptions, since many of the students might not have taken the second-semester first-year composition course in which research papers were addressed. Fourth, the guidance on subject-matter was relatively brief, consisting of a list of ten sample topics that offered varying degrees of direction. For example, in the most helpful of the suggested topics, a key rhetorical term ("problem") and the order of ideas in the sentence implied a common line of thought and thus a principle of organization for the term paper (i.e., describe a problem and then describe its solution):

- A history of water-borne diseases in the United States. The Role of the Engineer in addressing these problems.

In two other topics, the key rhetorical term "problem" was used, but the sentence order was confusing, since the solution was mentioned ahead of the problem:

- Available models, with descriptions and evaluation, to address _____ problems
- An overview of Risk Assessment in addressing environmental problems

In another case, the sentence order implied a problem and a solution, but the rhetorical term "problem" was not used:

- Nuclear wastes—options for final disposal

In the rest of the topics, the concept of a problem/solution line of thought was only implicit; that is, the topic might refer to a problem but not to a solution, or might refer to a solution but not to a problem:

- Near ground ozone problems with emphasis on Tulsa and OKC
- An overview of microbial physiology and its application to waste water treatment

- Tulsa's trash to energy program
- Agricultural impacts on Oklahoma's receiving waters
- Advantages and disadvantages of chlorine as a primary disinfectant
- An overview of critical environmental legislation in the United States

Therefore, to enhance the original printed directions, the course-specific website provides seven types of information developed specifically for CIVEN 3813: (1) concept/organization, (2) information search, (3) citations, (4) cohesion, (5) format, (6) links to online resources, and (7) people to contact for individual help.

1. Concept/Organization: Selecting and organizing a topic

This set of pages helps the student understand the central concept or main line of thought for the CIVEN 3813 paper: to write an essay explaining a problem and an engineering solution to the problem. To this end, the webpages incorporate key concepts from the course materials for the upper-division service course in technical writing. In that course, engineering students write a series of documents based on problem-solution line of thought, including a proposal (describing a problem and a plan for finding a solution) and a recommendation report (describing a problem and recommending a plan of action for solving it).

For CIVEN 3813, this problem/solution material is applied to writing a science essay based on published sources. One page shows students how to use a "discovery questions" heuristic to analyze various facets of the problem (the background, a troublesome situation or event and evidence that it exists, the bad effects of the situation, the causes of the situation, the inadequacies of previous or existing attempts at a solution, the need (the goals or criteria for success in evaluating any possible solution), and the solution (including explanations of possible solutions, analysis of advantages and disadvantages of various potential solutions, and the final successful solution), as described in Broadhead and Wright (1985-86) and Broadhead (1997).

After the problem/solution line of thought and the discovery questions have been explained, another webpage applies the discovery questions to the subject of "acid rain," a common problem addressed by environmental engineers. A final webpage for this segment of the website shows a sample problem/solution essay on the topic of "acid rain," thus providing a model for the CIVEN 3813 term paper. (The "acid rain" materials were generated by Teresa Sholars, an instructor at the College of the Redwoods, Mendocino Campus, as part of a project to develop course-

specific instructional materials for use in a learning assistance center at that school.)

2. Information Search: Finding bibliographic strategies and tools for acquiring data

This section of the website focuses on two factors. One webpage describes tools for finding information (online databases and Internet/WWW search engines). A second webpage recommends a strategy for reading whatever source documents are uncovered. That is, students are urged to analyze source documents with the discovery questions in mind—e.g., looking for (and recording) data that support the claim that a problematic situation exists, or looking for (and recording) information about status quo solutions, or looking for (and recording) potential goals or criteria for evaluating solutions. In this way, students are more likely to incorporate information into their own paper's line of thought, and they are less likely to plagiarize unintentionally.

3. Citations: Citing sources and compiling a list of references

This section of the website provides a short, focused set of instructions for the format of citations in the texts, general guidelines for a bibliographic entry in a references list, and a sample list of references—all based on the instructions to authors publishing in the *Journal of Environmental Engineering*. The webpage on the format of in-text citations does not simply describe the format of name-and-date citations, but also incorporates recommendations on style taken from the course packet and website for the upper-division service course in technical writing. For example, when trying to report information gathered from a written source (whether printed or electronic), students often fall into a habit of using "sentence frames": *Johnson says that..., Macintosh reports that..., Table 3 shows that....* When such sentences are strung together into a paragraph, the line of thought may become very difficult to see. As the website material explains,

> Clausal frames can obscure the line of thought in the literature review of a technical or scientific report. For example, the connection between two different studies (one by Johnson, the other by Levenspiel) is difficult to see in the following string of two sentences, since the clausal frames interrupt the flow of ideas (between conversion relationships and their use as predictors):

> Johnson showed that simple analytical conversion relationships *exist. Levenspiel showed that these relationships can predict the behavior of batch and continuous reactors.*

> The line of thought is better presented in either of the following passages:

> *Simple analytical conversion relationships exist (Johnson,* 1984). These relationships can predict the behavior of batch and continuous reactors (Levenspiel 1986).

> Simple analytical conversion relationships (Johnson 1984) can predict the behavior of batch and continuous reactors (Levenspiel 1986).

In this way, students receive brief, highly focused advice on a relevant matter of style. If necessary, they can follow up by reading more detailed materials on the website for the technical writing service course. Or they can consult tutors at the university writing center for feedback on how well they are implementing the guidelines.

4. Cohesion: Signaling the line of thought

The cohesion webpages describe several important ways of signaling a line of thought (or relationships between ideas) in a text. These cohesive elements include forecasts, transitions, connective words and phrases, parallelism, and given/new order. Each element is briefly explained and then illustrated by a version of the "acid rain" essay that has the relevant element highlighted in color. The pages also include links to more extensive explanations and examples on the websites for the two service courses in technical writing.

5. Format: Observing professional guidelines for the paper

These webpages present information gathered from the "general manuscript requirements" of the American Society of Civil Engineers ("ASCE On-Line Authors' Guide," undated). Elements that are covered include typing and layout, gender-neutral language, visuals, definitions and symbols, and math & SI units.

6. Links: Consulting other webpages with resources for environmental engineering

This page consists of links to professional organizations and schools.

7. Questions/Comments: Contacting a human for individual help

This page includes website links, "mail-to" links, and telephone numbers for several human beings who will talk to students about their CIVEN 3813 term papers. For advice about selecting an appropriate topic, students are referred to their CIVEN 3813 instructor. For help in finding sources of information, they are guided to a particular reference librarian who specializes in civil engineering (and who assisted in the development of information on the website about search engines, engineering databases, and links to professional organizations). For assistance in writing and revising their papers, students are urged to consult a tutor at the university Writing Center. And for questions or problems regarding the CIVEN 3813 website, they are encouraged to contact the director of the technical writing program.

Connecting Academic Interest Groups Through the Course-Specific Website

From their one-with-one collaboration in developing the course-specific website, the engineering and technical-writing instructors hope to generate opportunities for interaction among many of the individuals and groups interested in the writing of engineering students, and thus to further the goals of WID and WAC from the bottom up. The website's instructional materials can be accessed by several different types of user for different reasons, and in this way offer the hope of creating a community out of individual users in initially isolated contexts.

Context #1: The Individual Student

For highly motivated students in CIVEN 3813, the course-specific website is an easily accessible resource. As noted earlier, students at OSU who have passed the first-semester composition course with an A or a B grade are not required to take the second-semester composition course (which focuses on a research paper). Because of rigorous course requirements in their major, very few engineering students take the lower-division technical writing course (which focuses on development, cohesion, and style), and few students take the upper-division technical writing course (which focuses on audience analysis, usability, and workplace genres) until their senior year (and often their semester of graduation). Thus, students who enroll in CIVEN 3813 are not likely to have had any formal instruction about conducting bibliographic searches, writing summaries, making citations and lists of references, or developing an academic genre such as a problem/solution report based on published research. These often crucial instructional materials are available in the CIVEN 3813 website. But, of course, mere availability may not often result in actual individual use except by the most highly motivated students. For

most students, the website materials will be accessed in other, more structured contexts.

Context #2: Students and Teachers in CIVEN 3813

The website is also a useful resource for class, small-group, and one-to-one conferencing activities by students in CIVEN 3813. When first discussing the CIVEN 3813 writing tasks in class, the teacher (McTernan) can review the website materials with the class as a whole (using a theater-style projector connected to a computer). Or, using a desktop computer, the teacher can discuss the website with an individual student during an office meeting. Or the teacher can assign students to become familiar with the website material in a homework assignment. In these ways, both the teacher and the students have access to an expanded vocabulary for thinking and talking about rhetorical, linguistic, and stylistic aspects of the assignment—with each aspect of the assignment discussed and illustrated in terms of a subject and topic relevant to environmental engineering. Students who have trouble mastering concepts can follow links to information and instruction on the websites for the lower-and upper-division technical writing courses, where, depending on individual need, each student can get a quick answer to a common problem, or can follow additional electronic links to explore the reasons for the problem and the rationale for a variety of possible solutions. In this way, students have access to relevant, focused writing assistance within the course structure of their major discipline, yet in an electronic network that encourages students to explore logical and thematic connections between engineering and technical rhetoric.

Context #3: The CIVEN 3813 Student and the Writing Center Tutor

The website is a helpful tool in the writing center. With or without the encouragement of their CIVEN 3813 teacher, engineering students with more serious writing difficulties can seek out assistance in the writing center, where they can review the website materials with a tutor. Where the language of the instructional materials fails to connect with the CIVEN 3813 student, the tutor may be able to analyze the instructional examples in detail or to suggest alternative explanations if the website material by itself is not successful. The student seeks out the writing center tutor for help with a course-specific task, and the tutor seeks out the website as a starting point for discussion—and also for a quick education about the kind of writing assigned in the CIVEN 3813 course.

Context #4: Students and Teachers in the English Department's Writing Courses

In trying to prepare students in engineering (and other disciplines) for workplace writing, instructors in the English Department's technical writing classes have the ongoing task of finding ways to connect general concepts with specific applications—a task implicit in Aristotle's definition of rhetoric as the art of finding in the specific case the available means of persuasion. After years of consulting and other workplace experience, an experienced faculty member can draw on a repertoire of anecdotal cases. Such a repertoire is rarely available to a new graduate TA responsible for a section of English 2333 ("Introduction to Technical Writing") or English 3323 ("Technical Writing"). But if the TA has become familiar with the CIVEN 3813 (either while serving as a writing center tutor or while undergoing an intensive, week-long orientation prior to serving as an instructor for English 2333 or 3323), then the TA—and the TA's students—can benefit greatly from the directions, illustrative passages, and sample texts on the CIVEN 3813 website.

Thus, as in the writing center, the potential for interaction is reciprocal. On the one hand, the CIVEN 3813 website connects engineering students to website instructional material for the English Department's technical writing courses, which offer many examples of workplace applications of concepts of argument (e.g., the problem/solution line of thought in a proposal or recommendation report), cohesion (e.g., given/new order), and style (e.g., effective uses of active and passive voice). On the other hand, instructors and students in the English Department's technical writing courses are free to move in the opposite direction, linking their concern with workplace rhetorical and linguistic strategies to ongoing academic tasks such as the CIVEN 3813 report. Such two-way interactions are explicitly encouraged during start-of-semester orientation meetings for technical writing instructors, in periodic staff meetings throughout the semester, and in a required graduate practicum on the pedagogy of the undergraduate technical writing course. With increased opportunities to explore the common genres, recurring strategies, and perennial problems of engineering literature in various contexts, the teaching assistants and lecturers are better able to enrich their instruction.

Of course, the potential for reciprocity also exists for instructors of first-year composition courses—usually graduate students in literature or creative writing, with a strong orientation toward the expressivist goals of *learning to write* WAC programs. As a result, only those who have served as tutors in the writing center are likely to view the CIVEN 3813 website as a relevant instructional aid—although this may change in the future as new WAC efforts are pursued.

While opening new opportunities for fruitful interaction among academic groups with a stake in writing instruction for engineering students, this bottom-up approach of course-specific websites does not in

itself accomplish the higher goals of WAC, such as the use of writing to discover and explore ideas. Nor does it immediately integrate the potentially opposed goals of WAC and WID. But it does address some of the immediate, practical needs of engineering students, and thus also of a diverse range of instructors and other staff who are in various ways responsible for their education. By being helpful to different users in different contexts, the CIVEN 3813 website offers the hope that shared use of its resources will help to develop an awareness of shared goals and strategies. A network that begins by addressing sometimes disparate goals for different users in different contexts may in time give rise to a sense of shared goals, shared knowledge, and shared behaviors—that is, to a sense of community and common purpose.

Certainly these larger goals have not yet been realized. But the mere presence of the CIVEN 3813 resource has already led to a formal USDA grant proposal to develop similar websites for seventeen courses in the OSU Forestry Department. A similar effort at grant funding has been discussed at the first meeting of a newly-formed OSU committee on engineering writing (composed of representatives of five engineering departments, the dean of engineering, and the director of the technical writing program). And both the existing website and the promise of future efforts may invigorate an on-going effort to introduce a WAC program on campus. Thus, course-specific websites appear to offer a new, fruitful alternative to the status quo—a way out of the repetitive cycle of disciplinary misunderstandings and sometimes needless antagonisms among academic and professional stakeholders with serious, well-intended interests in the writing of engineering students.

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