Efficient, Reliable, Written and Oral Engineering Communications

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Abstract

Technical communications for engineers and scientists often must deal with complex subjects. Because of this complexity, writers and speakers must be careful to use a reliable form of communication. Careful analysis of audience interests and needs is essential. The communication needs to be clear, easy to understand, yet complete. The preparation process should also be simple, logical, and based on science for effective transfer of information.

An engineering communication course has been developed and taught for several years. It has survived the test of time. It has been designed to integrate both oral and written processes. It meets the above needs and satisfies the general education requirement for oral communications. In recent semesters, the course has experienced rapid growth and is even being used by majors other than engineering. The design of this course and tips on how to teach engineers skills of communicating will be presented.

Introduction

Dr. Bill Wulf, President of the National Academy of Engineering, stated that it is important for engineers to "know how to communicate effectively."[1] Dr. Wulf's statement indicates the value that communications skills add to engineering graduates. While many engineering students resist instruction in communications, they, nevertheless, must have communications skills to succeed in the modern world of engineering.

The challenge is to develop a class that makes the education of communication science and the development of communication skills efficient and interesting. This challenge has been met with

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an engineering communications course (PETR 3308) currently offered by the Petroleum Engineering Department at Texas Tech University.

The objective of this paper is to overview the historical development of this engineering communication course, which was designed to integrate both written and oral communications education. A brief overview of the course content and tools will also be provided.

Course History

The current engineering communications course, PETR 3308, is open to all students—not just engineering students. It primarily serves engineering students but a few math and chemistry students also choose to take the class. Students must complete the second English composition class and have junior standing or higher before they can take the PETR 3308 class.

Some departments substitute the class for a technical writing requirement. Some use it for an oral communications requirement. We do not use it for both classes in the same degree plan, but some departments have reduced the total number of hours in their degree plan by eliminating the technical writing course requirement and using the PETR 3308 class, which meets the university oral communication core requirement as well as integrating oral and written technical communications into one class.

The course has an early history associated with a need for the course and the development of the content to teach the science and skills of technical communication. The course also has a recent history and a recent rapid growth in the number of students taking the course. We will review both.

Early History

The concept for the course began in the late 1980's. At that time, the College of Engineering had a writing center to help students and professors in engineering to improve writing skills and to integrate intensive writing into classes. Jean Ann Cantore, Director of the Engineering Communications Center, and James Gregory, Professor in Agricultural Engineering, developed the initial course for improving professional communications. They experimented with the concept and content of the course through a special problems course. The class was not large, but a few of the students in the class were successful in student paper contests, which was an encouraging feedback for the class. James Gregory along with co-worker, Associate Professor Clifford Fedler, had recently won two Top Ten Paper Awards from the American Society of Agricultural Engineers. Clifford Fedler and James Gregory also published a paper[2] in the Journal of American Society of Engineering Education describing a writing matrix to help professionals organize technical papers. This experience, the writing matrix tool, and the information from the Engineering Communication Center provided the foundation for the course.

The course grew and was team-taught by James Gregory and Jean Ann Cantore. The course evolved into a permanent junior level Agricultural Engineering class. Civil and other engineering students began to also take the course as well as agricultural engineering students. Jean Ann Cantore and James Gregory converted their teaching notes into a formal textbook, *Engineering Communications with Confidence and Reliability*[3]. Technology changed from slide presentations to PowerPoint presentations for oral technical presentations. These changes were included in the second edition of the book, *Designing Communications with Confidence and Reliablility*[4]. In the early to mid 1990's, the Agricultural Engineering Department was eliminated and the environmental components of the program were merged into Civil Engineering. After the elimination of the Agricultural Engineering Department, the course was not taught for a few semesters. This change put the course on hold but did not eliminate it from the Texas Tech University list of courses.

More changes occurred, which ultimately affected the future of the course. With the hiring of a new Dean of Engineering, James Gregory was appointed Associate Dean for Undergraduate Studies. The new Dean eliminated the Engineering Communications Center to save money; however, the Petroleum Engineering Department at the suggestion of James Gregory took over the communication class.

Recent History

Based on the previous experience, it was known that the integrated written and oral communications class was an effective way to teach engineering students the science of communication. Lloyd Heinze, Associate Professor of Petroleum, with the help of James Gregory began teaching the PETR 3308 class during fall 1996. Two students from this class wrote and presented technical papers for the Gulf-Southwest Section Meeting of ASEE. The class began to grow then wavered in student numbers in 1999 (Figure 1). Two possible reasons exist for the decline in student numbers during this time period. One reason is that the teacher assigned to teach the class in 1998 experienced severe medical problems. There also was a trend this semester to return to a more conventional technical writing format. The feedback from these problematic changes quickly caused students to reduce their interest in the course. It became necessary to fix these problems.

In 1999, Akanni Lawal, Associate Professor in Petroleum Engineering began teaching the communication class. He promptly returned the class to the original format. He returned to the use of the textbook developed by Cantore and Gregory. He also brought experience to the class from his years working in industry. He understood and appreciated the value of the communications tools developed by Cantore and Gregory. Furthermore, Dr. Lawal had a very successful record of writing NSF and other grants and receiving funding from various organizations. In essence, he added a component of persuasive writing and speaking that had not been emphasized in prior years. Dr. Lawal also saw the value of the information for some of his graduate students, especially international students working in a second or third language. He

has now developed a parallel graduate course that uses the basics from the PETR 3308 course and adds considerable work on research proposal development. It is obvious that Dr. Lawal has taken ownership for both courses and is part of the reason the courses are a success (Figure 1).

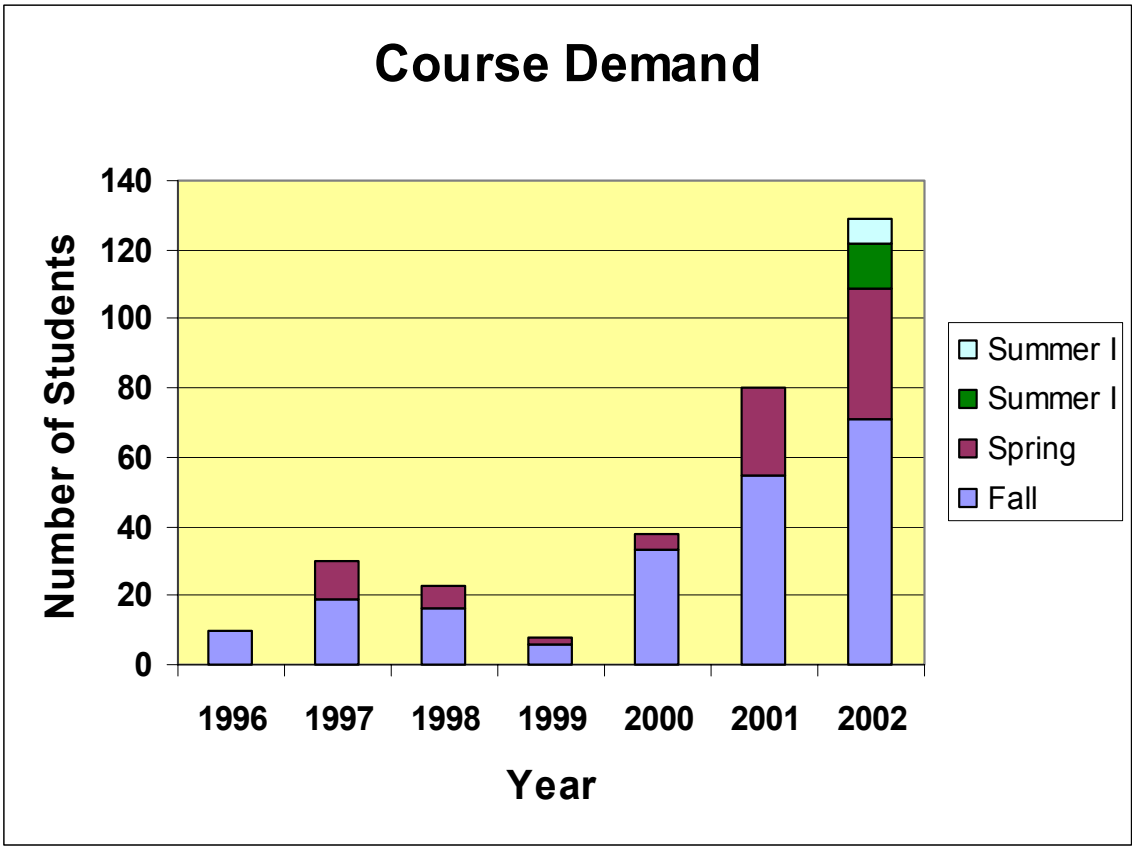

Figure 1. Growth in number of students and course offerings over time.

Another development that has helped the course occurred in 2000. James Gregory, working with computer science students in a software engineering class, produced a website that allowed people to quickly analyze their career interests and learning styles (www.coe.ttu.edu). The purpose of the tool was to help students to assess their personal interest and associate it with majors in college. The process developed by Gregory is closely related to the Myers Briggs Type Indicator, which is in part related to the mental processing that occurs in the left and right front lobes of the brain. Because locations on the career map produced by this analysis associate with majors or career types, the career map can be used to help teach audience analysis and how to target communication information to specific audience needs. The process is quick and easy to use on the web and makes this part of the class interesting for students. The learning style also relates to multiple sensory stimulation and the increase in reliability of communication when parallel modes, text and figures for example, are used in the communication process. This

analysis teaches students that the communication process is a science that can be understood and applied to design reliable and efficient communications. With these changes the course has grown at a rapid rate since 1999 (Figure 2).

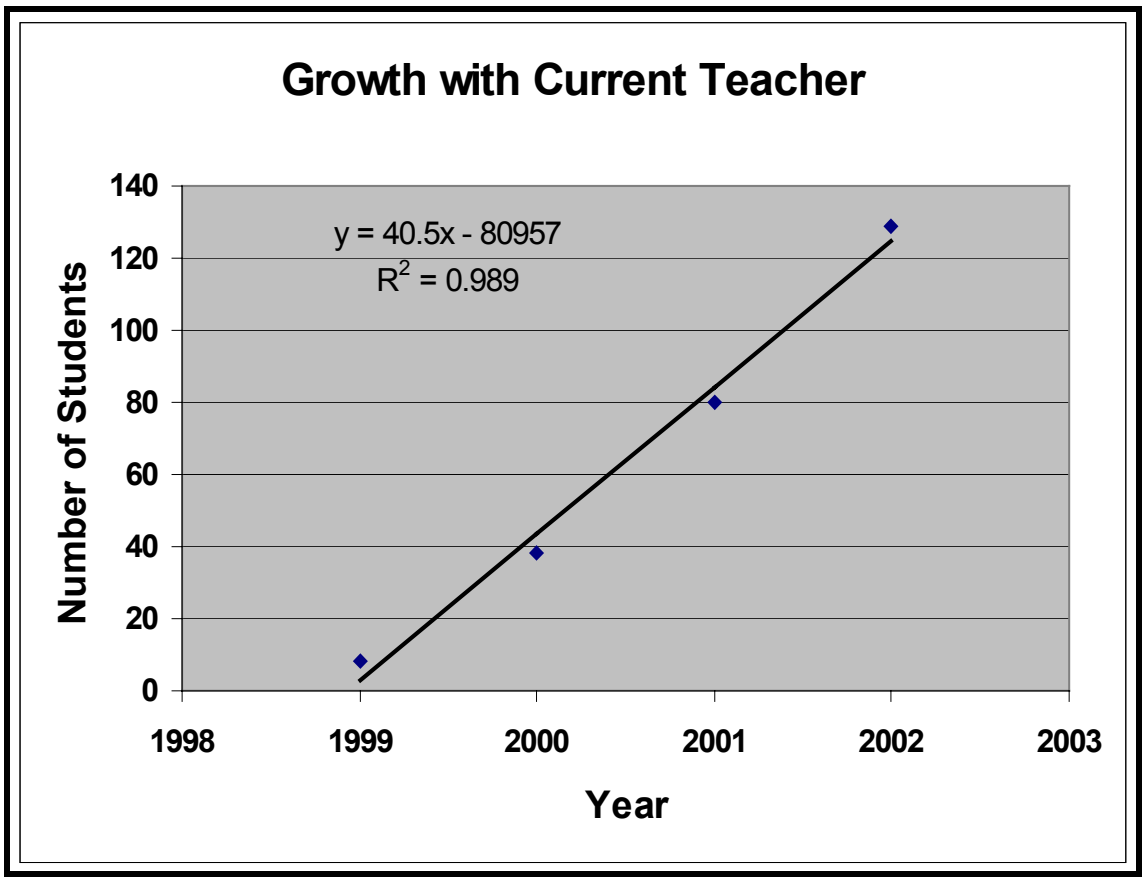

Figure 2. Rapid growth with current course structure.

Content and Tools for PETR 3308

All communications courses have content in common. All must to some degree deal with language components: sentences, paragraphs, grammar, etc. The PETR 3308 course deals with the practical components of professional communications, including letters, memos, e-mails, telephone calls, resumes, technical papers, technical speeches, and proposals. Students are taught to zone information to understand and develop their message instead of outlining the information. They are taught to use FATE[5], Figures, Appendixes, Tables, and Equations as tools for parallel communication. They are taught that the sequential components of a technical paper, (1) title, (2) abstract, (3) introduction, (4) objectives, (5) development, (6) results, (7)

conclusions, (8) summary, and (9) references are common components for most technical papers. They are also taught a special relationship between these components as shown in Figure 3. For example, title, objective, and conclusions are related and give focus to the paper. Each of the vertical columns has a unique purpose in the paper. Students are also taught that titles should have seven words or bits of information plus or minus two. They are taught that the human brain has the ability to retain seven plus or minus two bits of information in short-term memory. Therefore, titles are easier to remember if the seven plus or minus two rule is honored. Students also discover that short titles usually are too vague to describe the message in the paper. Students are taught how to avoid and deal with writer's block using the writing matrix in Figure 3. Having students write the objective section usually solves the problem. Next, the students write the conclusion section. We also encourage students to write their introduction after they write the results section so that they focus the introduction on the need that is being address through the results from the paper.

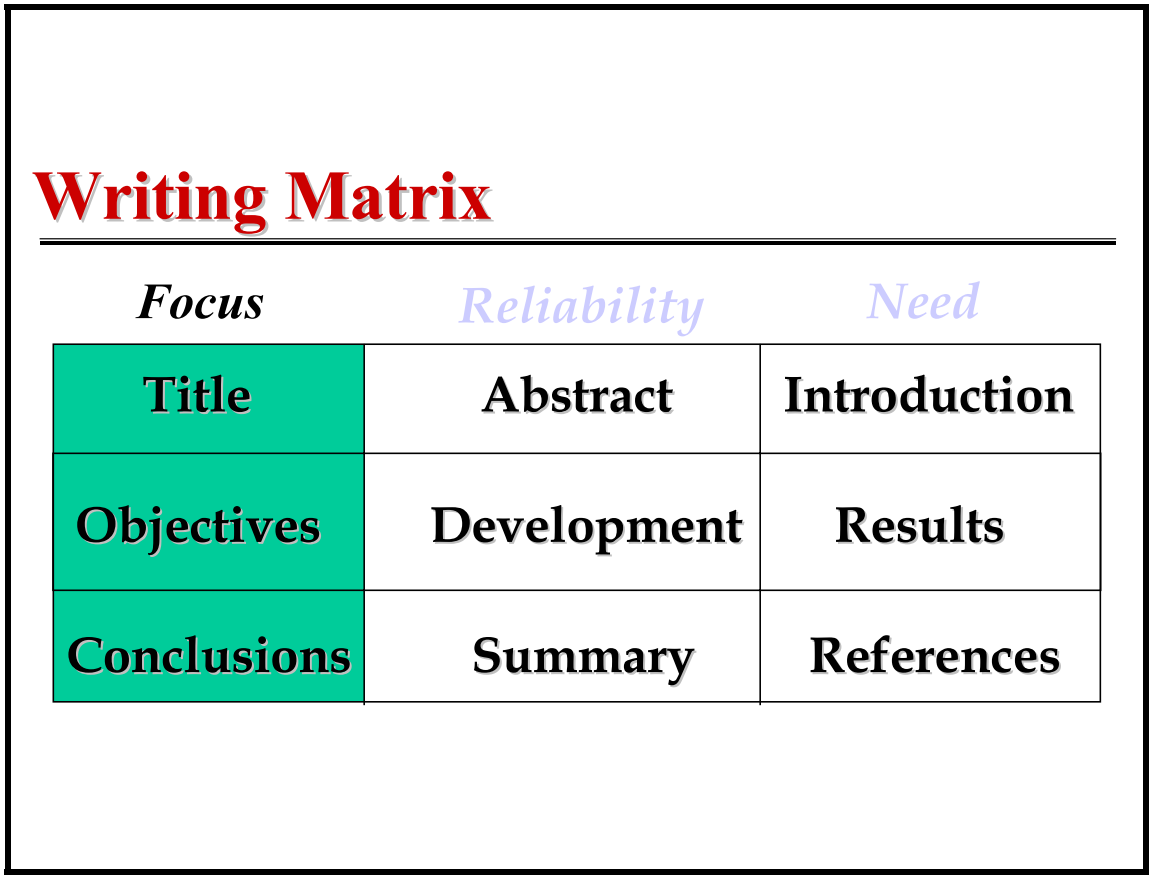

Figure 3. A writing matrix to organize technical papers.[2]

Summary and Conclusions

An engineering communication class has been developed and tested over a decade of time. The integrated written and oral communication course seems to be an efficient method to teach the science and art of technical communications. The course is both practical and theoretically based on fundamental communication science. When students choose to compete in student paper contest or submit papers at professional meeting, they have generally been successful. Students generally find the class interesting and an excellent alternative to the conventional technical writing or speech classes. We recommend that other programs consider our course design and communication tools.

References

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JAMES M. GREGORY
Dr. Gregory has served as Associate Dean for Undergraduate Studies in the College of Engineering at Texas Tech University for eight years. He has spent over a decade in the research and development of tools to improve engineering education and student success in college. Dr. Gregory is a registered Professional Engineer in Texas.

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Dr. Heinze holds the Watford Professor in Petroleum Engineering as Texas Tech University. He has directed summer orientation in the College of Engineering the last six years. He is the department's undergraduate advisor. Dr. Heinze is a registered Professional Engineer in Texas and Wyoming.