Developing the Communications Skills of Engineering Undergraduates: Program Models that Meet the Needs of Students, Institutions, and Industry (2001073)

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Abstract

Industry practices, and the new ABET requirements reinforce the position that part of engineering education is developing the writing skills of engineering students. Currently, several methods can be employed to enhance those skills: creating writing centers in engineering colleges or departments, requiring technical communication courses, training and sponsoring engineering students to work as writing tutors within more centralized writing centers, and working with faculty to improve the design and evaluation of engineering writing assignments.

Each of these methods is adaptable to almost any given engineering program. The possibility for long-term success in adapting these approaches is increased when participants plan programs collaboratively and establish structures for continued assessment and program refinement over time. Ongoing dialogue between engineering and communications faculties within the institution is essential for genuine integration of the communications program into the engineering curriculum. The authors, who have been engaged in developing engineering communications programs that respond to the unique requirements of the sponsoring institution, have first hand knowledge of the critical role of engineering faculty in the success in any programs to improve engineering students' communications abilities. While the programs they represent differ markedly in approaches and features, they share a common philosophy of interdisciplinary collaboration.

In this paper, we describe several models for communications instruction and support for engineering students in these two different institutional settings. We suggest ways that similar programs might be adapted for use elsewhere, stressing the crucial role of collaboration between engineering and communications faculty, regardless of setting and model. We also discuss the importance of institutional, faculty and financial support in developing and maintaining programs that encourage students' commitment to improving their own communications performance.

University of North Carolina at Charlotte

During the past five years, the University of North Carolina at Charlotte William States Lee College of Engineering (COE) and the University Writing Programs (UWP) have engaged in both formal and informal collaborative efforts to 1) improve the quality of engineering student writing, 2) assist engineering faculty in

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giving more effective feedback to students, and 3) develop a set of procedures for assessing writing as a response to the ABET 2000 requirements for communication skills. This presentation describes the activities involved in this collaboration.

Improving the Quality of Engineering Student Writing

Because the engineering faculty at UNC Charlotte recognizes the importance of helping students develop their writing skills both for work within the academy and in their chosen professions, members of the COE faculty contacted me as the Director of the University Writing Program and asked me to work with them on several initiatives.

Training Teaching Assistants: For the past two years, I have trained the upper-division undergraduate teaching assistant to grade writing assignments in Engineering (ENGR) 1201 and 1202: Introduction to Engineering Practices and Principles I and II. This training involved practicing making comments on papers, responding to faculty criteria for writing assignments, and calibrating their responses for consistency.

Giving Presentations on Technical Writing to ENGR 1201 Students: For approximately 1-1.5 hours each semester, I give a presentation to over 600 students on good technical writing skills. This presentation is given at the point in the semester when students are preparing to write their first or second paper. The presentation includes a discussion of 1) engineering writing styles, 2) good technical writing strategies, 3) the relationship of writing to the faculty's criteria, and 4) advice from previous teaching assistant graders. Faculty teaching 1201/1202 have commented on the improvement in student writing because of these presentations.

Redesigning Writing Assignments: As a corollary to helping students improve the quality of their responses to writing assignments is an initiative to help faculty improve the actual description of the assignments themselves. In ENGR 1201, students write a team report on a design case study. By re-designing the assignment, the quality of the student reports improved dramatically.

These efforts, among others, have been successful in improving the writing of engineering students.

Participating in Curricula Development Teams

Working with groups of engineering faculty to improve the curriculum is another collaborative effort between COE and UWP.

1. *Civil Engineering API Grant Team*: Beginning in 1997, I worked with members of the Design and Communication team in the Department of Civil Engineering. Their task was to develop a vertical curriculum that integrated design, teamwork, and communication skills that satisfied the ABET 2000 requirements as well as revised their curriculum. Communication skills were designed into several courses particularly using team projects that required both oral and written products.

2. *Civil Engineering Technical Communication Team:* The Director of the

Writing Resources Center and I currently are working with a team of civil engineering faculty to design a standard set of criteria for lab reports. Faculty believe that this kind of consistency will help students improve the quality of their writing.

Developing ABET 2000 Writing Assessment Procedures

The new ABET 2000 requirements state: IC3i. "Competence in written communication in the English language is essential for the engineering graduate. 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. Oral communication skills in the English language must also be demonstrated within the curriculum by each engineering student." This new language makes it incumbent upon colleges of engineering to integrate writing throughout their curriculum and then to assess student writing as a way of looping the results back into the curriculum.

Because I have worked with engineering faculty and have some expertise in assessing writing, the College has asked me to present to them an effective and efficient model or set of procedures for assessing student writing. Building on a university-wide survey given to students in writing-intensive courses, we plan to develop a two-tiered assessment: 1) survey students currently enrolled in engineering writing-intensive courses, and 2) read sets of papers from such courses to assess the quality of writing among senior engineering students. During this presentation, I will share this set of procedures with participants.

Working closely with a university writing program or with faculty in technical communication is a collaboration that help colleges of engineering achieve one of their goals: to strength the communication skills of their students. This kind of collaboration also can lead to interesting research, grant possibilities, and collegiality among faculty member.

Writing Center/Professional Communications Center Program – College of Engineering and Information Technology, University of South Carolina

Program elements

The engineering communications program at the University of South Carolina is a continually evolving set of instructional modules, workshops, and consultation services for students and faculty, as well as various writing and editing activities performed for the institution itself. The director of the program, who holds a Ph.D. in English (Rhetoric and Composition) coordinates program development with the engineering faculty, supervises the consulting staff of four English and Linguistics graduate students, and oversees the production of selected college publications. At the end of the 1999-2000 academic year, the USC engineering college housed two distinct communications programs: the Electrical and Computer Engineering (ECE) Writing Center and a Professional Communications Center.

The primary function of the ECE Writing Center, created in 1995, was to provide regularly scheduled classroom instruction on report writing to sophomores in electrical and computer engineering and to evaluate these students' writing abilities. The ECE Writing Center began as a Human Resources Development Project funded by the Gateway Coalition of Engineering Colleges to explore the feasibility of using the writing center model, rather than a formal technical writing course approach, to improve the communications skills of engineering undergraduates. Since its inception, the ECE Writing Center's instruction has been an integral part of the syllabus for the sophomore lab class, EECE 201. As the program evolved, the writing center was asked to assume a much more prominent instructional role in the EECE 201 class and to develop a system for evaluating students' portfolios. In addition, the ECE Center provided in-class workshops and individual communications consultation to students in other ECE courses and offered specialized workshops on pronunciation to international graduate students and postdoctoral researchers in the department.

The Professional Communications Center (PCC) was created in 1998 to extend and institutionalize within the college the services and concepts developed in the pilot ECE Writing Center project. In the most recent academic year, the PCC provided classroom instruction in mechanical and chemical engineering lab courses, videotaping and evaluating students' oral presentations, and individual consultation on communications assignments in engineering electives. However, in response to the university's and college's increasing emphasis on research, the PCC has devoted more of its resources to helping undergraduates and graduate students publish scholarly papers and present their research. Services specifically for graduate students have included workshops on writing the thesis or dissertation and seminars on the role of engineering teaching assistants in improving the communications skills of undergraduates.

Collaboration and Evolution of the program

The changing emphases and priorities of both the ECE Writing Center and the Professional Communications Center demonstrate the key advantages of integrating writing center programs into the engineering curriculum. Through interdisciplinary planning and frequent communication, the writing center becomes an ally of engineering faculty and the institution in responding to changing needs, pressures, and constraints. The various iterations of the Writing Center's role in the EECE 201 syllabus and the gradual expansion of the PCC's role to support the institution's research initiatives and edit college publications illustrate these alliances in action.

Iteration and Research: The USC Model

The ECE Writing Center's work with the engineering instructors of a sophomore lab course, EECE 201, provides one successful model of integrating writing instruction into engineering. From fall 1995 to spring 1999, the Writing Center used a variety of approaches to incorporating writing instruction into the EECE 201 course, with varying degrees of success.

Fall 1995

The fall 1995 semester was the first semester of Writing Center involvement in the EECE 201 course. In 201, students attended workshop sessions, outside of class time, in the Writing Center every other week. These sessions were voluntary, but students were strongly encouraged to attend by the ECE professor and TA teaching the course. A writing center session followed this general format:

- The consultant began by discussing the week's topic (e.g. organization). Initially, the topics were chosen for their general application to lab report writing rather than tied to specific lab assignments.

- The consultant then invited group members to share their experiences with this topic or with any other aspect of the lab report writing that week. The consultant might also share instructional handouts that related to report writing with the students. These handouts were developed as Writing Center staff collaborated with the 201 faculty and teaching assistants.

- Following the group meeting, the consultant wrote a progress report to the engineering professor and teaching assistants explaining what concepts the group covered. These reports also allowed the Writing Center to share concerns that students voiced or trends that the consultant noticed in student papers.

This model relied largely on student self-disclosure of problems, willingness to bring drafts of labs to the group, and on voluntary attendance of the groups. Perhaps not surprisingly, this model failed because busy students often skipped their writing groups, and almost no students chose to share writing problems they were having. At this point in the Writing Center's involvement with EECE 201, students wrote 12 lab

reports each semester. The lab assignments were designed and labs were graded by the course professor, Dr. Roger Dougal, and in subsequent semesters by Warren Dixon, a graduate teaching assistant.

Another weakness of this initial model was the distinct separation of the Writing Center instruction from the engineering course. The only contact students had with the Writing Center was a brief introduction on the first day of class and then students only saw Writing Center consultants at group meetings in the Center. However, many students opted not to attend these meetings since they were not on the syllabus and did not "count" toward their grade.

Spring 1996, Fall 1996 and Spring 1997

Based on the December 1995 discussion, the ECE Writing Center implemented a new model of writing instruction in 1996 through the spring 1997 semesters. The ECE Department hired a Technical Writing graduate assistant to teach the writing component in the 201 course and to grade the writing portion of the lab reports. At this time, the Writing Center director and staff felt strongly that the Writing Center should maintain a strict separation between the Center and any involvement with grading. The Writing Center's identity should be one of a safe place for students to bring pieces of writing where a reader would give them critical feedback in a grade-free zone. This separation from grades was to enhance the consultants' ethos as "student advocates." Consequently, it was decided that the technical writing TA would not work in the Writing Center but would share an office with the engineering TAs. Thus, the technical writing TA was not officially associated with the Writing Center in any formal way.

One of the strengths of this model was that the technical writing TA became a liaison for the Writing Center who could strongly support Writing Center advice like the addition of a technical memo assignment to the syllabus. The Writing Center staff strongly endorsed the modification of one of the twelve lab report assignments to a technical memo assignment. Such a change would give the students a chance to explore one of the most common forms of business and engineering communication, the memo. Previously, engineering students only learned one genre of writing in EECE 201, the lab report. The technical writing Teaching Assistant worked with the Writing Center staff to design a context-driven memo assignment for the class, and she worked with the engineering TAs and professor on creating the evaluation criteria for the new assignment.

However, as with the previous models, this one also had problems. The main limitation of this second model is that graduate teaching assistants who have composition backgrounds and a knowledge of technical fields like engineering are difficult to replace when they graduate. Most composition graduate students at USC already have assistantships in the English Department, so there is not a large pool of available replacements. Furthermore, as the English department tightens enrollment numbers, which happens from time to time, the pool of potential applicants is further reduced. Also, there is the perception that writing and technical content are separate entities that can and should be graded separately.

Fall 1997 through fall 1998

After the technical writing teaching assistants graduated, the Writing Center resumed full responsibility for teaching writing in the 201 course, while the grading of writing reverted back to the engineering TAs. In fall 1997 through fall 1998, the Writing Center consultants taught writing in one half of the two-hour recitation. After a brief presentation on the writing topic of the week, the consultants divided the class into groups according to their lab sections. These groups of about 10-15 students per consultant then discussed the week's topic and any other student concerns about writing in the course. However, there were problems with this model too.

The Writing Center and the ECE TAs clearly identified weaknesses in this model of instruction. These weaknesses involved lack of student participation and students having difficulty applying abstract principles of writing instruction to the lab report writing that they were expected to do. One problem that the Writing Center had using this model was a lack of access to student writing samples. Most students did not bring drafts of their lab reports to class, so the Writing Center had to rely on its own manufactured examples of lab report writing to guide and direct the group discussions. At the time, this weakness did not seem crucial. However, after the discussion of the spring 1999 model later in this chapter, it becomes clear that this lack of real examples was a serious drawback. This model did have an important strength: the ECE TAs worked closely with the Writing Center consultants in addressing students' communications needs in the course throughout the semesters. The Writing Center's role in 201 remained flexible as both TAs and consultants reflected on what methods best served the 201 students.

The New Spring 1999 Model

In an effort to bridge this division of engineering and writing instruction, the Writing Center instituted another new model of writing instruction in the spring 1999 semester. This model was a modification of the Technical Writing TA model. In the new model, the engineering professor posted the two Writing Center TAs, Deanna Ramey and Tom Bowers, on the syllabus as well as the four engineering TAs. The Writing Center TAs provided the writing instruction in the first hour of the recitation, and the engineering staff remained present and attentive. Then, the Writing Center TAs remained in the class while the engineering recitation occurred. It made sense to have the writing instruction come **before** the engineering instruction for two reasons:

- Many students lost the incentive to listen if they received the instructions for the next lab exercise before the Writing Center spoke.

- The Writing Center often discussed aspects of the previous week's lab reports, so if students already had their minds on the next lab, it was difficult to ask them to refocus on last week's work.

- Also, the Writing Center TAs graded (for the first time) the writing portion of the labs (40 out of 100 points on each lab). "Writing portion" refers to the parts of the lab that are textual (both content and style) rather than graphical, although the Writing Center did evaluate the effectiveness of document design and whether graphical matter was properly incorporated into the text. This was an unexpected success from the Writing Center's perspective, because our teaching was greatly improved by this increased access to student writing. Since consultants saw all of the students' labs, we had a much greater knowledge of which problems students were encountering in their writing. One of the most important results/benefits of this exposure to students' work was that we could better customize the instruction we provided in the course.

Conclusions about the ECE Project

Each of the models of writing instruction have taught the Writing Center and the ECE engineering students and professors involved with the 201 course something about teaching writing in engineering contexts. One main lesson learned is that "integration" requires a much higher level of instructor and departmental commitment than we had previously anticipated. The evaluation sessions that the Writing Center and the EECE 201 professor and department Chair conduct at the end of each semester are vital to the success of the course and of the Writing Center's continued improvement of the communications instruction for the course. One of the main hindrances of all the models attempted so far is the transient nature of a graduate student staff. The connections established between Writing Center consultants and the engineering

professor and TAs who teach EECE 201 have to be created with new staff members as people graduate and leave the university. This reconnection effort necessarily impacts the fluidity of both the integration and the instruction itself.

Evolution of the Professional Communications Center

From the outset, one principle goal of the Gateway-funded ECE Writing Center project was the export of the concept and program to other departments in the college and to other institutions in the Gateway Coalition. To pursue this objective, the ECE Writing Center conducted a number of workshops for faculty and teaching assistants in other engineering departments. It also organized and conducted three 2-day workshops on engineering writing centers attended by institutions within the Gateway Coalition. These efforts generated interest in writing center services both locally and beyond South Carolina. However, institutionalization of any innovation from a pilot project always carries a price tag plus the burden of developing new mechanisms for collaborating with a larger constituency.

Impetus for institutionalizing the Professional Communications Center (PCC) came from the former dean of the college who proposed that the director of the ECE Writing Center assume responsibility for writing and editing college publications, as well as for developing a college-wide communications program. Financial support for the Professional Communications Center, specifically the director's salary and stipends for two English graduate students, was added to the college administration budget rather than shared by the departments. The ECE Department chose to continue its Writing Center and employed two English graduate students who were supervised by the PCC director. (Last year, the program in computer engineering was merged with computer science; thus the former ECE Writing Center is now the EE Writing Center.)

The process of gathering and editing information for the college's newsletter, ***Innovations***, gave the PCC staff ample opportunities to meet faculty in all of the college's departments and to learn about research and education developments. Perhaps even more important, drafting articles involved the staff and faculty in some degree of collaborative writing and in discussing a multitude of communications topics from rhetorical strategies to the writing processes of individual engineers. This interaction aided the PCC staff in understanding the direction of engineering research and at the same time, provided engineering faculty a chance to explore ways to use PCC services in their classes or research projects. The resulting collaborative projects have included communications modules for freshman design courses, communications instruction and follow-up on-line consultation for students in graduate level distance education courses, in-class seminars on literature searches and rhetorical analysis of engineering articles, instruction for students in preparing posters and reports for presentation to industrial advisory board members, and in-class workshops on proposal writing in a senior design class. Many of these activities, which have been described in detail elsewhere, have become regular features in course syllabi. [i] [ii] [iii]

While the Professional Communications Center and EE Writing Center continue to provide undergraduate instruction and consultation, new services for researchers at all levels have been requested by faculty advisors and the chairs of various departments. The engineering college is a major contributor to the University of South Carolina's intensive effort to attain AAU status. Since refereed publications and conference papers are major factors in measuring the quality and productivity of a research institution, the engineering college is seeking innovative ways to support researchers in their writing and presentation activities. Both centers provide editorial consultation to research faculty and student research assistants, especially international researchers for whom English is a second or third language. In addition, the senior communications consultant in the EE Writing Center, an experienced linguist, conducts bi-weekly pronunciation sessions for international researchers in the department and is planning additional workshops on writing for these international scholars. Moreover, as previously mentioned, the two centers recently initiated a series of workshops on thesis and dissertation writing as a result of the expressed

concerns of research directors, dissertation advisors, and departmental graduate directors. Each of the first two workshops began with remarks by one of the graduate directors, emphasizing not only the importance of clear communications skills but also the integral place of writing in the research process. Specific workshop topics have included time management, incubating ideas, organizing lengthy and complex texts, and achieving coherence in lengthy documents. Each workshop has concluded with interactive group sessions led by an advanced graduate student or a recent Ph.D. recipient. In these sessions, consultants and the research writers discuss writing processes, writer's block, and effective ways of communicating with research directors and team members. The participants' evaluations of these offerings have been positive and the engineering faculty has played a major role in encouraging attendance.

These collaborative workshops for graduate students and other researchers have an indirect but powerful influence on students' and faculty's perception of the writing and communications centers' services. When faculty and graduate students participate enthusiastically in programs offered by the centers, undergraduates soon see the centers as professional communications resources. This byproduct is by no means inconsequential. Many engineering undergraduates are skeptical about the value of traditional writing centers. These extremely bright engineering students view writing centers as remedial services for students who need help with grammar, staffed by English majors who know nothing about engineering genres and discourse conventions. The close collaboration among engineering faculty, students involved in research, and communications specialists helps dispel undergraduates' negative views of writing center programs in engineering.

Adaptation to other settings

The essential feature of the engineering writing center model developed at the University of South Carolina is its collaborative approach to planning instruction that meets the needs of students, faculty, the institution, and ultimately, the needs of professional engineers and their employers. The major benefit of creating a writing center program within the engineering college is the unique opportunity it affords for integrating communications theory and practice into the entire fabric of the institution. Advocates of the writing center approach hold that this degree of integration helps emerging professionals appreciate the inseparable connection between communications and engineering. Because of its flexibility and its collaborative approach, the writing center model is adaptable to any situation where interdisciplinary dialogue is possible. Realistically, the model is probably most suited for major research institutions where the engineering college is but one of many professional colleges. In such situations, the limited resources of humanities or English departments may not be sufficient to develop and offer the highly specialized communications courses required by engineering programs. Interdisciplinary collaboration is also more difficult in large, geographically dispersed institutions.

Engineering colleges considering the adaptation of a writing center program should first engage in open dialogue with communications professionals about the goals, limitations, and support for a proposed project. This initial effort at interdisciplinary communication should help identify areas with greatest potential for productive collaboration and clarify expectations for program outcomes. Strategies and measures for program assessment, for example, should be discussed early in the planning stages. As the topic of writing assessment is problematic even within the discipline of rhetoric and composition, this area can easily become a source of great concern to the both the institution and the writing program director. The list of other topics to be addressed early is not particularly long, but discussing them may be both time consuming and discomforting. The anxiety level can rise rather quickly in interdisciplinary discussions of such sensitive issues as the qualifications, compensation, and status of professional communications staff, not to mention overall costs of operating a writing center.

Establishing a writing center program in engineering requires a major commitment from both the institution and the professionals who have primary responsibility for designing and operating the program.

However, the benefits of achieving a seamless integration of engineering and communications theory and practice into the preparation of future engineers justify the investment of funds and energy.

<u>Conclusion</u>

Collaboration between faculty in colleges of engineering and writing programs is becoming more common. These two groups create assignments, design evaluation criteria, and revise pedagogies in an effort to teach engineering students how to write and communicate more effectively. Such partnerships are both rewarding to the faculty participants and to the students who learn new strategies for communicating from experts across the curriculum. Whether an engineering program creates an in-house writing center, like at USC, or cultivates a relationship with a university-wide writing program, like at UNC Charlotte, engineers and writing specialists can customize these models to create productive partnerships between engineering and writing faculty.

<u>References</u>

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Name of the First Author

Dr. Elisabeth Alford is the Director of the Professional Communications Center, College of Engineering and Information Technology, University of South Carolina. Her first position within the College, beginning in fall 1995, she collaborated with faculty and administration of the Department of Electrical and Computer Engineering, with leaders of USC's Writing Center Task Force, and rhetoric and composition faculty to develop a Gateway-sponsored writing center in the ECE Department. That writing center served as a model for the College-wide program of writing and communications instruction and consultation which she currently manages. She has made numerous presentations on engineering writing and communications instruction at national and regional engineering and English conferences. Dr. Alford received her PhD in English, with a specialization in rhetoric and composition, from the University of South Carolina. Prior to returning to USC, she was an executive in a health care association.

Name of the Second Author

Dr. Deborah S. Bosley, Director of the University Writing Programs and former Coordinator of the Technical Communication Program at UNC Charlotte, has earned a national reputation in the field of technical writing (particularly working with engineering faculty and students). On her campus, in only two years, she has delivered workshops to over 1100 students and 335 faculty members by providing experiences to enhance the writing skills of students and the assignment skills of faculty. She has published widely in the field of technical communication, including two national awards for best article of the year presented by the Association of Teachers of Technical Writing (an academic organization) and the Society of Technical Communication (a practitioner's organization). For fifteen years, she has conducted technical writing training at such companies as Hoechst Celanese, IBM, and First Union Bank among others. Currently, she is involved in an NSF proposal with faculty from Rice University, Carnegie-Mellon, Cornell, and others, to develop assessment methods for engineering writing by applying industry expectations to academic practice.

Name of the Third Author

Dr. Deanna R. Rogers, Assistant Director of the University Writing Programs at UNC Charlotte and Director of the Writing Resources Center, received her PhD in English from the University of South Carolina. She worked with Dr. Alford in the ECE Writing Center and the Professional Communications Center in the USC College of Engineering from 1995 – 1999. Her dissertation, <u>Assessing Writing Instruction in a Sophomore Engineering Course: Iterations of Integrating Writing from 1995 – 1999</u>, is based on research that she conducted while working in the ECE Writing Center. She has presented papers at numerous regional, national, and international conferences on engineering education, composition, literature, and writing center methodology.

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[i] Using Writing to Improve Retention: Rethinking the Purposes of Communications Assignments in the Freshman Year Experience Course for Engineers. Molly Gribb and Elisabeth M. Alford. ASEE 2000. St. Louis.

[ii] Using Rhetorical Analysis to help undergraduates acquire effective professional writing skills. Edward F. Young and Elisabeth M. Alford. FIE 99.

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