Abstract - Undergraduate engineering students acquire the discourse of engineering not only in formal classes but also through their interactions with teaching assistants in engineering lab courses. The TAs, by their comments on student papers and their instruction in the lab, influence students' progress in learning to write, speak, and think like engineers. Few teaching assistants, however, have received explicit instruction in effective ways to respond to student writing or to help students improve their communication skills. Literature searches reveal that little information exists on programs to train engineering TAs to coach the writing process. A training program at the University of South Carolina, Department of Electrical and Computer Engineering introduces teaching assistants to principles of writing instruction and to special topics related to writing in engineering.

The TA training program, conducted by engineering faculty and writing specialists, consists of two formal workshops each year, supplemented by bi-weekly meetings. Workshop topics include 1) the relationship between writing assignments and course objectives; 2) the relationship between writing in labs and writing in the profession; and 3) methods for responding to student writing both orally and in writing. Bi-weekly meetings, which focus on specific writing assignments in the Department's lab courses, are attended by engineering faculty responsible for the courses, along with Writing Center consultants, and undergraduate and graduate teaching assistants from engineering and English.

Through the program, teaching assistants have learned methods for integrating writing into the lab course. These strategies include writing-to-learn exercises to teach engineering principles and handouts on technical formats and style. The TAs also use comments on lab reports to teach students principles of organization and clarity. This presentation reviews the literature on TA training in the disciplines and outlines the objectives, content, and advantages of the ECE training program. Training teaching assistants to assign and respond to writing not only improves the quality of undergraduate writing but also gives both the instructor and students a vocabulary and strategies for responding to the writing of their peers.

As evidenced by the ABET 2000 criteria, engineering programs are responsible for ensuring that their graduates have the ability to communicate effectively. Equally important, employers of engineering graduates emphasize communications skills in their recruitment and promotion practices. Although engineering educators, program evaluators, and employers agree that engineering graduates need to be able to communicate clearly and appropriately, there is no single, agreed upon strategy for fostering and assessing such skills within undergraduate programs. Traditional approaches for teaching engineering writing and oral presentation skills have included courses in technical communications and writing intensive courses in the engineering discipline, often team-taught by an engineering professor and a composition professor. Although these approaches can be successful, they are often labor-intensive and expensive. More important, such approaches are often limited to specific course requirements.

A third option, being developed by the Department of Electrical and Computer Engineering at the University of South Carolina, integrates writing instruction throughout its three-year sequence of required undergraduate lab courses. The USC program is funded in part by the Gateway Coalition (http://www.gateway.VPR.drexel.edu/) , one of several consortia of engineering colleges formed with the support of the National Science Foundation to improve the quality of engineering education. The Gateway Coalition has emphasized innovations in curriculum, particularly the integration of humanities and social sciences components into engineering courses.[1] The program at USC illustrates one approach for accomplishing such an objective, as well as some of the benefits that accrue. In the approach developed by USC’s Department of Electrical and Computer Engineering, students learn communications skills as they learn engineering techniques and concepts in the lab.

The department’s writing program includes three basic components: a discipline-specific writing center; assessment of student writing; and research into engineering discourse conventions. These basic activities are largely carried out by writing specialists: the writing program director who
holds a Ph.D. in Composition and Rhetoric, the assistant
director of the ECE Writing Center who also holds a Ph.D.
in Composition and Rhetoric, two graduate students in
English with experience in writing instruction and
consultation, and a senior engineering student who serves
as technical consultant.

In addition to the Writing Center and writing program
staff, the engineering graduate and upper-level
undergraduate students who serve as teaching assistants in
the department’s lab courses play a major role in
undergraduate writing instruction. Therefore, the
department’s writing program includes a variety of training
opportunities for these student lab instructors. Conducted
throughout each semester, the training sessions help
teaching assistants learn how to teach writing along with
engineering, how to respond to student writing and
speaking, and how to engage students in discussions to
help them acquire the language structures of engineering
discourse.

Rationale for the TA Training Program

The responsibilities of teaching assistants in engineering
programs vary greatly from institution to institution. Some
may be involved in setting up lab equipment and
monitoring procedures. Others may provide all the lab
instruction, including assigning and grading written
reports. In colleges with a primary emphasis on
undergraduate education, writing is assigned and graded by
faculty. But in universities with large graduate programs in
engineering, the task of grading lab reports frequently falls
to teaching assistants. Helping engineering TAs learn how
to assign, analyze, and respond to student writing provides
invaluable skills to these emerging professionals. Whether
the teaching assistants plan to teach in an academic setting
or work in another environment, training in the process of
coaching and responding to writing enhances their career
prospects and their abilities to write well both individually
and collaboratively. In addition, providing this type of
training to engineering TAs may be one of the more
effective means to help engineering undergraduates learn
the basics of engineering communications.

Because of their frequent interaction with undergraduates, lab TAs inevitably become role models for undergraduates, especially as the new students learn to think, talk, and write like engineers. Undergraduates learn how to describe engineering phenomena from listening to and imitating the TAs’ explanations of lab experiments. In those institutions in which TAs grade lab reports, students develop an understanding of criteria for good written communications on the basis of TAs’ marginal comments and grades on lab reports. And by watching lab instructors
as they present material in the lab sections, the novices get
their first hints about the proper way for an engineer to
make an oral presentation.

That students will learn from the examples set by the
teaching assistants is inevitable. Novices customarily
acquire the discourse of a culture by imitation in their early
tries to use the language that conveys meanings within
that culture. As the Russian psychologist Lev Vygotsky has
noted, learners develop concepts through using language.
Learners “grow into intellectual life” through social
processes as they interact with people in the environment
and with peers.[2] As one contemporary guidebook,
Teaching Assistant Strategies, recognizes, “TAs are often
agents of socialization, providing intellectual, emotional
and social support” to students in their adjustment to
college. This guide’s authors point out that in larger
universities, the smaller lab groups and sections led by TAs
may “allow instruction to take place at higher cognitive
levels than is possible in lectures.” They add that “TAs can
explain confusing concepts and clarify abstract ideas.”[3]

Although the lab TAs have a substantial influence over
the developing communication skills of undergraduate
engineers, these teaching assistants are not necessarily
aware of that influence. Teaching assistants do not always
recognize the need to model effective communication
techniques, especially if they are not directly involved in
assigning, grading, or responding to student writing. Even
in those institutions that expect TAs to comment on
students’ reports, teaching assistants typically are selected
on the basis of their scholarship in engineering and their
leadership skills, not on their ability to teach writing.
While many of them may be effective writers themselves,
most have probably not taken courses in English
composition beyond the freshman level. And though these
graduate and upper level undergraduate students have
probably learned the rudiments of writing lab reports for
specific courses, few have been taught the fundamentals of
Teaching Assistant Strategies, recognizes, “TAs are often
technical writing. Consequently, they often
eXperience frustration when they try to write comments on
lab reports that will help students improve their writing.

These frustrations were confirmed in discussions
between the TAs in the Department of Electrical and
Computer Engineering and the writing specialists who
developed the ECE Writing Program. These
interdisciplinary dialogues revealed that the engineering
TAs with grading responsibilities would welcome a basic
orientation to the principles of responding to student
writing and explaining strategies for correcting common
problems in technical writing. More important, the TAs
recognized the value of the new program to improve the
quality of student writing.
Literature Search – Models for Training Engineering TAs in Writing in the Disciplines

The ECE Writing Program began with an intensive literature search and surveys of writing center programs in Gateway Coalition schools. The program continues to perform bibliographic research of various databases and journals, including ERIC, Applied Science and Technology Abstracts, and individual journals in engineering education, writing center administration, writing across the curriculum, and writing in the disciplines. These continuing searches reveal that little has been published on the training of engineering TAs for their teaching roles, and even less on their preparation for teaching writing. They have, however, provided insight into the generalized and localized training provided to engineering TAs. Traditionally, individual institutions provide orientation workshops and guidebooks for the initial training of teaching assistants throughout the institution. At the University of South Carolina, for example, graduate teaching and instructional assistants attend at two-day orientation session and receive two manuals: A Handbook for Graduate Teaching & Instructional Assistants and Teaching at USC. The Handbook contains USC policies relating to graduate instructors and descriptions of pertinent USC services. Teaching at USC is a general introduction to principles of teaching that includes short sections on course planning, teaching, testing (including assigning and evaluating writing), and classroom management, along with a section of academic policies and regulations. A number of major universities have similar orientation programs and publications for their own graduate students.

A survey of TA training programs conducted by Weimer, Svinicki, and Bauer in 1989 provides data on representative programs and confirms that the approach used at USC is fairly typical of the 14 institutions included in their study.[6] However, ECE’s continuing literature search has found no comprehensive, nationwide data on elements and strategies of particular TA training programs. Among the current works on the general principles of TA training, two are readily available: Jody D. Nyquist, Robert D. Abbot, and Donald H. Wulff, eds., Teaching Assistant Training in the 1990s and Jody D. Nyquist and Donald H. Wulff, Working Effectively with Graduate Assistants.[8]

Beyond these general guides, there is little information on discipline-specific TA training programs, even though recent literature suggests that “instruction for teaching assistants should be discipline-specific so that teaching assistants gain an understanding of how to effectively communicate the knowledge of their field.”[9] Experts in writing across the curriculum programs point out that TAs in the disciplines often do some of the teaching and need consultation in teaching writing.[10] More often, though, writing across the curriculum programs have combined English faculty and TAs with faculty from a particular discipline, rather than training TAs in a discipline to coach the writing process. The writing links program at UNC Chapel Hill, for example, provides workshops for TAs in the disciplines who lead discussion sections in large lecture courses and for English TAs who teach writing courses linked to the lecture courses. According to Graham, the English TAs who are selected for the program “usually have some background, perhaps even an undergraduate major, in the lecture discipline.” Graham, however, does not mention whether the TAs in the disciplines have backgrounds in teaching composition or consulting with writers. The two groups of TAs do have a chance for interaction. According to Graham, both groups of TAs attend a week-long workshop prior to each fall semester. The “shared experience” of these initial workshops, she writes, is “crucial.”[10]

The specific disciplines in the UNC Chapel Hill writing links program are sociology, history, psychology, philosophy, geography and astronomy. Engineering, absent from this list, has largely been absent from writing across the curriculum and writing in the disciplines programs. As a result, resource materials to help faculty and TAs teach discipline-specific writing, such as The Bedford Guide to Teaching Writing in the Disciplines, contain no engineering examples or discussions of engineering genres.

Although a recent literature search uncovered no national, or coalition-wide, studies of general training programs for engineering TAs or programs and materials to instruct them in strategies for responding to student writing, one current article points to the involvement of TAs in writing and communications programs in engineering. In the Materials Science and Engineering Department at Virginia Polytechnic Institute and State University, a disciplinary program for writing and communications has been integrated into eight required courses of the three-year curriculum. The program at VPI includes in-class team-teaching by engineering and writing program faculty, weekly writing workshops, individual and small group consultation in a discipline-specific writing center, and faculty training and development. In describing the VIP program, Hendricks and Pappas note that graduate students from both the English and MSE Departments support the five faculty members who teach the writing program courses.[12] The authors note that the engineering graduate student was added in the second year of the program, but they do not describe the training provided to this student. They also provide no details on the graduate students specific roles in the writing program.
Organization of the ECE Writing Program

From the inception of its undergraduate writing program in 1995, the Department of Electrical and Computer Engineering recognized that the support of faculty and teaching assistants was essential for the program’s success. In addition, since the writing program was designed to complement the department’s existing sequence of lab courses, the new program would most directly affect the teaching assistants for those courses. Thus, training to introduce engineering TAs to fundamentals of technical writing instruction has been an integral and ongoing part of the ECE writing program from the beginning.

From fall 1995 through spring 1997, the ECE project has provided consultation and training to 16 engineering TAs and research assistants with some instructional responsibilities in the department. Although the composition of the group changed each semester, roughly half were graduate TAs and half were undergraduates. Three of the TAs who began as undergraduates subsequently became graduate instructors. In addition, ten teaching assistants from other departments have attended educational events sponsored by the project, and writing center staff have collaborated with one senior graduate instructor in another department to incorporate writing instruction in his laboratory course.

The various activities for teaching assistants offered within the ECE Writing Program are jointly coordinated by the associate chair of the department and by the department’s writing program director. Graduate students in English who staff the department’s Writing Center assist in conducting the various educational events for the engineering teaching assistants. The central elements in the program include workshops, staff meetings, and individual consultation related to writing assignments. In addition, the department has involved engineering TAs in special projects that entailed collaborative writing and oral presentations related to writing instruction.

Workshops

At the beginning of each semester, the ECE department conducts half-day workshops for engineering TAs. These sessions stress the importance of excellent communication skills for success as an engineering student and as a professional. At the workshop, representatives of the faculty discuss the role of the teaching assistant in helping students learn to communicate effectively, paying particular attention to the fundamentals of teaching writing and to effective strategies for teaching students how to communicate clearly. Principles of hierarchical organization, technical formats, inductive thinking, and coherence are highlighted and explained. Sample materials and handouts on structure, format, and coherence are provided to the teaching assistants for their use in lab courses. In addition, workshop participants are introduced to the concepts of writing-to-learn and provided sample assignments for incorporating this technique into the lab curriculum. These materials, and the repetition of important topics at each workshop, promote the use of standardized approaches and uniform vocabulary for talking about writing in each of the department’s lab courses. They also give the instructors access to tested instructional materials and guides for teaching.

These introductory workshops also give teaching assistants practice in responding to student writing and feedback on their approaches. Experienced English writing consultants from the department’s Writing Center distribute sample lab reports, lead participants in writing comments on the papers, and then discuss strategies that encourage students to improve. In these group discussions, the writing consultants explain why minimal comments and markings are generally more effective than extensive corrections. They also discuss the use of rhetorical comments, such as questions and requests for elaboration, that help students see how their writing is received by readers.

Each of these introductory workshops concludes with a general forum in which teaching assistants raise questions about writing and teaching writing. Response to the workshop sessions has been positive. The participants not only find the workshop content helpful in carrying out their duties as lab instructors, but they also learn more about resources and materials that are available to help them in the future.

Staff Meetings

Once a week throughout the semester, engineering teaching assistants and the English graduate students involved in the department’s writing program meet with the associate chair of the department and the writing program director. Each of these meetings includes a brief presentation on a topic related to teaching engineering or teaching engineering writing, with the engineering teaching assistants and writing consultants alternating responsibility for the topic of the week. Subjects addressed have ranged from an explanation of transistors and microprocessors to a comparison of writing formats used in freshman English courses and introductory engineering lab courses. The meetings foster continued discussion of the teaching of writing and reinforce the importance of good communications within engineering. They also offer writing professionals and engineering instructors additional opportunities to practice communicating to audiences outside their own discipline and a chance to expand their knowledge of the engineering discipline.
Individual Consultation

The Writing Center routinely provides consultation to engineering teaching assistants as they plan writing assignments for their students. The TAs frequently discuss drafts of assignments and handouts before they distribute them to students. This dialogue helps both the Writing Center consultants and the lab instructors anticipate students’ questions about the assignment and to predict what difficulties they may encounter. Such collaborative review leads to improved teaching strategies because they focus attention on how learners learn.

Special Projects

The ECE Writing Program, with continued support from the Gateway Coalition, has developed several special projects designed to share its materials and research with other engineering colleges. These projects, which include conferences for the Gateway Coalition colleges and a publication on teaching writing in engineering, have involved the department’s teaching assistants as resources, authors, and presenters. Their involvement has provided a way to demonstrate that engineering teaching assistants can quickly become adept at explaining the principles of writing instruction and that they have a wealth of first hand information about the writing processes of student engineers. In addition, through their participation, the TAs have gained valuable experience in collaborative writing and in planning instructional programs.

Workshop Presentations

During a 2-day conference on Writing Centers in Engineering, held in July 1996 and attended by writing center directors and engineering faculty from Gateway institutions, five engineering teaching assistants from the ECE department delivered a panel presentation on their approaches to teaching writing within lab courses. Preparing for the panel discussion required the students to analyze their use of writing in the lab course, to describe the relationship of writing assignments to the course objectives, and to assess the benefits of using writing to learn in the engineering environment. Through reflecting on their teaching practices in activities such as these, student instructors gain insight into the effectiveness of various methods. They also become more conscious of their roles and responsibilities in teaching engineering discourse conventions to undergraduates.

TAs Guide to Teaching Writing

In October 1996, the department’s teaching assistants and the writing center consultants jointly developed a manual: Teaching Writing in Engineering: The TA’s Guide.. The manual contains ten articles, three authored by engineering students. In helping to write the manual, the engineering teaching assistants not only gained experience in collaborative writing, but they also learned strategies for writing about writing. These two abilities—to write collaboratively and to explain writing assignments—are invaluable for educators and for anyone who wishes to help colleagues improve their writing. In addition, the 1996 manual is currently being revised. The revision process allows the TA authors to incorporate what they have learned through testing their own materials in the classroom. The authors also plan to publish the revised manual on the Gateway website so that the resource can be used and tested in other settings.

Conclusion - Program Benefits

A program to teach engineering TAs how to teach writing has benefits for both the instructors who receive the training and for the undergraduates in the lab courses. Although there has been no attempt to quantify changes in the quality of undergraduate writing since the writing program began, members of the ECE faculty have commented on the improvement they notice. One professor, for example, commented on the ECE Writing Center approaches this way: “I think that the time you spend working with the students in one-on-one sessions, helping them to organize their work, reviewing what they have done, pointing out and correcting errors, is far more effective than anything I write on the papers after they are turned in.”

These same approaches are the ones the engineering TAs are being taught to use. Thus, instructors acquire additional resources to use in fulfilling their responsibilities in grading papers. These resources include guides to teaching writing, an orientation to students’ writing and learning processes, and suggestions for writing comments that students can understand. Based on the responses of the teaching assistants in the ECE department, the instruction and materials they have received have enabled them to help their students become better writers. In fact, during a staff meeting, one of the ECE engineering TAs bragged about the quality of the students’ lab reports. “When they go to work, our students will already know how to write because we have taught them to write professional quality reports.” Although this particular TA did not elaborate on how or why the program has achieved results, part of the credit is attributable to the training program for the teaching assistants.

By providing writing instruction in the lab, teaching assistants can offer an especially effective form of teaching. In the lab environment, the instructors can teach writing to students at the time they need guidance to achieve
specific writing tasks and consequently, when they are ready to learn. Moreover, integrating writing instruction into lab activities helps students make connections between the work and words of engineering. As the ECE program demonstrates, appropriately trained teaching assistants can serve as a valuable resource in helping to ensure that the engineers of the future communicate effectively and clearly.

References

14. Bowles, J.B. Correspondence to Elisabeth M. Alford, Director, ECE Writing Center, January 2, 1996.