

# The Interweaving of Technical Communication in Engineering Courses Throughout the Curriculum of a Large Mechanical Engineering Department

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**Abstract** – The mechanical engineering curriculum at Virginia Tech interweaves technical communication in several courses that span the three years that students are in the Department. These courses include both design courses at the sophomore and senior levels and laboratory measurement courses at the junior and senior levels. This program, which graduates more than 220 undergraduates a year, has become a success. For instance, this program has been named one of three model communication programs for the more than 75 departments of Virginia Tech. Also, our spring 2004 survey of 313 alumni showed that technical communication was the area of the curriculum with the most improvement over the past four years—when the program took shape. This paper details the learning objectives of our program and the communication assignments and instruction in the curriculum to fulfill those objectives.

**Keywords:** Communication Program, Engineering Curriculum, Large Classes

## INTRODUCTION

Many engineering curricula, such as the engineering curricula at the University of Wisconsin–Madison, use a course outside of the department as the principal course for teaching technical communication to undergraduates. Other engineering curricula, such as at the University of Texas at Austin, have a departmental course that is dedicated to teaching technical communication principles. The mechanical engineering curriculum at Virginia Tech, though, interweaves technical communication in several courses that span the three years that students are in the Department. These courses include design courses at the sophomore and senior levels and laboratory measurement courses at the junior and senior levels. Anchoring the advice given in these courses is reliance on the *Writing Guidelines for Engineering and Science Students* web site: <http://writing.eng.vt.edu/>.

Granted, such an interweaving of communication and technical information occurs in other curricula across the country, but most of these curricula are for relatively small departments. In contrast, the Mechanical Engineering Department at Virginia Tech graduates more than 220 seniors each year.

Our program has become a success. For instance, our program has been named one of the three model communication programs for the more than 75 departments of Virginia Tech. Also, our spring 2004 survey of 313 alumni showed that technical communication was the area of the curriculum with the most improvement over the past four years—when the program began to take shape. More important, 92% of these alumni claimed that the Department's curriculum greatly (52%) or somewhat (39%) contributed to their personal growth in the area of written communication. In addition, 89% of these alumni claimed that the Department's curriculum greatly (45%) or somewhat (44%) contributed to their personal growth in the area of presentation skills.

This paper details the learning objectives of our program and the communication assignments and instruction in the curriculum to fulfill those objectives. Following that are our on-going efforts at

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assessment of the program. Concluding the document is a discussion of the strengths and potential weaknesses of the program.

## **EXPECTATIONS IN THE MECHANICAL ENGINEERING DISCIPLINE**

The Mechanical Engineering Department at Virginia Tech includes more than 35 faculty and more than 700 undergraduates. To meet the requirements of the Accreditation Board of Engineering and Technology (ABET), the Mechanical Engineering Department must show that its graduating seniors have, among other criteria, an ability “to communicate effectively” [1]. Affecting the way that our Department meets this communication criterion is another ABET criterion: that graduates have an ability to collaborate on multi-disciplinary teams.

Since the 1980s, many industry boards that advise engineering colleges have claimed that engineering graduates need more instruction on writing and presentations. Two examples are industry boards at the University of Texas and the University of Wisconsin [2-3]. Echoing these criticisms have been responses from industry boards at Virginia Tech [4]. For instance, the latest College industry board made the following observations about communication abilities of engineering graduates from Virginia Tech:

- (1) both oral and written communication of graduates were primary areas needing improvement;
- (2) particular improvement was needed in the abilities of graduates to communicate technical information to non-technical audiences;
- (3) particular improvement was needed in the command of grammar, punctuation, and usage by graduates; and
- (4) participation in senior design projects and in making presentations were valuable educational experiences for graduates.

## **LEARNING OBJECTIVES AND OUTCOMES**

Given in Table 1 are the learning objectives and corresponding assignments of the communication program in the Mechanical Engineering Department. These assignments occur in at least eight different courses spread out over three years. Note that prior to entering the Mechanical Engineering Department, students are enrolled for one year in the Engineering Education Department, which also provides instruction and assignments in engineering communication. Given in Table 2 are the expected learning outcomes for the students for both the sophomore year and the senior year. These two years were chosen because there is a clear difference in expected outcomes between the two years.

## **DESCRIPTION OF THE COMMUNICATION PROGRAM**

Responding to criticisms by industry, the Mechanical Engineering Department has incorporated writing and presenting instruction and assignments throughout the curriculum. At the heart of this instruction are two required courses: Mechanical Engineering Lab I (ME 4005), taught in the second semester of the junior year, and Mechanical Engineering Lab II (ME 4006), taught in the fall semester of the senior year. Two sophomore courses that prepare students for this instruction are Sophomore Design (ME 2024), taught primarily in the fall, and Introduction to Thermal Fluids (ME 2124), taught primarily in the spring. In addition, two courses that provide reinforcement for this instruction are Senior Design I (ME 4015), which is taught in the fall of the senior year, and Senior Design II (ME 4016), which is taught in the spring of the senior year. Linking all these courses is the popular web site *Writing Guidelines for Engineering and Science Students* (<http://writing.eng.vt.edu/>), for which the College of Engineering serves as the host [5]. This web site receives more than 30,000 visits and has more than 100,000 pages downloaded each month during the academic term [6]. The Google search engine lists this site first both under the topic of *engineering writing* (out of 10 million sites) and the topic of *scientific writing* (also out of more than 10 million sites) [7].

**Table 1.** Learning objectives and corresponding assignments of the Department's program.

Learning Objective	Corresponding Assignments
Students should know how to target an audience, purpose, and occasion in an engineering document	Each student will write more than ten documents to at least three different audiences in at least three different courses
Students should know how to collaborate on the writing of an engineering document	Students will collaborate on more than ten documents in four different courses
Students should know the differences between strong and weak engineering writing	Students will discuss many examples in more than ten class periods of guided instruction Students will revise two long reports after receiving comments on those reports In eight courses, students will receive feedback on one document and then write a similar document to that same audience
Students should learn how to complete long engineering documents in a timely fashion	Students will meet deadlines for at least six long documents (more than 12 pages double-spaced)
Students should know how to make a professional presentation about a technical subject	Students will participate in at least four formal presentations Students will formally critique at least three presentations
Students should know how to create a set of presentation slides to communicate technical information	Students will help prepare at least four sets of presentation slides that must both serve a presentation and stand alone as a set of notes

This section describes in chronological order the communication instruction given to students in the Department's curriculum. Given the large number of students in any one graduating class (more than 220), not all students take each course in the sequence discussed. However, the majority of students do (more than 150). Appearing in Figure 1 is a visual depiction of communication assignments for the courses.

**Sophomore Year.** In the first semester of their studies in Mechanical Engineering, students begin learning how to communicate work in their discipline. The first required course in which students face this challenge is Sophomore Design (ME 2024). In this course, which has multiple sections and multiple instructors, the students work in groups of three to four on a design project that leads to a formal report. Before the final version of the report is submitted, students receive feedback on a draft either by peers or by the instructor. Accompanying that report is a group presentation at the semester's end. The primary audience in this course, as in almost every course in the curriculum, is a technical manager who knows much about the technical area, but is managing several different projects and therefore needs to be oriented. Students also have three individual writing assignments (typically memos).

During the second semester of the sophomore year, students take an introductory course in thermal fluids engineering (ME 2124), which is typically taught in different sections by different instructors. During this course, students write three individual reports with 2-3 pages of double-spaced text and 3-4 pages of illustrations. Students receive marked and graded copies of their work.

**Junior Year.** During the junior year, students continue learning to write and speak about their discipline in three main courses: Mechanical Engineering Lab I, System Dynamics, and Machine Design. While System Dynamics and Machine Design give the students more practice in writing, Mechanical Engineering Lab I addresses engineering communication with formal instruction.

In Mechanical Engineering Lab I, students learn how to assess the differences between strong and weak engineering writing. This formal instruction occurs in a lecture (the first in a series of thirteen over the next calendar year) that discusses these differences. A second way that this course achieves depth on engineering communication is through downloadable outlines, for six laboratory reports for the semester, that help the students target the audience, purpose, and occasion. Because the outlines save time for the students on

their writing, the students are generally eager to download them. Included in the outlines are stylistic tips for such things as designing graphs and writing first sentences of sections.

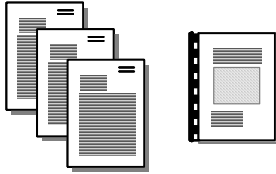
**Table 2.** Expected learning outcomes in the Department's communication program.

<b>Year</b>	<b>Expected Learning Outcome</b>
Sophomore	<p>For a general technical audience, students should be able to write a coherent description of a technical principle or design</p> <p>For a general technical audience, students should be able to write a short report that provides a solution to a problem; that report should have an introduction that orients the reader to the problem, a middle that is logical, and a conclusion that emphasizes the solution</p> <p>Students should be able to incorporate illustrations and equations into a technical document; those illustrations and equations should be properly formatted and should aid readers in understanding the technical principles presented</p> <p>Students should be able to work together in a team to complete a report</p> <p>For a general technical audience, students should be able to make a short presentation that communicates a solution to a technical problem; that presentation should have an introduction that orients the listener to the problem, a middle that is logical, and a conclusion that emphasizes the solution</p>
Senior	<p>For a specific technical audience, a general technical audience, or a non-technical audience, students should be able to write a coherent description of a technical principle or design</p> <p>For a specific technical audience, a general technical audience, or a non-technical audience, students should be able to write a long report that provides a solution to a problem; that report should have an introduction that orients the reader to the problem, a middle that is logical, a conclusion that emphasizes the solution, and appendices that address secondary audiences or issues</p> <p>For a specific technical audience, a general technical audience, or a non-technical audience, students should be able to argue effectively for a technical principle or design</p> <p>Students should be able to assess whether a technical document written by someone else succeeds in communicating the principles to the intended audience, with the intended purpose, and for the intended occasion</p> <p>For a specific technical audience, a general technical audience, or a non-technical audience, students should be able to make a long presentation that communicates a solution to a technical problem; that presentation should have an introduction that orients the listener to the problem, a middle that is logical, and a conclusion that emphasizes the solution</p> <p>For a technical presentation, students should be able to create a set of presentation slides that communicates the most important principles to the audience, that stands alone as a set of notes for the presentation, and that someone else in that person's group could pick up and use to make an effective presentation on that same subject</p> <p>Students should be able to work together in a team to complete a long report or presentation</p>

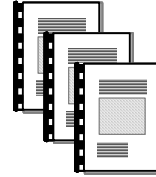
In addition to providing formal instruction and assignments on writing, Mechanical Engineering Lab I addresses the design slides for presentations. In engineering and science, the Mechanical Engineering Department at Virginia Tech is a leader in the design of slides for technical presentations [8–9]. This course devotes an entire lecture to the design of slides and uses examples from research presentations given by faculty and students in the Department. The design advocated by the program calls for a sentence headline, rather than a phrase headline, that states the main assertion of the slide. That assertion is then backed up first by images and then by words, where necessary. Because writing sentence headlines and creating images are more demanding than writing phrase headlines and bullet lists, this design is more difficult than typical designs, yet the results are worth the effort. Our students require fewer slides, those slides communicate information more memorably,

and those slides reveal the organization of the talk more readily. To practice the design of slides, students have two assignments in which they must design a set of slides for someone else (a technical manager) to be able to present.

## Sophomore Year



**ME 2024: Sophomore Design**  
1 formal report  
3 individual memos

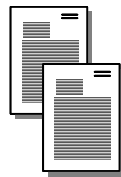


**ME 2124: Intro to Thermal Fluids**  
3 individual reports

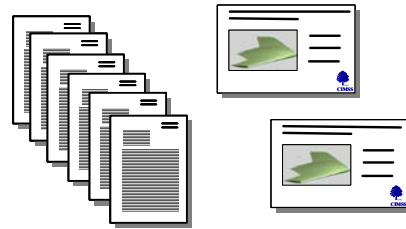
## Junior Year



**ME 3514: Dynamics**  
3 reports (group)

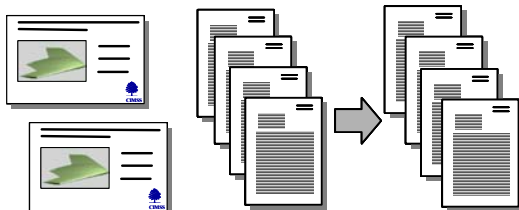


**ME 3614: Machine Design**  
2 reports (individual)

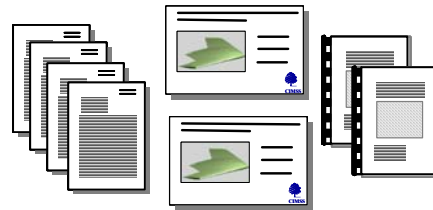


**ME 4005: Mech Engr Lab I**  
6 memo reports (5 pages each)  
2 sets of presentation slides (12 slides)  
2 lectures of formal instruction

## Senior Year



**ME 4006: Mech Engr Lab II**  
4 revised memo reports  
2 formal presentations  
9 lectures of formal instruction



**ME 4015 and 4016: Senior Design**  
2 long group reports  
Several progress memos  
2 long group presentations  
2 lectures of formal instruction

**Figure 1.** Visual depiction of communication instruction and assignments for eight required courses in the Mechanical Engineering curriculum.

**Senior Year.** During the senior year, students continue developing their writing and speaking skills in three main courses: Mechanical Engineering Lab II, Senior Design I, and Senior Design II. Mechanical Engineering Lab II is the program's centerpiece for writing and speaking instruction: nine lectures devoted to writing and speaking, two report assignments that involve marked and graded drafts, two other report assignments, and two group presentations in which students receive immediate oral feedback from two faculty and written feedback from a GTA and several peers. In the sequence of Senior Design I and II, teams of students write a series of progress reports, write two long completion reports, and make two formal

presentations (30-40 minutes each). In Senior Design I, students also hear one lecture discussing the writing of a proposal, which is an assignment in this course.

## ONGOING EFFORTS FOR ASSESSMENT

Assessment of the program occurs in three ways: (1) surveys of the students in the classes, (2) feedback from faculty, and (3) surveys of alumni who have gone through the program. This input is used to continually improve the program with most of the changes being formulated between semesters.

**Feedback from Students.** Most of the formal surveying for the communication program occurs in the two courses in which students receive formal instruction: Mechanical Engineering Lab I and Mechanical Engineering Lab II. In these courses, students complete two types of surveys: in-class surveys that are used to make course adjustments that semester and end-of-semester surveys that are used to make course adjustments before the next year's offering.

Surveys on the writing and speaking component of Mechanical Engineering Lab II have occurred since the fall of 2000, and surveys on the writing and speaking component of Mechanical Engineering Lab I have occurred since the spring of 2001. Through these surveys, instructors have made a number of changes in the writing and speaking components of those two courses. For instance, after the fall of 2000, attendance at all the communication lectures became a requirement. Interestingly, the students evaluated the communication lectures significantly higher in 2001 (3.26/4.00) than in 2000 (2.91/4.00). Instructors believe that the reasons for the higher rating were that the lectures better targeted the needs of the students and that more energy existed in the classroom. Having a full classroom, as opposed to a half-empty classroom, provided a better dynamic for both the instructor and the attending students.

**Feedback from Faculty.** In the past, feedback from the faculty has occurred informally with faculty in the capstone senior design course relaying comments about the writing and speaking of the students to the communicator coordinator. In the future, though, this feedback will occur more formally with a faculty survey to be given at the end of each academic year to solicit feedback from all instructors who have had writing and speaking assignments that semester in their undergraduate classes. Faculty feedback has also occurred through a faculty group in the Center for Excellent in Undergraduate Teaching (CEUT). This group has shared information about communication assignments and instruction in different courses. Through this sharing, this group has shared ideas. For instance, the CEUT group conducted two surveys about the effectiveness of large classes. Several ideas from these surveys have been used in the design of communication lectures in Mechanical Engineering Lab I and II and in Senior Design I. In the future, faculty feedback will serve to provide a check on how well students are meeting the learning outcomes defined in Table 2.

**Feedback from Alumni.** Finally, assessment of the communication program also occurs through surveys of alumni and from comments relayed by the Department's Visiting Board. Because the program has undergone so many changes in the past four years (for instance, inclusion of required communication lectures and presentation assignments in Mechanical Engineering Lab 2), we are not in a position to achieve a final assessment on how well the current program is preparing graduates for the long-term communication needs of the profession. However, our alumni survey in the Spring of 2004 showed that our Department has made significant improvement in the preparation of graduates to communicate their engineering work [14]. In that survey, more than 92% of the 313 alumni polled claimed that the Department's curriculum greatly (52%) or somewhat (39%) contributed to their personal growth in the area of written communication. In addition, 89% of these alumni claimed that the Department's curriculum greatly (45%) or somewhat (44%) contributed to their personal growth in the area of presentation skills.

These percentages are significantly higher than they were the last time the Department conducted the survey in 1999. Moreover, the area of communication was the area in the curriculum with the most significant improvement of any of the areas surveyed. Given that the most of the respondents (52%) came from the Classes of 2000-2003, these numbers strongly suggest that the changes that we have made to the communication program in the past four years have served to improve the amount of learning that students are receiving in this area.

## SUMMARY OF THE PROGRAM'S STRENGTHS AND WEAKNESSES

Given the commitment by so many faculty members to teach communication skills, the program includes a number of strengths. On the other hand, given the variety of situations in which mechanical engineers have to communicate and the difficulty of those situations, the program faces a stiff challenge in preparing its undergraduates. For that reason, the program contains a number of potential weaknesses that need addressing. This section summarizes these strengths and potential weaknesses. This summary appears in Table 3.

**Strengths of Program.** As shown in Table 3, foremost among the strengths of the program is the amount, variety, and distribution of communication assignments that the students complete. Stretching from the first semester of the sophomore year to the final semester of the senior year, students are called upon each semester to write or speak. For that reason, the skills are continually practiced.

**Table 3.** Strengths and potential weaknesses of the Department's communication program.

Strengths	Potential Weaknesses
Students gain much experience writing and speaking—they have assignments in eight courses spread over 3 years	Because 200 students are in each graduating class, giving individual attention is difficult
The <i>Writing Guidelines</i> web site and <i>The Craft of Scientific Writing</i> [10] provide unifying threads for the instruction	Because so many faculty and GTAs are involved, the potential exists for instructional cross-talk
Our GTAs, who are generally good writers and speakers, gain valuable editing experience in the program	GTAs bear much responsibility in evaluation, which is difficult, even for those with experience
The expectations for presentation slides are significantly higher than what others engineering students have	

A second strength of the program lies in the unifying threads provided by the web site *Writing Guidelines for Engineering and Science Students* and the textbooks *The Craft of Scientific Writing* [11] and *The Craft of Scientific Presentations* [13]. Even when engineering faculty may disagree about specific issues of style, these sources provide a foundation from which faculty and students can begin discussion about those disagreements. Such a foundation is important to avoid “cross-talk instruction” that could cause students to become confused about engineering writing and speaking. Addressing this concern of cross-talk is one entire lecture in Mechanical Engineering Laboratory II. A part of this lecture is a web-page [10] on the *Writing Guidelines* site in which ten faculty members from Senior Design I and II discuss their writing “pet peeves.” This web-page reveals that while different managers (faculty members in this case) generally agree on the goals of successful engineering writing, managers emphasize different aspects of style and form to achieve those goals.

A third strength of the program is the training given to the GTAs, all of whom are from the Department. Using and training graduate students to work in the Department's writing program is good for the Department—it serves to “raise the level of the entire ship” [12], rather than just raise the writing level of the undergraduates. For Mechanical Engineering Laboratory I and II, the Department hires about 12 to 15 GTAs to direct the labs and to critique and evaluate the writing of the students. Because almost 75 percent of graduate students in Mechanical Engineering are native speakers and many of these have come through the program as undergraduates, the Department has a strong pool of candidates from which to select GTAs for these courses. Selection is based not on GRE scores, but on demonstrated abilities to write and speak. For candidates who come from schools other than Virginia Tech, we conduct interviews to determine how well the candidate speaks English and to ascertain whether the candidate would feel comfortable assessing the writing of others. Typically, 2 to 3 GTAs each semester are non-native speakers.

A fourth strength of the program is the instruction given to students about presentations. In Mechanical Engineering Lab II, students participate in two hour-long presentation sessions, in which they make a technical presentation and then receive spoken feedback from two faculty members and written feedback from a GTA and several other students. Students also receive cutting-edge instruction about the design of presentation slides—instruction requested by other institutions such as the University of Texas, the University of Illinois, the University of Oslo, Los Alamos National Laboratory, MIT, the University of

Texas Medical Branch, United Technologies, the Environmental Protection Agency, and Sandia National Laboratories.

**Potential Weaknesses in Program.** As was shown in Table 3, the principal weakness of the program lies in the large number of students—more than 200 in each graduating class. Given this large number, few students receive much individual attention from faculty on their writing and speaking. Instead, most one-on-one instruction for each undergraduate occurs between the undergraduate and a graduate student. In many cases, this one-on-one instruction is fruitful, at least from the perspective of the undergraduates, as the survey results of Mechanical Engineering Lab II show.

A second potential weakness of the program is that because so many faculty and GTAs are involved in instruction, students could receive conflicting instructions. So far, such “cross-talk” instruction has not been a major complaint in the program. One means for discovering “cross-talk” has been a survey given relatively early in Mechanical Engineering Lab II. Feedback on this survey has exposed inconsistencies between the instructor’s advice and a GTA’s advice in time for those inconsistencies to be resolved before the final three reports are evaluated. Also, the communication coordinator devotes a lecture in the Senior Design Lab to ironing out the gray areas of writing with different managers. As a part of this lecture, ten faculty members have contributed their lists of writing “pet peeves” [10], or those rules of writing that they insist upon, but that other managers do not. The differences in these lists serve to teach students that not all managers emphasize the same rules of form and that some rules of form lie in gray areas.

A third potential weakness of the program lies in having GTAs bear most of the responsibility for evaluating the students. Evaluating technical reports is difficult, even for someone who has much experience. To overcome this hurdle, Mechanical Engineering Lab I and II have regular grading sessions for the GTAs. In addition, Mechanical Engineering Lab II has a two-day training session before the semester begins. Given the large numbers of GTAs (15 would be a typical number for Mechanical Engineering Lab II), it has been difficult to make the evaluations consistent. One change that was instituted to help this situation in Mechanical Engineering Lab II was to have each GTA serve as a mentor for only one problem. In this scheme, each undergraduate is evaluated by four GTAs: one GTA for the report of each laboratory problem. Because students make the GTAs aware of inconsistencies in their evaluations, the GTAs have to work with each other to reconcile those differences. This reconciliation has made the evaluation more consistent in the course.

## FUTURE IMPROVEMENTS

Through analysis of our program, we have decided upon several improvements that we would like to make in the program. These changes are summarized in Table 4. Most important is the incorporation of a proposal assignment into the program. Given the financial stakes often involved with engineering proposals and the persuasion needed for successful proposals, proposals are perhaps the most important and challenging engineering document to write. Our students need experience writing a proposal before they graduate. In the fall of 2003 and 2004, we experimented with a proposal lecture and corresponding assignment in Senior Design I. As part of the design process, each design team was asked to write a formal proposal to their technical manager requesting permission and funds to pursue a particular design. In 2003, most of the faculty felt that the proposals were not particularly strong. However, in 2004, with the addition of a sample design proposal to the *Writing Guidelines* web-site, many of the faculty members have seen improvement. The consensus from this work is that we need to develop this assignment further.

A second needed improvement is to give the students more instruction and feedback on their resumes and job correspondence. An opportunity for an assignment in this area exists in the first two weeks on Mechanical Engineering Lab II. In 2004, we experimented with having the students submit a resume on a volunteer basis, and although many students did submit a resume, many did not. We are considering making this submission mandatory next year. A third needed improvement is to give the students more instruction and experience with library research. At this point, we are not sure where this experience will fit into the program, but we will determine if opportunities exist in Sophomore Design or Senior Design I.

Yet a fourth needed improvement for the communication program is to give students experience writing to a non-technical audience. This situation is challenging because the evaluators of all assignments



are either faculty or graduate students in the Department. One idea, though, for giving students this experience is to have one of the reports in Mechanical Engineering Lab II aimed at a mixed audience: non-technical managers and technical managers. In this report, students would have to write the title, summary, and introduction to the widest audience and at least one appendix specifically to the non-technical audience.

The final two needed improvements involve fostering communication among the Department faculty who include communication assignments in their undergraduate classes. Because these faculty members evaluate the writing and speaking of the students, they are in an excellent position to assess how well the program is teaching these skills to the students. Securing input from these faculty members is needed. Our plan is to use a web survey to solicit their input in late May. Because we do not want these surveys to become a burden, we will solicit input only from faculty members who had writing and speaking assignments in that semester. Yet a second means to foster communication among the program's faculty involves sending an updated version of Table 1 and Figure 1 to the faculty each August. Updates to this figure would be gathered in the surveys in January and May. Using Table 1 and Figure 1, we will help faculty members realize how their communication instruction fits into the program.

**Table 4.** Needed improvements to the Department's communication program.

<b>Needed Improvement</b>	<b>Plan for Incorporation</b>
Give students the experience of writing a proposal	Further develop a proposal assignment, instruction, and model into Senior Design I
Give students instruction and feedback on resumes	Incorporate an assignment and corresponding instruction in Mechanical Engineering Lab II
Give students more instruction and experience with library research	Consider having an assignment in Sophomore Design or Senior Lab I
Give students more experience writing to a non-technical audience	Consider having a report to a varied audience in Mechanical Engineering Lab II
Survey faculty who include communication assignments in undergraduate courses to assess progress made by students	Have writing coordinator administer surveys in January and May
Update faculty annually on status of Department's communication program	Provide update in August; solicit information about changes in May (in survey)

## REFERENCES

- [1] Accreditation Board of Engineering and Technology, "Criteria for Accrediting Engineering Programs," <http://www.abet.org/> (Baltimore, MD: ABET, 2 November 2002), p. 23.
- [2] Elaine Busch-Vishniac, "Survey of Industry Concerning Educational Needs of Graduating Students," Mechanical Engineering Department Report (Austin: University of Texas, 1987).
- [3] J. G. Bollinger, "Alumni Survey Results," *Perspective* (Madison: College of Engineering, University of Wisconsin, Summer 1994), p. 2.
- [4] College of Engineering, "Employer Focus Group Summary Report" (Blacksburg: VA: Virginia Tech, October 2000), pp. 1-3.
- [5] *Writing Guidelines for Engineering and Science Students*, <http://writing.eng.vt.edu/> (Blacksburg, VA: Virginia Tech, 2003).
- [6] Michael Alley, Christene Moore, and Leslie Crowley, "Creation of a National Web Site on Engineering Writing," presentation, *2000 ASEE National Conference* (St. Louis: ASEE, June 2001).
- [7] Google, Search for *engineering writing* and *scientific writing*, <http://www.google.com> (28 November 2004), ranking of 1 for <http://writing.eng.vt.edu/> out of more than 8 million sites.

- [8] Michael Alley and Harry Robertshaw, "Rethinking the Design of Presentation Slides," *Conference Proceedings of the 2003 ASEE National Conference* (Nashville, TN: ASEE, June 2003).
- [9] Michael Alley, *The Craft of Scientific Presentations* (New York: Springer-Verlag NY, 2003).
- [10] "Common Writing Errors in Past Reports of ME 4015," <http://writing.eng.vt.edu/courses/me4015/> (Blacksburg, VA: Virginia Tech, 2003).
- [11] Michael Alley, *The Craft of Scientific Writing*, 3rd ed. (New York: Springer-Verlag, 1996).
- [12] Harry Robertshaw and Michael Alley, "Raising the Ship: Using Engineering Graduate Students Rather Than English TAs to Teach Writing to Engineering Undergraduates," *2001 ASEE Southeast Regional Conference* (Charleston: ASEE, 2 April 2001).
- [13] Michael Alley, *The Craft of Scientific Presentations* (New York,,: Springer: 2003).
- [14] Clint Dancey, "ME Alumni Survey," <http://www.survey.vt.edu/> (Spring 2004), 313 respondents.

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**Linda Vick** (Ph.D., VPI&SU 1996) is an adjunct faculty member in the ME Department of Virginia Tech and is the course coordinator for Sophomore Design (ME2024). Her industrial experience includes 11 years of research, development, and design of electromechanical systems and sliding electrical contacts.