Engineering Design and Communication: A Foundational Course for Freshmen

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In the past four years, Northwestern University has radically reoriented its approach to teaching communication to engineering students. Previously, the engineering school had a two-quarter communication requirement: students typically took an expository writing course and an oral course such as public speaking—often at the end of their undergraduate career. In 1994, however, the engineering school proposed a change. Prompted by new accreditation requirements from ABET (the Accreditation Board for Engineering and Technology) and other curricular innovations for the freshman year, the school planned to introduce a two-quarter design course for freshmen—and asked Northwestern's Writing Program to explore the possibility of integrating the writing requirement into this course. [1]

Although the initial impetus for this collaboration was simply to create "space" in the curriculum for the new course, the writing faculty saw potential in the proposal. As experienced writing teachers and communication consultants, we believed that a combined writing and engineering course could give students a deeper understanding of the role that writing plays in engineering. Such a course could also provide a strong foundation in communication for students to build upon during their remaining three years. However, we were also aware of the threats that face communication instruction in an integrated course. [2] Students and the engineering faculty were likely to see engineering design as the real focus of the course and see communication or writing as a skills set with a handmaiden's status. It was also likely that design would receive most of the classroom time and attention. For communication to become integral and not an add-on, the course would need to be truly interdisciplinary: students should not only learn the fundamentals of design and communication, they should also see how their combined knowledge of both fields will make them better designers and better communicators.

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Thus, the Writing Program agreed to the proposed collaboration under the condition that a team of Writing Program faculty be involved in the design of the course, rather than just its implementation, and that the course name reflect both disciplines: Engineering Design and Communication (EDC). Northwestern is currently in the third year of teaching EDC, offering it to more than 260 engineering freshmen. By next year, EDC will be a required course for all 380 engineering freshmen at Northwestern.

Course Rationale and Overview

In many ways, design and communication make ideal partners. Engineering design is enhanced by a communication focus because design is a communication-intensive activity. Designers constantly interact with clients, users, experts, teammates, and supervisors. Designers interview, explain, inform, persuade, document, and negotiate. As most designers know, good communication improves the quality of a design: clearly articulating goals and requirements sharpens a designer's thinking. Similarly, design enhances communication instruction. Good reports and presentations are not just written; they are rhetorically and graphically *designed* to accomplish specific purposes for specific audiences.

EDC takes advantage of this intellectual partnership between design and communication. EDC is a two-quarter team-based course in which students the study design and communication process while working on design projects for real clients.[3] Weekly lectures are delivered by both an engineering professor and a communication professor and focus on both engineering and communication topics. In section meetings each week, faculty from both disciplines coach and supervise student design teams.

Assignments blend design and communication. For example, in the first week, students engage in a hands-on project based on the Apollo XIII moon mission. Adopting the role of the engineers in Houston, students design modifications so that the carbon dioxide scrubbers on the spacecraft can be used in the lunar landing module. After brainstorming solutions for the problem and building a simple device, they write a set of instructions for communicating their design to the astronauts. Students immediately realize that if their instructions are ineffective, the astronauts will die—even if the scrubber design is superb.

For the remainder of the first quarter, teams work on a World Wide Web design project for a local university client.[4] Projects have included a web-based alternative to Northwestern's course evaluation system, an on-line registration system for intramural sports, and web-based support for Northwestern's new Human Resources software package. During the second quarter, students work on a new project for a client in the university, the community, or local industry, for example, an enhanced pager

system for volunteer firemen, a wheelchair for long-distance recreational use, and a new storage system for a nearby elementary school.

Working on real projects and having real audiences teaches students how communication is central to the design process. To complete the projects successfully, students must communicate effectively with teammates, faculty, clients, product users, experts, and other informants. Students write memos, assemble reports, document project management, interview clients and experts, survey users, conduct meetings, and present their designs both in design reviews and final presentations. Because each team's project and client needs are different, students learn that communication requirements arise from specific situations and that communication problems are often just as open-ended and challenging as design problems.

Advantages vs. Disadvantages: A Happy Equation

Although EDC is an exciting course, it does suffer from some disadvantages. First, students receive less writing instruction than they would receive in a stand-alone course. Even though communication is an equal partner with design, teaching time is shared and few class periods focus solely on communication issues. Second, since students write mostly in teams, many write less than in a traditional writing course. Some team members may choose to spend more time researching the workings of a hydraulic drive train than on drafting, revising, or editing. Consequently, they learn less than we would like about organization, paragraphing, sentence structure, and grammar. Finally, EDC is expensive: faculty from both disciplines teach small sections of students every week and spend many hours preparing state-of-the-art teaching materials.

We are convinced, however, that the advantages of EDC outweigh the disadvantages and that the course is a worthwhile investment: EDC students leave the course (1) much better prepared to handle the communication challenges they will face in their upper-level courses and in industry and (2) thoroughly convinced of the importance of communication in engineering. As a foundational course in communication, EDC offers the following advantages:

- *EDC jumpstarts the communication education of engineering freshman.* By studying communication in a course that replicates a workplace environment, students absorb crucial lessons about purpose, audience, and professional standards—and, as a result, produce reports and presentations that are unusually sophisticated for freshmen. Although we have not yet formally evaluated the long term outcomes of the course, engineering faculty routinely comment that their EDC

freshmen produce higher quality reports and presentations than do many of the design teams in the senior capstone courses.

- *Students learn how to situate writing within a broader communication context.* Although the communication faculty in EDC are primarily writing specialists, we realized that students would be ill-served by a design course that emphasized written communication over oral, interpersonal, and graphical communication. All four modes are integral to the design process. Thus, in EDC students learn the relationship between various types of communication: for example, how writing interview questions can help prepare them to conduct an oral interview; how drawing a sketch at a meeting can help ensure that everyone has the same mental image of the design idea being discussed; and how a written report can be transformed into a PowerPoint presentation. By the end of the course students have gained an enhanced appreciation of the breadth of communication and its overall importance in engineering. As one student commented in a journal entry, " [EDC] made me realize that engineers must be able to explain 'how' and 'why' for each and every solution. In my eyes, engineers do not just solve problems, but they communicate solutions; that is a prominent part of an engineer's work."

- *EDC introduces students to cutting-edge communication technologies, not only as consumers but also as designers.* By the end of EDC, students have become more independent and purposeful in using computer technologies for both engineering and communication. This gives them not only advanced communication competencies, such as how to write HTML, but also a sophisticated understanding of how communication is changing: how various media—including email, web, paper, telephone—interrelate; how text, graphics, and audio complement each other in communicating a message; and how visual communication is becoming increasingly important to the everyday "reader."

A Ripple Effect in the Engineering Curriculum

Engineering faculty involved in EDC have become communication converts. They are so convinced of the value of teaching communication

with design that they are ready to require a two-quarter capstone course in EDC for seniors. These same faculty have begun to reevaluate their upper-level engineering analysis courses, looking for opportunities to integrate writing into the student's learning experience. Students, too, are interested in building on their freshman communication competencies. They continue to add to their EDC design and communication portfolio, using it as a selling point when applying for internships and co-op jobs. And each year a cadre of EDC alumni returns to work in the course as design and communication consultants.

One of the original goals of EDC was to lay the foundation for a "culture of design" at the engineering school. We didn't realize at the time that a culture of design is by definition a culture of communication—but we realize it now. Laying the foundation for one means strengthening the foundation for both.

Notes

1. For examples of other new freshman design courses, see "ECSEL: Redesigning the First Year," *ASEE PRISM*, May 1993, pp. 30-33; B.W. McNeill, D.L. Evans, D.H. Bowers, L. Bellamy, and G.C. Beakley, "Beginning Design Education with Freshmen," *Engineering Education*, July/August 1990, pp. 548-553; D.L. Evans (Coordinator, Special issue: "Integrating Design Throughout the Curriculum," *Engineering Education*, 80(5), 1990; C.L. Dym, "Teaching Design to Freshmen: Style and Content,"*Journal of Engineering Education*, October 1994, pp. 303-310.
2. B. Shwom, "Serving Our Clients, Preserving Our Discipline: A Tension in Cross-Disciplinary Programs," Panel, "Crossing to the Other Side of Campus: Issues in Cross-Disciplinary Collaboration," Conference on College Composition and Communication, March 1996; P. Hirsch, "Creating Broad Changes in Writing Instruction: Collaboration and Reciprocity Between the Writing Program and Engineering School," Panel on "Crossing to the Other Side of Campus: Issues in Cross-Disciplinary Collaboration," Conference on College Composition and Communication, March 1996.
3. For a fuller description of EDC, see P. Hirsch, B. Shwom, J. Anderson, G. Olson, D. Kelso, J.E. Colgate, "Engineering Design and Communication: Jump-starting the Engineering Curriculum, " *ASEE Proceedings*, 1998.
4. J. Anderson, J. E. Colgate, P. Hirsch, D. Kelso, B. Shwom, and C. Yarnoff, "The Web as a Model Technology in Freshman Design, " *ASEE Proceedings*, accepted for 1999.

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