

**Integrating Teaming, Writing, and Speaking
in CHE Unit Operations Lab**

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Rationale

With the recent evidence for industrial demand^[1] and the advent of communication-focused ABET requirements,^[2] engineering programs across the nation are trying to find ways to integrate discipline-specific and multidisciplinary technical communication into their curricula. A review of the literature suggests that the majority of this integration has been in the form of genre-model writing classes for the freshman and sophomore level^[3] and portfolio-based additions to capstone courses at the senior level.

For the past two years, a research and teaching team in the chemical engineering department at North Carolina State University has been iteratively designing and implementing a junior-level writing and speaking module as part of a larger NSF grant.^[4] The purpose of this module is to provide instruction in technical writing, oral presentation, teaming, and project management skills within the context of the laboratory course. This serves as a precursor to a similar senior capstone course that includes instruction in multidisciplinary teaming.

Design features

The Teaming, Writing, and Speaking (TWS) instruction series is a discipline-specific module and consultation series that was designed to complement a junior-level chemical engineering laboratory survey course in chemical engineering (CHE 330). The students in 330 meet one morning a week for hour-long lectures on statistics and experimental design. In addition they have one three-hour afternoon period reserved every week for experiments. Students who enroll in the course attend four TWS modules, which take place during their allotted lab time on weeks when there is no experiment scheduled. They also meet as a team with writing and speaking consultant four times throughout the semester. Table 1 shows a typical schedule for students' activity in TWS and in the lab.

The TWS module focuses on developing collaborative oral and written technical communication skills by addressing how members of teams prepare oral and written laboratory reports and identify and resolve issues related to writing, speaking, and interpersonal interaction (Table 2).

Using in-class activities and discussions, the module applies topics in technical and small-group communication to real engineering teams and projects within the context of the course. Students are encouraged to develop a casual and productive inter- and intra-group rapport and are frequently asked to work in teams to discuss situations or perform tasks and then share their findings with the class. The instructor has structured activities and prepared lecture material to facilitate the instruction.

Table 1: CHE 330 Course Calendar

<i>Week</i>	<i>Module topic</i>	<i>Lab activity</i>	<i>Consultation topic</i>
1	Teaming (introduction)		
2		Conduct experiment #1	
3			Proper citations
4	Collaborative writing	Lab report #1 due	
5		Conduct experiment #2	
6			Report Organization
7	Teaming	Lab report #2 due	
8		Conduct experiment #3	
9			Graphics and layout
10	Collaborative speaking	Report #3 due	
11		Conduct experiment #4	
12			Rehearse oral presentation
13		Oral presentation	

The individual team consultations, on the other hand, are unscripted—although they frequently explore themes like graphics communication, mechanics, or academic integrity. The primary focus of these sessions, however, is to allow students to bring the consultant a work-in-progress for discussion in a workshop setting.

The consultation sessions emphasize the importance of developing and implementing a systematic writing and editing process. Often the consultant facilitates the integration of the collaborative writing, presenting, and editing skills that students were exposed to in the module by helping them apply these skills to creating the reports and presentations required by the laboratory portion of the course.

For the final consultation of the semester, several teams of students meet during the common module time and rehearse their presentations in a critical speaking environment where they can participate in the evaluation process and respond to real questions and answers from their peers. This opportunity to practice before a critical audience, like the one they will have on their presentation day, gives the students realistic speaking practice.

Table 2: TWS Proficiencies and Corresponding Skills

<i>Proficiency</i>	<i>Corresponding skills</i>
Collaborative technical writing	<ul style="list-style-type: none"> • write collaboratively • function as a peer editor
Collaborative technical presentation	<ul style="list-style-type: none"> • convey technical material orally in a way appropriate to the audience • work collaboratively to design and conduct a technical presentation
Teaming	<ul style="list-style-type: none"> • identify and fulfill team roles • create, use, and revise team ground rules • recognize and manage conflict in teams • recognize and manage decision making in teams • provide frequent and productive feedback to team members regarding teaming, writing, and speaking skills

The most novel aspect of this course is its unique integration with a preexisting junior-level laboratory survey course, which allows students to find immediate application for the concepts presented in the modules and consultations. Typically, as students apply the writing, editing, and management techniques,

their lab reports become more refined and the writing component of their grade on those reports improves. This proof of concept, in combination with a few directed assignments (Table 3), encourages students to internalize the processes and find ways to apply them in future lab writing settings.

Table 3: Assignments and Corresponding Proficiencies for Both CHE 330 and TWS

<i>Assignment</i>	<i>Course</i>	<i>Proficiency</i>
3 written lab reports	CHE lab course	technical; writing
Written executive summary	CHE lab course	technical; writing
Oral presentation	CHE lab course	technical; presentation
Informal written report (on how writing standards vary by context)	TWS module	writing
Project management organizational chart	TWS module	teaming
Process notebook (includes agendas, minutes, and reflections)	TWS module	teaming

The transferability of teaming, writing, and speaking instruction to other universities was also considered when designing TWS. The module format employs interchangeable, independent discussions and exercises that can be assembled in a variety of combinations. Likewise, the consultation format allows for flexible scheduling and targeted, personalized team attention. The two formats can be used alone or in combination. This allows an instructor to devote as much time and as many resources as possible.

Assessment

TWS, in its fourth iteration, has evolved from a basic-concepts lecture series to the module and consultation series described above. In Spring 2003, approximately half^[5] of the CHE 330 students will attend TWS modules and consultations. The other half will receive only the standard advice on preparing reports and presentations that has traditionally accompanied the laboratory lecture.^[6] Using the metrics listed below (see Table 4), we will be able to compare the subject group and the control group and quantify the effect of the TWS training on our students' performance and attitudes.

Table 4: Spring 2003 Experimental Metrics

<i>Metric</i>	<i>Corresponding proficiency</i>
Pre-and post-course self-report (survey)	teaming; writing; speaking
Comparative analysis of oral presentation	speaking
Comparative analysis of written lab assignments	writing
Teaming skills assessment rubric, completed by the instructor and the consultant	teaming

Conclusion

Since appearing in the ABET required competencies several years ago, fragments of teaming, writing, and speaking education have been distributed, sometimes haphazardly, across the core courses in engineering departments nationwide. Searching for an alternative method of integrating these new competencies, a team of researchers at North Carolina State University has constructed a junior-level discipline-specific teaming, writing, and speaking (TWS) module and consultation series. Material for this program is available on the web: <http://www2.ncsu.edu/unity/lockers/project/actionagenda/index.html>. Assessment data, which will be available in the summer of 2003, will suggest the impact of presenting this material in this format as opposed to less structured methods.

Lang, J.D., S. Cruse, F.D. McVey, and J. McMasters. "Industry expectations of new engineers: A survey to assist curriculum designers." *Journal of Engineering Education* 88.1 (1999): 43-51.

² Accreditation Board for Engineering and Technology. *ABET Home*. <http://www.abet.org>. 2002.

³ There are numerous examples of this type of course in the literature. One example is:

Walker, Kristin. "Using genre theory to teach students engineering lab report writing: A collaborative approach." *IEEE Transactions on Professional Communication* 42.1 (March 1999): 12-19.

⁴ The text of this article is derived from larger findings of NSF Grant #EEC-0080484 "Establishing New Multidisciplinary Curricular Paradigms: Biotechnology and Chemical Engineering." Acknowledgment for these findings should be given to the authors of this article and to Amanda Granrud, Coordinator of Undergraduate Tutorial Services in Writing and Speaking at NC State.

⁵ The typical spring enrollment for CHE 330 is approximately 75 students.

⁶ A number of methods were considered for dividing the class into TWS and non-TWS groups. Logistically, however, the use of the common lab time on non-lab weeks led to the following selection method for Spring 2003: students who enrolled in Monday, Tuesday, or Wednesday sections of the lab were assigned to TWS, while students enrolling in Thursday or Friday lab sections received the more traditional instruction. To prevent students from intentionally enrolling in or avoiding the module, students were not notified of this during registration.

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Chris M. Anson received his Ph.D. from Indiana University and is Professor of English and Director of the Campus Writing and Speaking Program at North Carolina State University, where he teaches graduate and undergraduate courses in language, composition, and literacy and works with faculty in nine colleges to reform undergraduate education in the areas of writing and speaking. He has published widely.

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Steven W. Peretti is an Associate Professor of Chemical Engineering at North Carolina State University. A recipient of the NSF Presidential Young Investigator Award in 1991, he has directed research in bacterial protein synthesis, bioremediation, gene transfer in biofilms, and green chemistry applications of bioconversion processes. Recently, he has become active in the areas of cross-disciplinary education and service learning.

JAMES J. SPIVEY

James J. Spivey is the Shrivens Professor of Chemical Engineering at Louisiana State University. He was Senior Program Director at Research Triangle Institute and Research Professor at NC State prior to joining LSU in Jan 2003. He worked with colleagues at NC State to enhance the teaming and technical communication skills of students in the undergraduate engineering curriculum.