REVIVING GRADUATE SEMINAR SERIES THROUGH NON-TECHNICAL PRESENTATIONS

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Graduate programs in various institutions are developed to advance the technical competency of the students. As a degree requirement, graduate students enroll in some mandatory classes dealing with advanced chemical engineering topics such as thermodynamics, transport phenomena, reaction engineering, and experimental design. In addition, a common course that most graduate programs have is a seminar series. Some programs offer the seminar series as a mandatory course for all the graduate students with or without earning credit hours towards their graduation. Seminars are primarily used as a method to introduce i) contemporary research topics, ii) applications of fundamental concepts in diverse areas, and iii) networking. The presentations also help reinforce technical concepts, and provide alternative research strategies or methods of analyzing experimental results.

Many colleagues would agree that as a graduate student, the impression of a seminar series is that it is less important than technical courses, adds little value, and is a waste of time. Multiple factors contribute to this impression. Since the chemical engineering discipline has a broad range of research topics, some presentations could address only a select population of graduate students. For example, a presentation on tissue regeneration may not be interesting to students researching thermodynamic modeling of fossil fuels. Similarly, a presentation on nanotechnology may seem irrelevant to students working on optimization of control systems. This problem may be compounded by two additional attributes of the presenter: i) poor presentation skills and ii) lack of cognizance about the audience background in a chosen topic. Lack of interest in the presentation could be evidenced during the Question and Answer (Q&A) session, which may or may not have many questions from the students. This suggests a need to revive the seminar series by incorporating concepts that are not addressed in core courses, but are important to the success of graduate students.

Recognizing the importance of soft skills for the success of students, many programs have addressed some deficiencies by developing courses or workshops. Research design methods courses have been developed in different programs to introduce literature review, hypothesis testing, peer-review process, grant writing, and grant submission process[1-4]; OSU also offers a Research Methods course to teach skills related to hypothesis testing, experimental design, grant writing, and research ethics. Workshop format has been reported in the literature.[5] Some have addressed teaching skills issues by i) pairing a graduate student with a mentor[6] or ii) develop-

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ing coursework.[7, 8] Apart from research topics and teaching methods, there are a number of topics and issues one has to address to train graduate students in soft skills, an area that has been predominantly ignored with the expectation of acquiring those skills on the job, or "the hard way."[9, 10] Further, these approaches address only a few students in the program, depending on their interest level and when they started graduate school.

This study describes using the graduate seminar series as an alternative approach to integrate soft skills into the graduate program. Diverse topics could be incorporated in every seminar series avoiding repetition in different semesters, while adding value to the seminar series. The advantage of using the graduate seminar series instead of another course is that experts in the field can be invited on a regular basis to update every graduate student about recent developments rather than creating additional courses. Some of the topics, the approach adapted, and the feedback from the students are discussed.

INCORPORATION OF SOFT SKILLS.

While adding soft-skill seminars, the number of invited technical presentations was kept constant from the previous semesters. In our program, the seminar series used to have six to eight invited speakers in a semester with the total of up to 10 weeks of seminars instead of 15 weeks. Thus, there were a few weeks that were not utilized in a semester, which could be used to introduce soft skills by inviting non-technical presenters. The available resources on campus were assessed by interacting with faculty members within the department. Some individuals were requested to present in the seminar series. The new schedule contained five to six presentations on soft skills (Table 1). Some topics are described below:

1. Technical Writing. Personnel from the Writing Center, Library Sciences, and Research Administration were invited to provide information regarding technical writing in different semesters. Some of the seminar topics addressed by the Writing Center faculty members included i) communicating technical information to others, ii) elements of research articles, iii) approaches to improving writing habits, iv) audience considerations in writing, and v) the most frequent grammar mistakes. A workshop format can also be adapted in which students are required to write some technical paragraphs as a part of one seminar with common deficiencies being addressed in a subsequent seminar.[11]

Students need training in different styles of referencing using software packages such as Endnote and Reference Manager. Library personnel explained how to build a search library and how to cite articles in a document. In a subsequent seminar, library personnel explained changes in scientific search engines, and in creating alert systems with the release of new publications. Personnel from the college of Engineering Research Administration, who deal with proposals, were invited to introduce students to grant writing and the role of research administration. They introduced topics such as finding available grant opportunities, various components in a grant, grant submission process through web portals such as <http://grants.gov>, and management of a grant post-award.

TABLE 1
Example of a Class Schedule

Week	Topic
1	Introduction and Review of Departmental Safety
2	Soft Skill 1: Safety Training 1
3	Research Presentation 1: Gender in Engineering Workplace
4	Soft Skill 2: Technical Writing Basics
5	Research Presentation 2: Algae-based Biofuels
6	Soft Skill 3: Intellectual Property of Research
7	Research Presentation 3: Thermodynamics of Protein Folding
8	Research Presentation 4: Carbon Sequestration
9	Soft Skill 4: Using Endnote and Referencing
10	Soft Skill 5: Safety Training 2
11	Research Presentation 5: Drug Delivery
12	Research Presentation 6: Application of Microfabrication in Medicine
13	Research Presentation 7: Optimization and Automation
14	Research Presentation 8: Cellulosic Biofuels
15	Soft Skill 6: Cultural Presentation

2. Safety Demonstrations. One topic commonly addressed in most graduate programs is laboratory safety, where the laboratory manager or instructor responsible for undergraduate teaching laboratories performs the safety instructions. Graduate students are reminded about the importance of the material safety data sheet, safe experimental practice, and waste disposal constraints within the organization. Repeating the same content every semester may not be an effective methodology, however, particularly for Ph.D. students who may be in the program for many semesters. Since one seminar is insufficient to address many topics related to safety, some programs have a course on chemical safety in which all graduate students must enroll. There are also a number of general safety topics one has to consider, however, with ever-changing global issues. For example, educating students on campus safety is gaining more attention after the Virginia Tech incident.

One strategy we adapted was to introduce a short reminder from the laboratory manager on the first day of class every semester. Students took an online quiz to retrain on the day-to-day laboratory safety issues on a regular basis. Incoming new graduate students were told to meet the laboratory manager separately to learn about the procedural issues. This helped reduce the redundancy for returning graduate students in addition to saving a day of the seminar for other safety topics. Personnel from the Environmental Health and Safety (EHS) department were invited. This was coordinated by the laboratory manager who regularly interacts with safety-related issues. Each presentation addresses a different safety topic. For example, one seminar dealt with providing a hands-on training on fire extinguishers (Figure 1). EHS personnel brought in the equipment and organized the session in an open area. After a few minutes of initial discussion, students had an opportunity to use the fire extinguisher on a gasoline fire.

Other topics discussed in the seminar include workplace safety and industrial safety (a video presentation entitled *Shots Fired* [12]), good day-to-day laboratory practices, and *First Aid* (a video presentation[13]).

3. Cultural presentation. With increased globalization of business, it is recognized that understanding other cultures is important for student success. At the undergraduate level, study-abroad programs have gained traction in many universities with the development of departments to carry out these functions.[14, 15] Graduate students, however, do not have similar opportunities except through a few attempts in achieving this possibility by institutional collaborations.[16, 17] Although these approaches provide an opportunity for cross-cultural learning, they demand significant monetary commitment from the programs and students. Thus, long-term sustainability is contingent upon budgetary issues.

An alternative approach, which is less expensive, is to utilize the resources present in the program. Most graduate programs contain a wealth of diverse cultures due to the presence of international students in addition to domestic students. This provides a plethora of opportunity to understand other cultures from students with similar technical background. To take advantage of this opportunity, a seminar is dedicated to a cultural presentation every semester. This seminar is scheduled a week before the Finals week to provide a relaxing social environment for the graduate students. In the beginning of the semester, student volunteers from different cultures are sought. During these presentations, students are encouraged to obtain the help of staff members within the department, and their expenses are also reimbursed.

One presentation dealing with the Native American culture was done by a graduate student who grew up in that environment. The presenter also invited other tribal members to discuss various cultural aspects during this seminar. There was a demonstration of clothing and other paraphernalia used on various occasions and a discussion about the Native American involvement with the Federal government. Other presentations were from graduate students from Nigeria, India, Saudi Arabia, and Thailand. Nigerian students came dressed in their traditional clothing (Figure 2, next page) and prepared some snacks from the region for all the students. They presented the history of Nigeria, their cultures and school system, and job opportunities for chemical engineering graduates.

4. Other soft skills. There are a number of other soft-skill topics such as ethics, legal studies, management skills, intellectual property protection, contractual agreements, and teaching methodology[18] that could be considered as seminar topics. We had seminars on i) intellectual property (such as the importance of maintaining a laboratory notebook, and

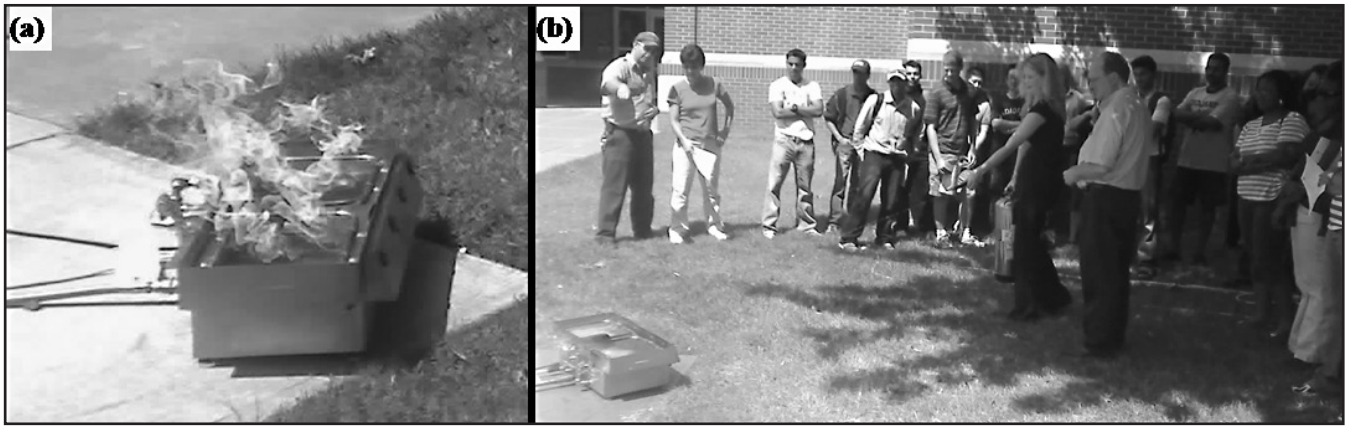

Figure 1. *Fire extinguisher demonstration. (a) Photograph of the setup to demonstrate usage of fire extinguishers. (b) Hands-on experience of pulling the pin on the fire extinguisher, aiming the nozzle at the base of the fire, and then sweeping from side to side (P.A.S.S.) to extinguish the fire.*

how to apply for a patent), ii) contractual agreements, iii) ethics, and iv) engineering attributes. Within the department, we have a faculty member who has a degree in patent law in addition to a degree in chemical engineering. This individual discusses topics related to intellectual property. Faculty members from the psychology department whose research is on ethics were also invited to present. Another faculty member who worked in industry prior to his/her academic career discussed differences between academic environment and industrial practice.

Overall, there are more than 30 topics (in different categories excluding cultural presentations) of soft skills that can be incorporated into the seminar. Based on the resources available in each graduate program and by surveying student interests, additional topics could be incorporated. These topics are rotated between semesters based on the convenience of the faculty members. This also reduces the burden on the speakers who are willing to present in addition to enriching the seminar series. Hence, unique topics can be incorporated for six to seven semesters based on four to five soft-skill presentations (excluding cultural presentations) per semester. Using the average graduation time of Ph.D. students (10 semesters) in most programs, some topics are repeated for a few students depending on when they joined the program.

Figure 2. *Cultural presentation. (a) Photograph of a graduate student presenter dressed in traditional clothing. (b) Photograph displaying some of the paraphernalia used during various occasions.*

IMPROVING STUDENT INTEREST DURING PRESENTATIONS

Typically, seminar ends with a Q&A session where the audience is allowed to ask questions of the speaker. Based on the presentation topic and the presenter, there may be few questions. Faculty members or some graduate students working in that research area might ask more questions. The majority of the students do not ask questions due to multiple reasons: 1) lack of interest in the topic, 2) lack of confidence in asking a question, and 3) no requirement to do anything else after the presentation, *i.e.*, there is no homework or exam on that topic.

To encourage participation in each seminar, students were required to submit homework for every seminar electronically through the web portal "Desire to Learn," set up for the course. Since all graduate students have to enroll in this one-credit course, the homework was applied towards their grades. They were also given instructions about the required homework content to submit: a) presentation title; b) what they liked in the seminar; c) what they disliked about the seminar; and d) other useful comments to the speaker. Students were told that the primary alternative option to get an exemption from the homework is participating in the discussion (such as asking a question) at the end of that seminar. The instructor kept track of who asked questions, or a student could send an e-mail confirmation. Another alternative is a graduate student presenting a seminar in the series, which requires consultation with the research advisor and the instructor. When a graduate student is the presenter, the comments from the peers are summarized and given as a feedback to the presenter. During these presentations, students who do not ask questions in external speaker presentations are thus encouraged to ask questions. This is done to encourage public speaking.

STUDENT FEEDBACK

Two times in five semesters, students were assessed about their experience in the seminar series. The response has been very positive and helpful in deciding the contents for the subsequent seminar series. When asked about what they have liked in the seminar series, some comments are as follows: "The seminars have become more useful and well planned. I enjoy most of them and learn from them. The cultural presentations are great and I like the safety seminars"; "more non-technical presentations would make the seminar series

more interesting"; "I have liked most of the non-technical seminars." When asked about what they have disliked, some comments are as follows: "homework submission"; "asking questions should not be made a substitute for homework. I have heard a few dumb questions as a result."

When asked about the type of presentations in which they are interested (Figure 3a), many students selected presentations on management skills as a topic of interest. Interestingly, the second choice was the research-specific technical presentation. In a subsequent survey, students were asked to suggest research-specific technical topics they would like to hear. Many of the topics were related to the industrial practice of chemical engineering such as i) best practices used in chemical engineering, ii) the role of chemical engineers in industry, iii) preparing for industrial jobs, and iv) experience of new graduates in the industrial environment. A few topics relevant to the research interest of some students were also suggested. These suggestions reflect a large number of topics that can be integrated into the graduate seminar.

Students also expressed more interest in topics related to writing skills. To better understand what category of writing skills students were interested in, they were asked to rank four major categories (Figure 3b). The majority of the students expressed a high level of interest in "writing a technical paper in a peer-reviewed journal." Addressing the technical paper writing in a peer-reviewed journal in research methods is an option, similar to other reports.[2] Less interest in grant writing could be attributed to prior exposure to the concept in the Research Methods course taught in the program. A subsequent question in the survey asked the students to describe a course they took that dealt with technical writing, engineering ethics, and safety. Students who indicated grant writing as a choice were either concurrently enrolled in the Research Methods course or soon to be enrolled in a different semester.

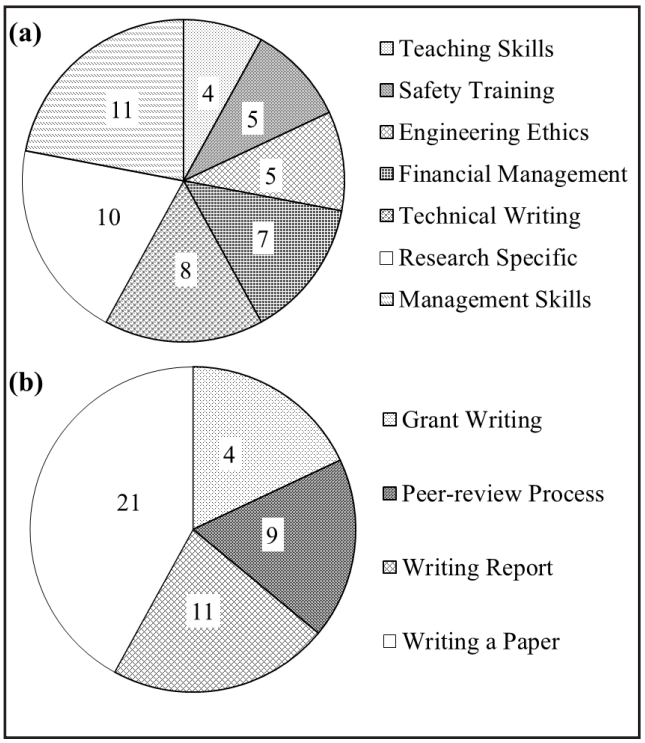

Figure 3. *Students' preference on type of presentation. (a) Number of students preferring a topic as the first choice. (b) Number of students preferring a specific technical writing skill as the first choice.*

Interestingly, only few students ranked the topic on teaching skills as interesting and many suggested that it is not as important as management skills. This opinion could be a reason why a course to introduce teaching may not be successful for a longer period of time. Multiple factors could be attributing to this opinion, however, including: a) interest in pursuing an industrial job opportunity rather than an academic job, and b) lack of awareness in pedagogical research/requirement. Introducing the importance of teaching skills through the training of teaching assistants is an option that is under consideration.

When asked about the appropriate ratio of technical and non-technical presentations in a seminar series (Figure 4),

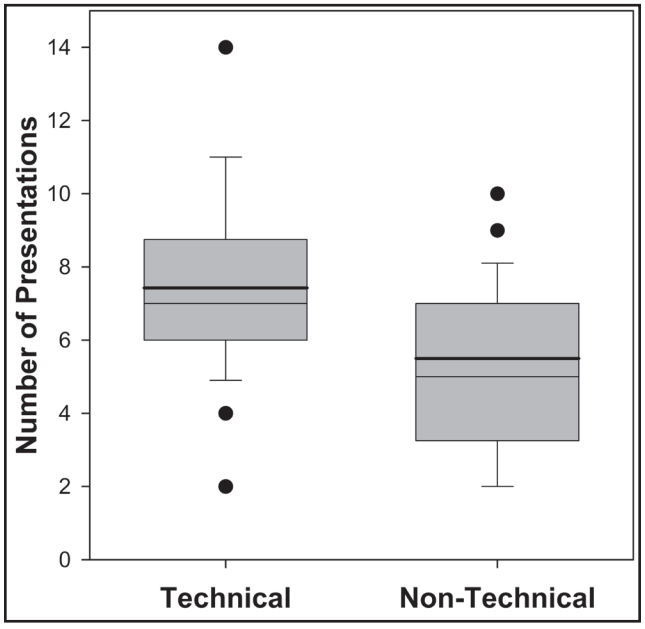

Figure 4. *Preference to number of technical and non-technical presentations. Box plot showing the distribution of number of presentations in a seminar series that students would prefer with 10th, 25th, 50th, 75th, and 90th percentiles and the mean value (thick line within each box). Values that were outside 95th and 5th percentiles were treated as outliers.*

a broad distribution was obtained. The average response, however, was 7.5 technical to 5.5 non-technical presentations in a series. This outcome could be somewhat skewed as the number is similar to the current schedule.

EVIDENCE OF LEARNING

There is indirect evidence of learning from the modifications to the seminar series. With the altered method of safety training, an immediate effect that the laboratory manager has observed is the significant improvement in the day-to-day response from the graduate students towards safety requirements. Increased awareness of safety has helped decrease the number of unlabeled containers and improper usage of personnel protection equipment. Those students who have graduated and work in industry have also given encouraging feedback on the seminar series while helping identify other safety topics to consider. Further, some of the students have asked for other types of safety training such as CPR.

An encouraging observation is that more students have started using the Writing Center after faculty members from that area presented in the seminar series. This suggests that the students have identified the need for improving writing skills. Obtaining help on grammar and formatting corrections from the Writing Center helps the faculty advisor to focus on technical content. In addition, a few students have taken courses on legal studies and technical writing upon receiving relevant information in the seminar.

There has been a significant increase in the number of questions (>7 per seminar) asked at the end of technical presentations. Providing an exact increase in number of questions is hindered by time constraints, *i.e.*, there are many occasions where the instructor has cut short the Q&A session due to shortage of time. Unsolicited comments from a few technical presenters have been positive on the number and quality of questions they received. One of the external technical presenters wrote in an e-mail to the instructor, "I like the seminar format, there were some good questions after." The increase in the number of questions suggests that students are attentive during the presentation.

REFLECTIONS OF THE INSTRUCTOR AND COURSE REVISIONS

To accommodate all the presentations, developing the entire schedule very early (preferably a semester before) is important. One has to identify the resources available on campus and coordinate the schedule. Based on the feedback from students, some of the research topics have been incorporated into subsequent seminars. For example, recent graduates from the program who have been working in the industry were invited. They are advised *a priori* that the purpose of the presentation is providing their transitional experience rather than technical content related to their work. Also, a faculty member in the department who is an editor of a journal was invited to address the peer-review process. In addition, plagiarism in the modern digital world was also discussed using a case study.

Incorporating a cross-disciplinary conversation has some limitations and may be difficult although persuasive.[19] For example, while presentations from the library personnel are useful, they have to be informed about the student background and niche areas to discuss. In terms of the safety presentations, two seminars per semester were dedicated for four semesters. Student feedback suggested that one seminar per semester may be optimum to address many topics, however. Subsequent seminars had one seminar per semester (or two seminars per year), which also saved a seminar day for incorporating other soft skills. Feedback from students also suggested that they enjoyed the fire extinguisher demonstration and would like more demonstrations. The fire extinguisher demonstrations were repeated in the sixth semester. Graduate students enjoy the cultural presentations and there has been a positive response to these presentations. Similar presentations from various cultures can be integrated and the topics could vary as well. If the graduate program has little diversity in the population, contacting the international services office of the university, which typically advises international student organizations, is recommended. These students could be invited to give presentations.

The instructor also plays an active role during the Q&A session to improve the interactions. One approach adapted to improve the quality of questions is for the instructor to identify students who ask irrelevant questions (which some students perceive as dumb) and advise them about relevancy. Further, submitting homework electronically has helped this process to be very efficient and less time consuming.

SUMMARY

Graduate seminar series provides a unique opportunity to incorporate soft skills into the graduate program every semester. Adapting this approach has three primary advantages:

i) Making the seminar series more effective by eliminating redundancies in the schedule while utilizing the entire available time

ii) Enriching their learning experience by incorporating soft skills, and

iii) Decreasing the monetary burden on the department to invite external speakers for every seminar in the semester.

Coordinating the seminar series to incorporate soft skills requires significant time commitment from the lead faculty member. Although a seminar in many of these topics may be insufficient to make a graduate student proficient in each

skill, they are intended to provide an opportunity to recognize whether each student has the skill set to perform these functions. In other words, the intention is similar to a technical seminar. The non-technical seminars provide an opportunity to see whether students are interested in enhancing a particular skill set.

REFERENCES

1. Burrows, V.A., and S.P. Beaudoin, "A Graduate Course in Research Methods, *Chem. Eng. Ed.*, **35**(4), 236 (2001)
2. Hill, P.J., "Teaching Entering Graduate Students the Role of Journal Articles in Research," *Chem. Eng. Ed.*, **40**(4), 246 (2006)
3. Holles, J.H., "A Graduate Course in Theory and Methods of Research," *Chem. Eng. Ed.*, **41**(4), 226 (2007)
4. Aucoin, M.G., and M. Jolicoeur, "Is There Room in the Graduate Curriculum To Learn How To Be a Graduate Student? An Approach Using a Graduate-Level Biochemical Engineering Course," *Chem. Eng. Ed.*, **43**(4), 306 (2009)
5. Giraldo, E.J., D. Valdes, J. Ferrer, and W. Frey, "Case Analysis: A Tool for Teaching Research Ethics in Science and Engineering for Graduate Students," *Proceedings*, ASEE Annual Conference, Paper 2183 (2009)
6. Baber, T.M., D. Briedis, and R.M. Warden, "Teaching and Mentoring Training Programs at Michigan State University—A Doctoral Student's Perspective," *Chem. Eng. Ed.*, **38**(4), 250 (2004)
7. Brent, R., and R. Felder, "A Professional Development Program for Graduate Students at North Carolina State University," *Proceedings*, ASEE Annual Conference, Paper 1047 (2008)
8. Wankat, P.C., and F.S. Oreovicz, "An Education Course for Engineering Graduate Students," *Proceedings*, ASEE Annual Conference, Paper 1655 (1999)
9. Pulko, S.H., and S. Parikh, "Teaching 'Soft' Skills to Engineers," *Int. J. Electrical Eng. Ed.*, **40**(4), 243 (2003)
10. Kumar, S., and J.K. Hsiao, "Engineers Learn 'Soft Skills the Hard Way': Planting a Seed of Leadership in Engineering Classes," *Leadership and Management in Engineering*, **7**(1), 18 (2007)
11. Harris, K.R., and S. Graham, *Making the Writing Process Work: Strategies for Composition and Self-regulation,* 2nd Ed., Cambridge, MA: Brookline Books (1996)
12. *Shots Fired on Campus (Student Edition): Guidance for Surviving an Active Shooter Situation*. Produced by The Center for Personal Protection and Safety <http://www.cppssite.com/products>
13. *First Aid on the Job: Initial Response*. Produced by Coastal Training. <http://www.coastal.com>
14. Harichandran, R., D. Mason, D. Prestel, J. Merrill, P. Streng, T. Maleck, and V. Galishnikova, "Innovation in a Large-Scale Study-Abroad Program in Engineering," *Proceedings*, ASEE Annual Conference, Paper 3460 (2004)
15. Parkinson, A., "Engineering Study-Abroad Programs: Formats, Challenges, Best Practices," *Proceedings*, ASEE Annual Conference, Paper 422 (2007)
16. Neoh, K.G., R.B.H. Tan, A.A. Mirarefi, and C.F. Zukoski, "Globalization of ChE Education and Research: An NUS-UIUC Mode," *Chem. Eng. Ed.*, **35**(4), 244 (2001)
17. Yokoyama, A., "An Innovative Method for Integrating a Diversity Workshop in Chemical Engineering Course," *Chem. Eng. Ed.*, **43**(1), 10 (2009)
18. Wankat, P.C., "Pedagogical Training and Research in Engineering Education," *Chem. Eng. Ed.*, **42**(4), 203 (2008)
19. Harris, K.R., and P.A. Alexander, "Integrated, Constructivist Education: Challenge and Reality," *Educational Psychology Review*, **10**(2), 115 (1998) ❐