COMMUNITY-BASED PRESENTATIONS IN THE UNIT OPS LABORATORY

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The chemical engineering unit operations laboratory has long been the primary venue for hands-on exposure by undergraduate students to bench-top and pilot-plant scale equipment. It has also provided an opportunity to address otherwise-neglected accreditation-related topics such as group activities, data analysis, statistical design of experiments, and technical writing. As the call continues for increased emphasis on the development of effective communication skills in the undergraduate curriculum,[1-2] the use of oral presentations in an integrated laboratory sequence[3] and in laboratory and design courses[4] has been advocated, in addition to the development of separate courses specifically tailored toward communication skills.[5] The question of where the technical content for these presentations should come from, however, is an open one.

Often, technical presentations by undergraduate engineering students are based on their research projects or topics selected (often by the instructor!) specifically for a course. This provides an invaluable opportunity to develop and enhance presentation skills, but may limit exposure to a new topic or the opportunity to apply one's new-found engineering knowledge to everyday situations. Unit operations presentations at Tulane University are designed to encourage students to venture out into the community, to identify and visit local industries, businesses, and public works that use engineering tools, and to report their findings to their peers and instructors. As will be described in this paper, these sources for presentation material are ubiquitous and independent of the community's proximity to traditional chemical processing industry facilities. Identification of appropriate topics, presentation format, outcome assessment, and integration across the curriculum are described herein, but we begin with a description of how the presentation itself fits into the overall structure of the unit operations laboratory course.

TULANE'S UNIT OPS LABORATORIES

The undergraduate chemical engineering laboratory experience at Tulane is similar to that found at many universities. The sequence comprises two courses: the first offered in the spring term of the junior year and the second during an intensive three-week summer session immediately following the first. Students, working in groups of 3-4, remain in these groups for the duration of the laboratory course.

The technical presentations under consideration in this paper are contained in the first course (UO Lab I), which focuses on bench-top scale apparatuses. The second course (UO Lab II) primarily emphasizes pilot-plant scale equipment and will not be described in further detail here. As outlined in Table I, there are seven experiments in UO Lab I, including a safety report and the technical presentation. After a few introductory lectures on technical writing, plant safety, and the

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theoretical background of the experiments, four half-day (4-hour) lab sections are allotted to each experiment. Note that the technical presentation receives the same amount of laboratory time as the formal experiments. It also receives the same weight in grading. The primary logistical difference between the presentation and the other experiments is that students may (and often do) visit the host organization outside of the regularly scheduled laboratory class hours, and may spend the remaining laboratory hours making follow-up visits, collecting relevant information, and preparing their presentation.

COMMUNITY-BASED PRESENTATIONS

Community-based presentations are the result of visits to facilities or industries found in any university community: water treatment, food processing, office buildings (or sports stadiums), and health care. Since most Tulane chemical engineering students have visited a chemical process facility through the AIChE student chapter, or interned at one of the local companies, they are encouraged to pursue a topic that gives them an opportunity to see something new, such that chemical processing plants, while common in the New Orleans area, are some of the least-often visited facilities. Some examples of facilities that have been reported on, and examples of the technical content they provide, are listed in Table 2 (specific company names have been removed to better illustrate the universality of these sources and their ready availability in a variety of college campus settings). It is worth noting that there are additional goodwill benefits to be gained from university-community interactions of this nature, particularly if alumni are involved. The pedagogical utilities of these presentations will be the focus here, however.

Each group of students is encouraged to be creative in selecting a project topic, which has led to some very interesting and informative presentations; *e.g.*, rainwater drainage from the Louisiana Superdome and production of artificial sea water at the New Orleans Aquarium. There must, of course, be a strong technical component to the topic and presentation, but the primary goals are to get the students out into the local community and to interact with professional (not necessarily chemical) engineers.

Unit operations presentations at Tulane University are designed to encourage students to venture out into the community, to identify and visit local industries, businesses, and public works that use engineering tools, and to report their findings to their peers and instructors.

Topics must be cleared with the laboratory instructor, but the topic selection criteria are few. During their visit, the students must

- *Speak with a technical professional*
- *Ask technical questions*
- *Take photographs, if allowed*
- *Obtain process flow diagrams, if allowed*
- *Obtain detailed information on process equipment; e.g., capacity, material of construction, operating parameters, vendor*
- *Optionally consider the economics and/or environmental impacts associated with the topic facility*

There may be additional conditions specific to the site. For example, a visit to virtually any facility first requires clearance and safety train-

TABLE 1
Laboratory Experiments Comprising Unit Operations Laboratory I

Laboratory	*No. Half-Day Periods*
Safety Report	2
Batch Reactor	4
Turbulent-Flow Heat Exchanger	4
Flow and Heat Exchange in Fluidized Beds	4
Cross-Flow Heat Exchanger	4
Viscometry	4
Presentation	4

TABLE 2
Example Presentation Topics

Location/Topic	*Example Unit Operation/Engineering Topics*
Aquarium	Fluid flow, water chemistry, filtration
Brewery	Fermentation, filtration
Chemical process facility	Variable
Chemical process industry vendor	Variable
Chemical process research facility	Variable
Country club	Fluid flow, environmental impact
Dairy	Heat transfer, fluid flow, packaging
Faculty research project	Variable
Food processing facility	Variable
Hospital	Variable
Nuclear power plant	Heat transfer, energy balance
Office building/Sports stadium	Heat transfer, fluid flow (esp. rain handling)
Pumping station	Fluid flow
Sewage plant	Water treatment, filtration, biological reactions
Student health services	Variable
Vineyard/Winery	Fermentation, packaging
Water treatment facility	Fluid flow, flocculation

ing. These, too, are learning experiences. As described above, the students may make their site visit outside of laboratory class hours, but are otherwise expected to turn in their report (in this case, make their oral presentation) on time, which is one week after the completion of the final regularly scheduled laboratory period.

The conditions of the presentation are

- *The presentation should be about 20 minutes long*
- *Each group member must present and describe at least one slide or concept and there should be an equitable sharing of the presentation time among group members*
- *The presentation must have technical content. This could be theory behind a process, equipment specifications, materials-selection issues, environmental issues, or economic consideration, as appropriate*
- *The students must answer questions about their presentation*

There is no explicit or implicit requirement that the presentation be electronic in format, although such is often the case (the vast majority of presentations are prepared using Powerpoint or similar software). Regardless of the presentation medium, the students are evaluated on effective use of visual aids, as described below. There are no requirements for dress, other than students are encouraged to present themselves in a professional manner.

Particular emphasis is given to eliminating "crutch" words during the oral presentation. Overuse of words such as "you know" and "like" in contemporary speaking can easily make their way into presentations. Students are warned that they must eliminate, or at least minimize, the use of these phrases. Similarly, students are encouraged to practice their presentations to the point that reliance on note cards is unnecessary.

TABLE 3
Presentation Rubric

Attribute	*1* *Not Acceptable*	*2* *Below Expectations*	*3* *Meets Expectations*	*4* *Exceeds Expectations*	*Score*
Clarity and readability	Not clear or readable	Difficulty reading	Clear and readable	Superior clarity and readability	
Use of space	VA cluttered	Too little or too much information	Appropriate amount of information	VA very well laid out	
Format	No consistent format	Formatting errors	Appropriate format		
Color (if used)	Colors too hard to distinguish	Poor choice and use of colors	Easily distinguishable colors	Use of color enhances clarity	
Wording concise	Slides full of text	Slides too wordy	Slides appropriate		
Presentation Organization					
Logical order of topics	Totally disjointed, no organization	Some items presented out of order	Organization as per guidelines	Superior organization enhances communication	
Appropriate use of time	Far too long or far too short	Somewhat too long or too short	Appropriate length		
Objective	Not stated	Poorly stated	Clearly stated		
Background and significance explained	Neither stated	Only one stated	Background and significance stated	Clear statement	
Theory (if applicable)	No theoretical development	Weak theoretical development	Good theoretical development	Clear theoretical development	
Results	Not explained	Unclear	Clear	Clear as not to require questioning	
Discussion	No explanations provided	Few explanations	Explanations for most results provided	Explanations for all results provided	
Conclusions	No conclusions	Present, but not logical	Present, logical, and clearly explained	Present, logical, and superior explanation	
Other					
Presentation mechanics (voice, mannerisms, poise)	Many distractions	Some distractions	No distractions	Superior presentation	
Response to Questions	Nonresponsive	Incomplete	Clear and direct	Complete	

The presentations are not videotaped, but this enhancement could easily be incorporated.

By the time students have reached their junior year, they have given at least one, and often times several, technical presentations in their chemical engineering courses, such that they are familiar with the mechanics of preparing an effective presentation. The emphasis in these presentations, then, is on delivery and content.

PRESENTATION AND OUTCOME EVALUATION

Student presentations are evaluated using a presentation rubric, such as one available from Professor Joe Shaeiwitz at West Virginia University.[6] The evaluation rubric used for these presentations (Table 3) is currently used in many chemical engineering courses at Tulane, including the Tulane Practice School.[7] This standardization of evaluation criteria is an important tool in documenting ABET evaluation processes.

The criteria in this rubric are easily adapted to the course and project at hand. For example, the technical content can be more heavily weighted, if desired, or the use of computer software or programs can be evaluated as a separate category. The idea is to create a standardized set of minimum guidelines that the students will know they are being judged against throughout their undergraduate experience. This approach is invaluable in effectively integrating presentations across the curriculum.

The effectiveness of these community-based presentations in meeting ABET educational objectives and program outcomes is assessed, in part, at the end of the semester with electronic course evaluations. Course evaluations in Tulane's School of Engineering are conducted online through Blackboard course software.

In addition to rating the instructor, laboratory teaching assistants, and course content, the students are asked to evaluate how certain outcomes/objectives were met. For the Unit Operations Laboratory, ABET Outcomes a, b, e, f, and g are listed, of which Outcome g:

> *This course met the stated objective that students will have the ability to communicate effectively.*

is the most germane to the community-based presentations.

Of course, this also includes written communication, which is heavily emphasized in the Unit Operation Lab. More appropriate to evaluation of the effectiveness of presentations is a specific educational objective for the Unit Operations Laboratory (here arbitrarily labeled Objective #4):

> *This course met the stated objective that students have learned to give oral presentations of technical material.*

In the most recent version of course evaluations, student responses and "point values" (for internal quantification purposes only) to these questions are made from the following options: 1 = Strongly Agree; 2 = Agree; 3 = Neutral; 4 = Disagree; or 5 = Strongly Agree. So, for example, an average response of 1.5 on this scale of 1 to 5 would indicate that the "average" student agrees/strongly agrees that this objective/outcome is being met. The most recent evaluations (2003 and 2004) are provided in Table 4. (Data are available for previous years that further support these conclusions, but a different scoring system was used, which only serves to confuse the issue).

TABLE 4
Student Course Evaluation Results Relevant to Community-Based Presentations

	Average Response (1=Strongly Agree; 5=Strongly Disagree)	
Course Term	*ABET Outcome g*	*Educational Objective #4*
Spring, 2003	1.4	1.9
Spring, 2004	2.0	1.9

Results indicate that students generally feel that both of these outcomes/objectives are being met. There are currently no data on how other constituencies (employers, parents, etc.) rate the effectiveness of community-based presentations on meeting these same objectives.

CONCLUSION

A method for incorporating community-based presentations into the chemical engineering unit operation laboratory sequence has been described in this paper. These presentations are based on visits to engineering-related facilities found in most university communities. Presentations are treated equivalently with experiments on a grading basis and are evaluated using a standardized presentation rubric that is used across the curriculum for all technical presentations. In addition to the development and refinement of communication skills that the presentations provide, as confirmed by outcome assessment, there is the potential for additional benefits, including enhanced department visibility in the community, improved (non-giving related) contact with alumni, and initiation of outreach activities.

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