RENEWED EMPHASIS ON TECHNICAL COMMUNICATION AT TEXAS TECH

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ASK A PRACTICING chemical engineer the following question:

> "Do you consider writing ability to be essential to the performance of your job?"

Ninety-five percent of those responding will probably answer in the affirmative. At least that was the response obtained from 135 graduates of ChE from Texas Tech University who were polled about the importance of technical communication. This appears to be a typical attitude representative of all engineering professions. For example, articles on how to write better reports appear routinely in professional journals [1, 2, 3]. And, if the information is to be transferred to the public domain, professional societies provide ample information for the author on procedures for presenting papers at professional society meetings or in professional journals. Admittedly these instructions deal more with "form" rather than "style", but the desire for clarity is still universal.

It is somewhat surprising, therefore, to learn that there is a growing concern among educators about the inability of students (and ultimately engineers) to communicate [4, 5, 6, 7, 8]. At the university level there has, of course, been a reduction of formal instruction on communication skills in engineering degree programs over the last two decades. Surveys by the AIChE reveal that the average semester hours of credit required in communications courses in ChE curricula has dropped 50 percent, from eight hours in 1957 to four hours in 1976 [9]. Whether or not this de-emphasis has contributed to the overall decline in the communications skills of engineering graduates is still open to conjecture. However, because of an apparent low level of performance in rhetoric by senior students, the ChE Department at Texas Tech decided to re-emphasize technical communication skills.

. . . the Technical and Professional Writing Program of the English Department was asked to prepare and administer a course in technical writing.

At the beginning of the 1974-75 academic year the department initiated a program which it hoped would enhance the technical-writing skills of graduates. To accomplish this, the Technical and Professional Writing Program of the English Department was asked to prepare and administer a course in technical writing. This instruction was to be supportive of the normal report writing required in the senior level unit-operations course sequence. The final format which evolved required each student to receive one hour of instruction per week on the basics of technical communication. The students were then asked to write their unit-operations reports based on a variety of criteria. For example, they were asked to submit their reports in either (1) letter form, (2) as a memorandum or (3) as a fully documented formal report. In addition, they were asked to write for a variety of readers such as (1) a nontechnical administrator, (2) nonscientific personnel, or (3) a fellow engineer. A total of eight to ten reports were prepared by each student throughout the two-semester course sequence. In order to evaluate a student's performance, a member of the engineering faculty graded the reports on their technical content while report-design elements (language, style, and format) were evaluated by the faculty representative from the English Department. The final course grade, therefore, became an evaluation of the student's ability to master the technical aspects of the unit-operations course as well as his effectiveness in communicating this technical information.

COURSE DESCRIPTION

THE TECHNICAL CONTENT of the unit-operations course did not change appreciably following the adoption of the new program. In general it followed a traditional format in which the students were divided into working teams of three to four members. The groups were then assigned four experiments to be carried out during the semester. These included the standard heat and mass transfer studies, those experiments

which gave a combination of heat and mass transfer, a kinetics experiment, and a system to elucidate mixing operations. A list of the experiments performed is shown in Table 1.

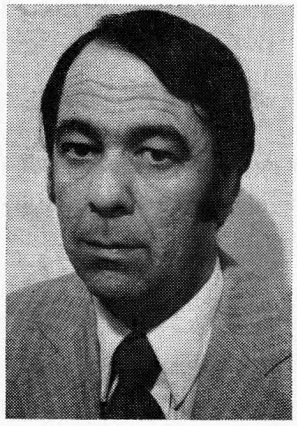
In general, the difficulty of the experiments varied from rather simple repetitive measurements to the development of complicated abstract concepts. Hence the students were subjected to varying degrees of difficulty in the type of technical information they were asked to communicate.

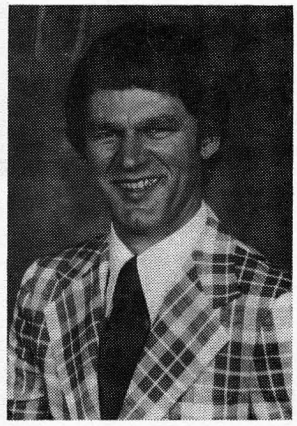
Communications content of the course is based on the coursework-design used in Technical and Professional Writing Program courses. Texas Tech offers a major in technical writing and editing based on many new concepts in writer training developed and tested over the past five years. In the unit operations laboratory the central concept used has been an "engineered approach" to writing.

In the "engineered approach", writing solely to convey information is not stressed. Instead, the objectives to be achieved (design criteria), audience characteristics (materials), and design techniques (methods), are strongly emphasized. An algorithmic method for report design is taught in order to convey the step-by-step procedure required for predictably successful writeups. Sentence structure presentations are adopted from recent results in linguistics. Enabling students to describe relationships between sentences ("good" and "bad" ones, ones linked together by paragraphing, ones having the desired effects on readers, etc.) is a primary objective. Report format for memorandum, letter, and formal reports is adopted from American Chemical Society publication specifications.

TABLE 1
Unit Operations Laboratory Experiments

1. **Fluid flow**
   a. **Friction factor for fluid flow in pipes**
   b. **Newtonian and non-Newtonian fluid behavior**
   c. **Venturi and orifice meter measurements**
2. **Heat Transfer**
   a. **Free and forced convection systems**
   b. **Drop and film condensation**
   c. **Double pipe heat exchangers performance**
3. **Mass transfer**
   a. **Liquid-liquid extraction**
   b. **Filtration of aqueous slurries.**
4. **Combinations of heat and mass transfer**
   a. **Distillation**
   b. **Evaporation**
   c. **Humidification**
   d. **Drying**
5. **Chemical kinetics**
6. **Unsteady-state operations**
   a. **Mixing coupled with titration**
   b. **Stirred-tank cooling**





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Grading reports is like real-world evalution of engineering work based on the twin criteria of effectiveness and efficiency in achievement of communications objectives. Misspelled words, for examples, are not frowned on for reasons of social unacceptability or instructor disapproval; they are disparaged because they are not effective or efficient in a report's achieving objectives among persons who recognize them as misspelled words.

Classwork and grading procedures are supplemented by conferences with students. The conferences are designed to provide tutorial teaching and provide additional rapport between ChE students and technical-writing teachers.

Three types of reports are required in the course in order to simulate the complete spectrum of writing required of professional engineers. Formal reports correspond to well documented communications for wide distribution throughout a company, an industry, or a profession. Memorandum (short-form) reports correspond to col-

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league and management oriented communications within an organization. Letter reports correspond to contract related communications between two organizations. Differences and similarities among audiences of the three reports—as well as format and language differences and similarities—are stressed as key materials in report design.

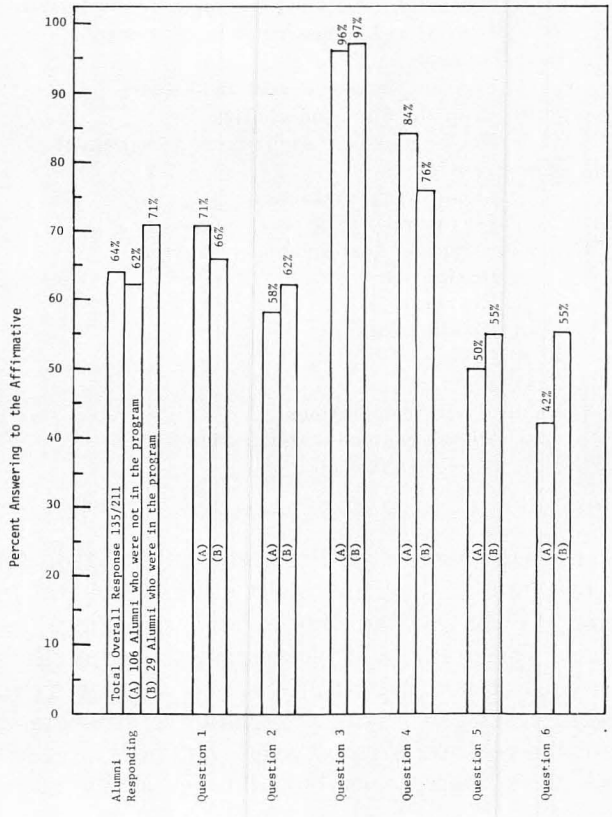
PROGRAM EVALUATION

IN GENERAL THE FIRST few semesters of the program were qualitatively evaluated by the professors involved in the instruction. Simple improvement in an individual student's performance seemed to suggest that the added emphasis given to technical communication was indeed accomplishing its goal. This achievement was not without conflict, however. Initially some students were unhappy with the added time spent in the technical-writing class and the additional assignments. Many students also expressed strong feeling about having their papers graded by two different professors and on two different bases: for technical content and for communication effectiveness and efficiency. Nor did all the voiced dissent come from the students. There was some disagreement among the faculty during the initial stages of the program concerning the proper format and style to be followed in the reports. Fortunately, time and compromise have brought solutions to most of these early conflicts. Now a manual of instruction is being developed to help formally establish the program. In addition, several other engineering departments have begun similar technical-communications instruction within their own courses.

Even though the new program appeared to be successful, it was deemed desirable to have some additional evidence of its success. Moreover, it was felt that some input from graduates of the program would be helpful in developing an even more effective program in communication skills. Consequently, a short questionnaire was developed and mailed to department graduates from the preceding eight years. These alumni included graduates from the last two years who had had the benefit of the new instructional program, as well as those from earlier years who had not experienced any formalized instruction outside of that supplied by the ChE faculty of the department. The following six questions to be answered "yes" or "no" were asked of each person in this group.

1. **Did you receive all your undergraduate education at Texas Tech?**
2. **Do you feel the technical writing instruction you received at Texas Tech was adequate to meet the responsibilities of your job?**
3. **Do you consider writing ability to be essential to the performance of your job?**
4. **Do you feel a course in technical communication should be required for all B.S. engineering graduates?**
5. **Has your company ever offered to provide instruction for improving communication skills of its engineering employees?**
6. **If Texas Tech offered an off-campus course in communication skills at or near your plant location, would you attend?**

The results of the questionnaire are summarized in the following graph. Of the 211 questionnaires mailed, 135, or 64 percent, were returned. For comparative purposes the responses were separated into two classifications: (a) those alumni who had only departmental emphasis given to their technical writing skills while attending Texas Tech and (b) those alumni who graduated



during the last two years and received the new instructional program developed by the English Department. The latter group composed 19 percent of the total responding population.

The response to Question 1 indicates that students at Texas Tech are following a national trend by obtaining some of their education at local or area schools before getting their final degree at a state institution such as Texas Tech. This pattern of switching schools means that the final degree-granting institution has an added responsibility to their graduates. The students must be exposed to those basic fundamentals which will enable them to succeed. In the case of communication skill, competency is all too often inferred from transcripts and is rarely tested. Thus graduates may be ill prepared to meet their job requirements with respect to communication unless the university takes specific steps to prepare them.

Question 2 responses appear to support the general assumption that the program has had a positive impact. Thus, 62 percent of the people who had the new course felt it was adequate. However, a nearly equal 58 percent of those who didn't have the benefit of the new program felt that they still had received sufficient instruction. Question 4 might also be taken as proof of the program's success. In this case 76 percent of those in the course felt that a general program for all B.S. candidates was desirable while 84 percent of those not in the program felt it was. This implied that those having the new instructional program found it to be sufficient.

The answers to Question 3 indicate that the overwhelming majority of graduates feel their writing ability is essential to job performance. Apparently their companies do also, since for both populations (a and b) more than 50 percent of the responses to Question 5 indicated that they had been offered some form of additional instruction in writing. The 135 respondents worked for a total of 58 companies, 26 of which offered the additional instruction.

Finally, Question 6 seems to indicate that at least 40 percent of all the graduates are still willing to take more instruction if it were offered at their convenience. On the surface it might appear as though the responses to Question 6 are not compatible with those of Question 2. One interpretation is that the increased emphasis on technical communication by the program has tended to make more students aware of their deficiencies. Hence they would aspire to do more work in this area to improve their abilities. There is also a certain degree of maturation which must be assigned to the earlier graduates of the population.

The groups were then assigned four experiments to be carried out during the semester. These included the standard heat and mass transfer studies, those experiments which gave a combination of heat and mass transfer, a kinetics experiment and a system to elucidate mixing operations.

PROGRAM RESPONSE

ALTHOUGH THE GENERAL response of the questionnaire was judged to be supportive of the new program, some unsolicited written responses were even more enlightening. These are included in the Appendix in an abridged form. In addition to these longer comments there were several penciled replies. In general these were in reference to the necessity of good communication skills, and almost exclusively of the short letter form. Longer formal reports seemed to be within the purview of graduate degree holders and those in research groups. There were also comments encouraging the development of communication skills for transfer of technical information to the nontechnical person.

Finally, response from the technical writing faculty also seems to strongly support the program. Their observations include the following points.

- **The senior unit-operations laboratory students, because of their level of maturity and their background in rigorous studies, grasp the material more rapidly and thoroughly than younger, less experienced students.**
- **The students are more highly motivated to learn writing procedures and techniques within the "applicative-oriented" context of unit-operations laboratory than are students in "stand-alone" technical writing courses.**
- **The "engineered approach" to writing used in the program dispells doubts and poor attitudes toward writing that may have resulted from less rigorous writing coursework undertaken during freshman college years or in public-school classroom.**

In summary, responses to the questionnaire and responses of instructors indicate that the new emphasis on technical communication appears to

be accomplishing its intended goal. In addition, it has provided some valuable insights into some new directions the program might go in order to be more meaningful for the new engineer on the job. □

APPENDIX

Abridged Responses to the Questionnaire

"Tech writing at work is far different and less involved than those unit ops reports. I've written letters to spend $15 million since I've been at work and have never written more than two pages per project."

"Tech writing: no need to emphasize technical aspects . . . concentrate on freshman English, basic grammar and sentence structure."

"For your information I now supervise the efforts of some twenty Chemical, Civil, Mechanical and Petroleum Engineers in our area office. I have found that the majority of the engineers on my staff, particularly those having just graduated from college, are weak in communication skills. I have also found that only about 50% of an engineer's total efforts are spent in technical analysis, the remaining 50% of an engineer's time is normally spent in "sales" of his ideas to his supervisors. As a result I feel that communication skills are of vital importance in the producing industry."

"I feel a course in written communication is justified, however I differ with the title "Technical Communication." Since most reports (or letters) are written to management, or with the intent of informing management, too much emphasis on the technical points can tend to confuse. I received most of my writing "training" while getting my MBA (whether popular or not). During this time I was forced to word both written and oral communications in terms nontechnical personnel could understand and relate to. In my opinion, writing could more easily and effectively be given by a department not so closely related to the detailed technical aspects."

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BOOK REVIEW: Rate Data

Continued from page 39

students in their courses. In contrast to the usual classroom experience Churchill exposes students to lousy data, teaches data handling techniques, encourages critical evaluation and skepticism, and makes error analysis a reality. It becomes clear why rates of change are associated with derivatives and process rates are not. Adoption of his approach might even help to eliminate the widespread notion that the rate of a chemical reaction is equal to (–dC/dt) !

The book is liberally studded with quotations such as, "No generalization is wholly true, not even this one." My favorite came in Chapter 12 after an immoderate series of 24 batch system integrations (including 11 different ones in kinetics) : " 'One more such victory and I am lost.' Pyrrhus." The quotations were almost universally unpopular with the students, probably because they interfere with the most rapid search for the key to a homework problem solution. However a mature reader will find meaning (and frequently amusement) in nearly every one.

At the end of the course five students said they liked the book, three said they did not, and nine expressed no opinion. Two years later the same seventeen students were surveyed. There were eight respondents, all of whom thought the book was important or potentially valuable. Seven of them still had their copies, and three had used them on their jobs. Virtually all users will be inconvenienced by the absence of a nomenclature section. The units might be described as "early American traditional." Churchill could do all of us a favor, (and better demonstrate the coherence of the rate concept in diverse applications) if he would produce an SI edition.

It is easy to recommend the book to currently practicing individuals for self study. It is even pleasant bedside reading. For the most part the subject matter is familiar, but it appears in a new and interesting context which should increase understanding considerably. Unfortunately the implementation of routine use of this book in conventional undergraduate curricula is awkward at best. It could serve well as a text for a senior elective course. A colleague suggested using it in a seminar to introduce new graduate students to data handling and analysis in the determination of rates from experimental measurements. Ultimately, this review urges you to use your imagination to get its vital message through to chemical engineering students. □