# Promoting Undergraduate Research by Creating a Research Option in a Technical Communication Course: Initial Project Phase<sup>\*</sup>

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#### Abstract

Although many institutions such as the National Science Foundation, the American Association for the Advancement of Science, and the National Research Council have called for more undergraduate research, incorporating significant research experiences into undergraduate engineering curricula has proven to be challenging. This paper presents the initial phase of an experiment in the College of Engineering at Virginia Tech to address this problem by means of a research option in the traditional technical communication course. In this research option, students have the opportunity to prepare for and to document a summer research experience. To that end, the research option of the course is divided into two segments: (1) a spring segment to prepare students for a summer research experience, and (2) a fall segment to teach students to how document that research experience. This research option culminates in an undergraduate research symposium that is to show other undergraduates the benefits of and opportunities for a research experience. This paper documents the initial phase of this experiment—namely, the recruiting of students into the research option. Included is a discussion of a pilot symposium on undergraduate research that served as an advertisement for the research-option course and that provided lessons for next year's symposium. Also included are the statistics on the number, diversity, and quality of undergraduates who have applied for this research option. Twenty of the twenty-five slots for the pilot course were filled, the students have been of high quality (an average GPA of 3.7/4.0), and 11 of the 20 students are from underrepresented groups in engineering. This recruitment phase demonstrates that such a research option appeals to students who are qualified to attend graduate school. In addition, the course appeals to groups that are underrepresented in engineering.

## Introduction

The Boyer Commission Report has urged universities to "make research-based learning the standard" for the education of undergraduates [1]. Also calling for more research by

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undergraduates in science, technology, engineering and mathematics are the National Science Foundation [2], the American Association for the Advancement of Science [3], and the National Research Council [4]. Participation in research not only deepens a student's understanding in science, mathematics, engineering, and technology, but also promotes communication and teamwork to solve complex problems [5]. As stated by the Reinvention Center at Stony Brook [6], "When undergraduates working alongside faculty participate in the generation of knowledge or artistic creation, they join the university's rich intellectual community and they derive unique, life-long benefits." For these reasons, engaging more engineering undergraduates in research is a goal of many engineering colleges. However, given the pressures to reduce the number of credit hours in engineering curricula, engineering departments are hard pressed to find courses to foster an appreciation for research.

One opportunity that exists is the three-credit technical communication course required by so many engineering curricula, including the University of Texas at Austin [7], the University of Wisconsin at Madison [8], and Virginia Tech [9]. Typically, these courses require students to perform library research that serves as the content for the assignments: proposal, formal document, and formal presentation. Given that students are already laying the foundation for a significant research experience in this course, the question arises whether the literature review in this course could be complemented with experimental, computational, or theoretical research in actual laboratories. The benefits would not only be that the students would gain a valuable research experience, but that the students' appreciation for the communication would deepen, because the students would be more likely to assume ownership of the content.

This document presents the initial phase of a proof-of-concept test [10] for whether an undergraduate technical communication course could effectively be linked to larger research experiences, such as those offered by Summer Undergraduate Laboratory Initiative (SULI), Los Alamos, Virginia Tech, or other universities. Presented in this paper is a description of the technical course to be tested. Following that are the two tasks that constitute the initial recruiting phase of the project: (1) the holding of an undergraduate research symposium to attract qualified undergraduates to the course, and (2) the recruitment of undergraduates into the course.

#### **Description of Technical Communication Course to Be Tested**

Spanning two semesters and framing a summer research experience, the technical communication course to be tested has been designed both to enrich the summer research experiences of undergraduates and to attract other undergraduates to pursuing such research experiences. As shown in Figure 1, the first part of the proposed course, which is to be taught in the spring before the summer research experience, is to prepare undergraduates for that research experience by having them apply and be selected for research positions, learn about best research practices (including ethics in research), and perform a literature review on their intended research topic. The second part of the course, to be taught in the fall following the research experience, is to give students the time and instruction needed to properly communicate their summer research in papers, presentations, and posters. At the end of the proposed fall course, the students are to participate in an open symposium. One of the purposes of the symposium is to attract other undergraduates into pursuing research experiences, either on-campus in a research laboratory or

off-campus at another institution. For that reason, freshmen, sophomores, and juniors in engineering will be encouraged to attend the symposium.

The College of Engineering at Virginia Tech is the testing site for this course: The College has a large and diverse undergraduate engineering population from which to draw students, the College has many respected laboratories in which undergraduates can perform research, the College has an office of Academic Affairs that is committed to helping undergraduates, especially those in underrepresented groups, obtain research experiences, and the College is a leader in technical communication.



Research Experiences by Students Summer 2005



Preparing for Research (1-credit) Spring 2005: 20 students



Documenting Research (2-credits) Fall 2005



Undergraduate Research Sympos Fall 2005

**Figure 1.** Relation of proposed technical communication course to summer research experience. The purpose of the course is to deepen the research experience and to attract other undergraduates to such research experiences.

Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition Copyright © 2005, American Society for Engineering Education Consisting of no more than twenty-five undergraduates in the College of Engineering at Virginia Tech, this course will be tested to answer the following six questions:

- (1) How readily will undergraduates, particularly undergraduates from underrepresented groups in engineering, enroll for such a course?
- (2) For such a course, what percentage of students in the course will be able to find summer research positions in the time allotted?
- (3) Will the spring and fall segments of the course significantly enrich the summer research experience?
- (4) How will the quality of final reports and final presentations in the tested technical communication course compare with the quality of final reports and final presentations in a typical technical communication course?

The first question will be addressed by the interest shown in the course by undergraduate engineers at Virginia Tech. Also considered will be the quality of those students, as evidenced by their grade point averages (GPAs), and the diversity of those students. The second question will be answered by examining the statistics from this pilot course. The third question will be addressed by surveys to students immediately after their summer experience and at the end of the fall semester portion of the course.

To answer the final question, we will have an outside assessment of the final reports and presentations created by the students in the pilot course. Those reports and presentations will be compared with reports and presentations created by engineering students of similar GPAs in a traditional technical communication course. The purpose of this evaluation is as follows. If technical communication instructors across the country are to be persuaded to accept such an option in their technical communication course, they need to be convinced that the writing and speaking skills acquired made by the students in the research-option course will be on a level (or perhaps higher) than the skills acquired by students in a traditional course. This pilot study will assess that level.

#### **Pilot Research Symposium**

On October 14, 2004, we held a pilot research symposium in the College of Engineering at Virginia Tech for the following two reasons: (1) to attract qualified undergraduates to the research-course sequence that we are testing, and (2) to gain experience for such a symposium that will culminate the research course sequence in the following year. Because this symposium was a pilot symposium and because the College of Engineering at Virginia Tech is so large, advertising for the symposium was focused on the three largest departments: Mechanical Engineering, Electrical and Computer Engineering, and Civil and Environmental Engineering. Next year, the intention is to expand advertisement of the symposium to all disciplines of engineering in the College.

Shown in Table 1 is a list of the tasks that led to the pilot symposium [11]. Forty-two abstracts were received by the deadline on September 6. All the abstracts were accepted either as for a formal presentation or poster. One feature of this symposium was the use of undergraduates, rather than faculty or staff, to fill the positions of symposium chair, session chairs, and judges. A reason for this inclusion was to increase the number of undergraduates who would gain experience from the symposium. Figure 2 presents the symposium proceedings, and

Figure 3 presents a photograph of the poster session. The web page for the pilot symposium can be found at the following location:

http://www.writing.eng.vt.edu/symposium.html

Milestone Date	Description
July 15	Selection of a symposium chair
July 17	Creation of symposium web page:
	http://writing.eng.vt.edu/symposium.html
July 17	Announcement of call for abstracts
September 6	Abstracts due to symposium chair
September 17	Announcement of accepted talks and posters
September 24	Submission of revised abstracts
September 26	Posting of revised abstracts on the web
September 27	Help sessions for the preparation of slides and posters
October 11	Workshop for presenters to obtain feedback on slides and posters
	and training for symposium judges and session chairs
October 14	Symposium

**Table 1**. Preparation tasks for the pilot symposium (all dates in 2004).



Figure 2. Program for the pilot undergraduate symposium on engineering research.

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Figure 3. Poster session of the pilot symposium for undergraduate research in engineering.

### **Recruitment for Pilot Course**

Just before the pilot symposium, recruitment began in earnest for the pilot technical communication course to be tested. The recruitment consisted of three efforts. The first was sending email announcements of the course to those students who would be eligible for such a course. In general, eligibility meant having a GPA above 3.5, which is the level that many national laboratories require for acceptance into their summer research programs. In creating the distribution lists for these emails, special attempts were made to recruit underrepresented groups in engineering. These emails were sent out just before the registration period of the Spring 2005 semester, in which the course sequence was to begin.

Second, an information session was held in the College on undergraduate research. This session informed undergraduates about the benefits and opportunities for undergraduate research on Virginia Tech's campus, at other engineering colleges, and at the national laboratories. In addition, the research-course sequence was discussed as a means to help obtain and deepen such a research experience. Associated with this effort was the creation of a special web page that listed research opportunities for engineering undergraduates at Virginia Tech:

# http://writing.eng.vt.edu/research.html

Third, the pilot engineering symposium for undergraduate research was used to distribute information about the upcoming pilot course in technical communication. Although the attendance by other undergraduates to this symposium was not as high as we had hoped, we learned several lessons that should increase attendance for next year's symposium [9].

Registration for the pilot technical communication course required instructor approval. One reason was to make sure that those who registered were qualified to secure an undergraduate research position. The final number of students in the course was 20. Table 2 presents that statistics on the students who were accepted into the course—more students applied than were accepted. Of particular note are the high GPAs of the students in the course: average of 3.70/4.00 and median of 3.77/4.00. The highest GPA is 3.97 and the lowest is 3.03. Ten of the students had GPAs above 3.9. Note that a couple of students who had GPAs below 3.5 were admitted into the course, because their resumes revealed that they would have a good chance of securing a research position. Either they had research experiences in the past or they showed a high likelihood of securing a summer research position for next summer.

Characteristic	Description
Total number allowed in course	25 students
Total number registered for the course	20 students
Average GPA of students registered	3.70
Median GPA of students registered	3.77
Gender breakdown	11 male; 9 female
Ethnic diversity	2 African-American; 4 Asian; 1 Hispanic;
	1 African
Number from groups underrepresented in	11 students
engineering	

Table 2. Statistics on the students who registered for the research-course sequence.

Also of note is the diversity of the students in the course. Nine of the students are women, four are Asian, one is Hispanic, and two are African-American. In addition, five other women expressed interest in the course, but had to withdraw their names because of scheduling conflicts. Of the 20 students registered for the course, 11 are from groups that are underrepresented in engineering. This high number of students from such groups indicates that the research-course sequence has an appeal to students from these groups. In addition to the gender and ethnic diversity of the students in the course is the diversity in regard to discipline of the students. The following areas of engineering are represented in this course: aerospace engineering, chemical engineering, computer science, electrical and computer engineering, engineering science and mechanics, general engineering, material science and engineering, and mechanical engineering.

#### Conclusions

This paper has presented our initial phase to test a research option for the traditional technical communication course. The purpose of this option is to promote and foster research among undergraduates in engineering. Completed in this phase was a pilot symposium for undergraduate research in College. One purpose of this symposium was to make other undergraduates aware of undergraduate research efforts in the College. Another purpose was to advertise the research option of the technical communication course that we are testing. Also completed was the task of recruiting undergraduates in the course. In this task, we have

successfully recruited 20 students for the course. This group of students has a high GPA (average 3.7/4.0), and this group of students is diverse (11 of the 25 students come from groups underrepresented in engineering). This recruitment shows that such a course option can attract both high quality students and a diverse pool of students.

Left to be done is the teaching of the research-preparation segment of the pilot course in the Spring 2005 semester, the monitoring of research experiences during the summer of 2005, the teaching of the research-documentation segment of the research course in the Fall 2005 semester, and the research symposium. After the course sequence, an outside party will assess the quality of assignments by the students in the pilot course versus the quality of assignments by similar students in the traditional technical communication course at Virginia Tech.

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