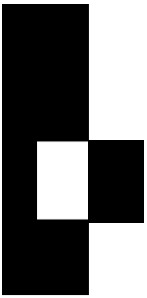

Letter from the Guest Editor

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Communications Across the Engineering Curriculum

In winter, 1998, *LLAD* circulated a Call for Proposals soliciting brief descriptions of potential articles for a special issue on Communications Across the Engineering Curriculum. If nothing else, the large number of responses we received confirms that this topic is generating much current interest, energy, and activity. Most of the proposals focused on a particular instructional experiment, program, or strategy. Other proposals took a somewhat broader perspective, placing engineering issues into larger pedagogical, rhetorical, or social/professional contexts that would be of potential interest to educators outside the engineering curriculum as well as to those who work within it. With this mix of proposals, Sharon Quiroz and I decided to organize this number of *LLAD* into two sections, the first devoted to full discussions of major issues and the second part containing briefer, focused descriptions of particular programs and strategies. After selecting some of the most promising proposals for outside review, we worked with the authors as they developed their ideas into articles. We hope that together, these contributions will stimulate your thinking about language and learning in technical fields, illustrate the range of innovative models for communications efforts across the engineering curriculum, and inspire WAC/WID efforts in other areas as well. This preface will briefly frame the special topic and then preview the articles that follow.

Engineering writing

Since the mid-nineteenth century, as engineering training shifted from apprenticeship experiences on the shop floor and construction site to formal academic programs in the lecture hall and laboratory, the pedagogy and place of writing in the curriculum have been topics of debate, frustration, and experimentation. Throughout the years, opinion polls, surveys, and anecdotal evidence have regularly attested to the importance of communications in engineering and to the writing deficiencies of recent engineering graduates (recent surveys include Davis, Barnum, Brillhart, Kimel, Pinelli, NSPE, Evans, Youra). Two major factors have

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constrained writing instruction in this curriculum: conventional patterns of engineering education and the very nature of communications in engineering.

Although engineering coursework has always offered many potential opportunities for communicating information, countervailing pressures have often made writing instruction seem superfluous or simply impossible to accommodate—pressures such as the sheer amount of information in any engineering subject, lock-step course sequences in which earlier offerings must cover material on which later courses depend, a perception that writing (important though it may be) is really someone else's instructional business, and accreditation requirements that, traditionally, have mandated many details of course content.

In addition to such pressures, the *situation* of writing is, arguably, more complicated in engineering than in most other academic fields. Poised between the pure sciences and industry, research and business, engineers must communicate among diverse groups for a broad range of purposes.

> The engineer must not only speak the language of, say, the physicist, but also, in certain instances, the language of the industrial manager, the lawyer, of the foreman on a construction site. And the complexities of playing this intermediate role are vitally apparent in the written products of the engineer, the myriad letters, reports, contracts, specifications, and proposals addressed to audiences with varying interests and technical backgrounds. Unlike the physicist, whose professional writing is almost always addressed to a community or, more often, a subcommunity of other physicists, the engineer in "real life" is much more likely to face complex rhetorical problems in translating information from one community to another. (Russell 120)

These rhetorical problems are further complicated because engineers must communicate effectively not only in writing, but also in oral and visual forms; they must convey information individually and collaboratively, in hard copy and on-line, via phone and fax and face-to-face.

Historically, engineering communications has fallen between the curricular cracks. Responsibility for engineering students' verbal literacy has been scattered everywhere (dispersed among different colleges, programs, departments, and courses) but based nowhere in particular. Although such diffusion can weaken the potential benefits of *concentrated* writing instruction, the unstable "ownership" of communications has led to a range of instructional experiments of varying success—from English

department courses (literature, composition, and later, technical communications), to "engineering English" classes within the technical college, to collaborative approaches aimed at integrating writing and engineering, either through separate but coordinated courses in each subject or through writing assignments incorporated into technical classes and laboratories. (For the history of relationships between engineering education, WAC, and technical communications, see Connors, Russell 101-32, Kynell).

Writing pedagogy within the engineering disciplines can be traced back to the 1890s, when MIT initiated a "cooperative" method of instruction. Various fields began requiring students to write technical papers in upper-level courses, papers that were critiqued both by instructors from English and from the technical discipline. Coordination of this kind was widely viewed as valuable and other institutions experimented with this strategy. In a different version of coordination, for example, at the University of Cincinnati, assignments in English composition classes included topics devised by engineering professors. In a textbook based on this method, Clyde W. Park, English professor in Cincinnati's engineering college explained that

> No novelty is claimed for so obvious an idea as the linking of certain phases of instruction in English with the written work done by students in their technical courses. The experience of numerous colleges over a considerable period has proved the essential soundness of the plan. Instead of being classed as an isolated subject, English has come to be regarded as an integral part of the curriculum. (vii)

This last claim was more of a local circumstance than national norm. However, Park described a connection between writing and thinking that remains the hallmark of WAC projects. "The effort needed to produce a clean-cut statement of his thought compels the student to do the sort of thinking that is essential in the study of a technical subject" (xix).

Coordination efforts such as these were widely admired, yet often problematic, given the artificial division of form and content, the uneasy status of English instructors in engineering, and apparent difficulties in bridging the "two cultures." By the late 1930s, interest in collaborative efforts waned. At the same time, the field of technical communications courses emerged within English. Ironically, tech comm evolved as a specialty separated from both literary study and engineering curricula even though it developed primarily to serve the needs of engineering students. In fact, "until the 1950's technical writing and engineering writing were synonymous" (Connors 330, 333).

Over the past twenty years, several developments have contributed to successes with WAC in engineering, including the institutionalization of WAC/WID programs, the growth of technical communications as an academic discipline, increasing uses of technologies in the field of composition, a renewed emphasis on the quality of undergraduate education in engineering, and criteria and procedures for accrediting engineering programs. (Because engineering is a profession as well as an academic major, national accreditation standards strongly influence curricular decisions. Over the past two decades, these standards explicitly supported a writing-in-the-disciplines approach: "Although specific course work requirements serve as a foundation for [writing] competence, the development and enhancement of writing skills must be demonstrated through student work in engineering courses as well as other studies." Although recently revised standards are less explicit about the means of instruction, they include "an ability to communicate effectively" as one of eleven required "outcomes" for all engineering programs [ABET])

Two strands of contemporary work with language in engineering can be traced to historical antecedents. One method involves communications within technical courses and often includes a language expert who works with an engineering instructor on writing issues related to assignments. In the other approach, an English instructor teaches a stand-alone writing class (typically in technical/professional communications, although some programs only require a first-year composition course). If the first arrangement resembles a consulting model, the second could be thought of as a sub-contracting approach. Articles in the engineering education literature include discussions of stand-alone courses or workshops for engineering students (Sullivan, Wilcox) and of integrating communications (often in collaboration with a WAC specialist) either within selected courses (most recently, Chalifoux, Waitz, Sullivan, Sharp) or across an entire engineering program or department (Bakos, Hendricks, Ludlow).

Current research in several related areas has enhanced our understanding of engineering communications and has informed teaching practices. Among these investigations are:

- Ethnographic studies of writing in non-academic settings, including the engineering workplace (for example, Seltzer, Bazerman and Paradis, Winsor, Odell, Duin, Paradis, Rymer). "WAC is not only about writing to learn, it is also about writing to learn *to do*—with others. . . studying the ways writing is used in workplaces. . . [C]onsulting with people in workplaces about how to use writing more effectively and ethically, can expand our usefulness . . ." (Russell "Writing to Learn" 4)

- Case studies of technical communications failures within bureaucratic organizations (for example, Three Mile Island and the Challenger disaster have received extensive analysis, including Herndl, Vaughan)
- Studies of genre and conventionalized audience expectations (for example: Swales, Bazerman, Berkenkotter; Killingsworth, Freedman. Several articles in Bazerman's recent IEEE collection on engineering genre specifically address teaching issues.)
- Attention to rhetorical dimensions of engineering (for example: Herrington, Geisler, Winsor "Engineering," *Writing*)
- Investigations of how writing assignments and feedback can express methodological assumptions in engineering (for example: Miller, Jones, Kalmbach)

As rhetoricians and WAC specialists continue investigating communications in engineering and the professions, they must carefully avoid the missionary position and instead cultivate a perspective of critical self-consciousness about how they apply their insights into the discourses of other professions. "We must learn how to talk *with* the scientists and practitioners in other disciplines who are threatened by or contemptuous of the analysis we offer. Otherwise, when we say "rhetoric," they will hear "your writing is all manipulation." When we say "social construction," they will hear "you're all a bunch of frauds." When we say "ideology," they will think "political correctness." (Segal) Back in the English classroom, an appreciation of the ways in which technical fields use language can inspire exciting curricular innovation. For instance, Lovitt and Young describe how "to liberate the report and the proposal from the scientific and commercial disciplines to which we have consigned them, because they are so useful for getting things done in all areas" (117). They show how reports and other functional forms can energize freshman comp and demonstrate to students that writing is a form of social action. Novice writers learn that "[g]enre helps us generate knowledge, and . . . shape how knowledge is defined, communicated, used and understood. It is a constraint and a heuristic; it is social and personal. A close attention to genre develops both cognitive and social skills" (124). If writing instructors and WAC specialists engage in true dialogue with engineering educators and practitioners, they

> will see what other disciplinary cultures have to offer and be enabled by this insight to reach a consensus with the inhabitants of other disciplines. . . . Interdisciplinary conversations will reveal that standards considered universal by many English teachers are actually local. . . And these

> dialogues should demonstrate that some ideas in the teaching of writing new to English departments have long been part of other cultures on campus. (Blair 386)

Preview

The contributions to this issue emerge from many dialogues. We are pleased that Earl Dowell accepted our invitation to set the stage for this collection. In his Introduction, Professor Dowell, Dean of Engineering at Duke University and Chair of the national Engineering Dean's Council, explains why engineers must write and speak effectively. He briefly discusses the diverse audiences that engineers must address, opportunities created by new communications technologies, potential roles of engineering faculty in communications instruction, and new professional accrediting criteria that affirm the need for communications instruction while leaving open the specific ends and means.

The articles that follow the Introduction elaborate on some of its themes. Glenn Broadhead's essay maps the various professional and academic groups that have a stake in enhancing engineering students' communications abilities. Although these camps may vary at different institutions, the disciplinary borders and occasional turf conflicts that the essay describes will be familiar to most readers. Taking a "bottom-up" approach across disciplines, Broadhead and his engineering collaborator use instructional technology to help civil engineering students with a term paper. Although the website they constructed supports a specific assignment in a single technical course, this new resource can link many different parties who have a stake in engineering students' education in writing.

In addition to writing for experts in their area, engineers must also communicate across disciplinary boundaries, to other engineers in different fields and to non-engineering audiences who have their own areas of specialization. Drawing upon the work of Cheryl Geisler and Dorothy Winsor, Rolf Norgaard discerns an important paradox related to this rhetorical situation: although engineering education largely focuses on mastering domain content, professional expertise can be seen as highly rhetorical and constantly negotiated, as different specialists interact and communicate. Norgaard explores the pedagogical and institutional implications of this perspective in relation to engineering curricula and to new criteria by the Accrediting Board for Engineering and Technology (ABET) for certifying professional programs. The ABET 2000 standards (recently renamed Engineering Criteria 2000, or EC 2000) embody a radical change from former assessment procedures, a shift from centralization to local control, from product to process. The former method involved counting up instructional hours and educational experiences within tightly defined

categories. Under the new criteria, individual programs must demonstrate that they meet broad aims through a process that includes defining local goals, measuring outcomes, and using that information to continuously improve the curriculum. As Dean Dowell notes, the open-ended quality of these criteria create a challenge—a challenge that Norgaard sees as a potential opportunity for collaboration among language specialists and engineering educators.

Leslie Perelman offers a very different perspective on the rhetorical dimensions of engineering communications by tracing the Classical roots of contemporary humanistic and technical discourse (or, more precisely, the discourse of engineering design). To demonstrate how these traditions express themselves in a contemporary context, Perelman examines the modes of analysis and argumentation required by two different college writing assignments, one from a philosophy class, the other in computer engineering. This analysis shows how an explicit understanding of these rhetorical traditions can help bridge the "two cultures" while demystifying the composing process for novice writers.

Like Perelman, Robert Irish focuses on the deliberative quality of what he calls "engineering thinking." From the perspective of a language consultant to engineering courses, Irish shows how two conceptual frameworks—Benjamin Bloom's structure of cognitive levels and William Perry's scheme of psychological development—can be used to develop successful writing assignments that support problem-solving in engineering contexts. By analyzing the design and evolution of particular writing assignments, Irish demonstrates how the two models of cognitive growth and intellectual development can be applied in creative, flexible ways that challenge students to engage technical material at their own level of understanding and to push that understanding further. The partnerships between a language expert and engineering instructors described here offer implicit models for other collaborations on writing in the disciplines.

Following the four lead articles, the second section of this special issue presents four different approaches to enhancing engineering students' communications abilities and a fifth piece that outlines a process for assessing and improving WAC/WID initiatives in engineering (and, by extension, in other fields as well). In contrast to work in other academic disciplines, much of engineering activity results in a tangible product; therefore, the curriculum in every engineering field includes substantial design experience. The first two Briefs show how engineering project courses can give students opportunities to engage authentic audiences both inside and outside of the classroom. With the growth of "service learning," such projects often focus on a real client whose needs the students must understand, and who, in turn, must understand how to use the resulting product. In these projects, writing, speaking, and visual

communications are often part of an engineering process that includes phases such as *invention, design iteration, analysis, documentation, implementation, feedback,* and *ongoing revision.*

To connect writing and speaking with technical work in such a project, W.J. Williamson and Philip Sweany at Michigan Tech teach two separate, but parallel, "linked" courses in technical communications and in software design. As senior engineering students develop educational software for a middle-school class, they use writing as a tool for design, documentation, and reporting on progress. The instructors describe the planning, coordination, and ongoing contact required to help this effort succeed. Taking a different approach to "integration," Barbara Shwom and her colleagues at Northwestern University team teach a single course that combines writing and engineering. First-year design students must address several audiences, both in writing and orally—peers, engineering faculty experts, and clients outside of the classroom who benefit from the design projects these students produce. Instructors of writing and engineering share the planning, teaching, and coaching of student teams, while emphasizing conceptual similarities between the processes of writing and of product development.

Rather than focus on a single writing-intensive class, Jeffrey Donnell and his writing colleagues at Georgia Tech work at the department level, with a sequence of undergraduate laboratory and design courses in mechanical engineering. The authors drive a small wedge between form and content by separating what they call "scribal skills" (grammar, sentence structure, mechanics, organization) from rhetorical considerations (technical information in relation to audience concerns). At the graduate level, they teach genre by closely examining the conventional narratives that professionals use for each of several typical situations. Also working at the department level, Pat McQueeney discusses collaboration between the writing program and civil engineering at the University of Kansas. The goal was to incorporate many modest opportunities for writing in several courses at different stages of the curriculum. McQueeney shows how the process of developing a writing guide for this approach revealed important disciplinary expectations and assumptions about language use; at the same time, such a guide can have unintended effects if (and in light of differing disciplinary cultures) it is viewed as an end in itself rather than a resource to support ongoing instructional innovation.

The specific contours of any approach to communications instruction must necessarily emerge from local circumstances and resources. But regardless of the particular disciplines or strategies, WAC/WID efforts must be reviewed and refined. In engineering colleges, evaluation pressures are especially strong because national accrediting standards mandate that programs be reviewed regularly, on a six-year cycle, using a

process that measures "outcomes" against explicitly defined goals. Anyone who works with communications in engineering will need to show that their methods are effective by demonstrating precisely what students achieve. In this context, Barbara Olds and her colleagues at Colorado School of Mines have developed a model to assess communications instruction within engineering curricula. This model illustrates how to define goals and criteria, measure the outcomes, and continuously improve the teaching/learning process. A matrix provides both specific features and general procedures for assessing initiatives in language and learning.

Post script

This issue of *LLAD* is intended to contribute to several ongoing conversations and to foster new exchanges. You can add your voice to the discussion in any of these ways:

- Sign onto the email list for engineering communications, at <EngiComm@listserv.acns.nwu.edu>.
- Participate in the Special Interest Group (SIG) meeting on Writing Across the Engineering Curriculum at the annual Conference on College Composition and Communications (CCCC). Current projects include consulting with ABET (the engineering accrediting organization) on communications curricula and assessment standards, and constructing a website for writing in engineering (see below).
- Link and contribute to the engineering communications website (still very much under construction), at <http://web.mit.edu/odsue/wac_engineering/>.
- Respond to the articles in this issue of *LLAD* by writing to the journal or contacting the authors (email addresses are provided in the bios). We look forward to hearing from you.

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