Integration of a Communicating Science Module into an Advanced Chemistry Laboratory Course

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As new scientific frontiers are investigated and new technologies implemented, it becomes increasingly important for scientists to communicate these advances to the public (1–4). However, while scientific communication is widely regarded as an essential skill for scientists, the undergraduate science curriculum often does not include formal instruction related to the development of communication skills. Effective science communication skills include written and oral presentation competence as well as being able to communicate to different audiences including specialized, technical audiences and lay audiences.

Various approaches to improving students’ communication skills within the chemistry curriculum have been reported in the literature (5–20). In one approach, new courses related to scientific communication or technical writing were introduced into the chemistry curriculum (11, 14, 18). The introduction of a separate course gave students time to completely focus on improving their communication skills.

In a second approach, written or oral presentation components were added to an existing advanced laboratory course with the goal of providing students with the opportunity to hone their communication skills (5, 13, 15–17, 19, 20). Many of these examples have focused primarily on writing skills directed to a technical audience and have incorporated the use of peer feedback (17) or an undergraduate writing teaching assistant (16, 17). In the modification of an existing course, students were often provided with experience and feedback related to their written and oral presentation skills, but with little formal training in communication skills.

In a third approach, at the University of Strathclyde in Scotland, a comprehensive communications program was implemented in the chemistry curriculum (10). In the Integrated Communication Skills Package, students must complete three units (Team Business Game, Poster Presentation, and Oral Presentation Skills) over a three-year period (10). By the end of the program, students had improved their communication skills and also had a greater appreciation for the importance of communication skills for chemists (10).

In our approach, an integrated “communicating science module” that provides students with instruction and practice exercises designed to improve their oral and written communication skills was developed and introduced into an advanced undergraduate physical chemistry laboratory course. The content of the communicating science module will be described in detail in the next section. The communicating science module culminated with poster and oral presentations on laboratory experiments conducted in the course.

The rationale for integrating the communicating science module into the course was twofold. First, it would be difficult to introduce a new required course because the chemistry curriculum is already demanding, with 46 semester hours of required chemistry courses for a Bachelor of Science degree in chemistry (not including other required courses such as mathematics and physics). Second, by incorporating the communicating science material into an advanced laboratory course, the students were able to give oral and poster presentations on the laboratory experiments that they had just completed thus providing them with a clear context for their communicating science skills. The communicating science module was introduced in a physical chemistry laboratory course with seven students (6 chemistry majors and 1 chemical engineering major).

Description of the Communicating Science Chemistry Module

The communicating science course module for chemistry was developed as part of a university-wide initiative sponsored by the Office of the Provost. The initiative seeks to prepare students who have a commitment to careers in science and technology to confidently communicate their activities—and the significance of those activities—in nontechnical terms to the lay public, the press, policy makers, and politicians. The communicating science module that was developed for the physical measurements laboratory course consisted of six sessions that were presented during the semester. The experiments in the physical chemistry laboratory course were conducted in rotations with student groups simultaneously working on different experiments in the rotation. The communicating science sessions were scheduled intermittently during the initial two thirds of the course. To give the students the opportunity to practice their communication skills, a poster session and an oral presentation session were included in the course. Details of the content of the communicating science module are given below.

Unit I: Communicating Science to Different Audiences

In the first unit, which included two class meetings, two topics were introduced: the importance of communicating science and the concept of communicating science to different audiences. The teaching assistant (a biology graduate stu-
dent who had completed a similar module in an undergraduate genetics course the previous semester) led the discussion. She presented an example of how she would describe her research to three different audiences:

1. Technical, specialized audience (i.e., research conference)
2. Technical, but not specialized audience (i.e., general department seminar)
3. General public, very little science background

In addition, she presented several examples of how undergraduate biology students explained the basic concept of “antibiotic resistance” to a lay audience. The students critiqued the different descriptions of “antibiotic resistance”. The students were given two short assignments for the next class. One was to prepare a short (one minute) “elevator speech” explaining the second law of thermodynamics to a lay audience and the second was to write a short paragraph for a lay audience also explaining the second law of thermodynamics. The second session was highly interactive with the students presenting their one-minute elevator speeches. There was peer discussion of each speech pointing out the strong points and weak points. During the second part of this session, student groups were given a list of scientific terms, such as surface area, adsorption, calorimetry, catalyst, to discuss and eventually explain to the class in terms a lay audience would understand.

Unit II: Oral and Poster Presentation Skills

The second unit was covered in two class meetings. The first session was devoted to PowerPoint training and was held in a classroom equipped with computer stations for each student. Following a brief presentation about the advantages and drawbacks of PowerPoint presentations, the students practiced with the PowerPoint software. Most students were familiar with PowerPoint and focused on learning some of the more specialized PowerPoint capabilities. The second session focused on oral communication skills using Jessica Renaud’s oral presentation RSVP rubric, which is a training framework that focuses students’ attention on the following key presentation areas: R = responsiveness (e.g., audience analysis), S = speech patterns (e.g., speed, volume, enunciation), V = visual aids, and P = physical (e.g., use of stage, congruence of body language with message). The teaching assistant then gave a short oral presentation and the students discussed the strengths and weaknesses of the presentation using the RSVP rubric as a guide.

Unit III: Interviews and the Press

In the final unit, a leading scientist from the University of Iowa campus was interviewed by a local newspaper reporter. The students observed the interview and were able to ask questions of the scientist and the reporter at the end of the interview. The reporter then emailed a copy of her article and during the second session, the article and the approach that the reporter took were discussed by the students. Interviewing and interviewee skills that will be important to students when they enter the job market were also discussed.

Poster Session and Oral Presentations

The students were given the opportunity to showcase their communicating science skills by presenting a poster and an oral presentation on laboratory experiments. For both the poster and the oral presentation, the students were assigned an experiment as their topic and the presentation replaced the usually required written laboratory report. Examples of student work are provided in the Supplemental Material.

The poster session was scheduled near the middle of the course after the students had completed approximately seven laboratory experiments. Students were given a handout and links to several Web sites giving examples of effective poster presentations. Students were encouraged to use PowerPoint to prepare the posters. The poster session was held during the scheduled laboratory period and was attended by the students, the instructor, the teaching assistants, the communicating science instructors, and several other guests from the chemistry department. Students stood by their posters and presented their work and answered questions. The instructors and TAs completed evaluation sheets on the posters and each student’s lab report grade for that experiment was based on the evaluation of the poster.

During the last week of the class, students were required to present a ten-minute oral presentation on a laboratory experiment. The oral presentations were scheduled during a regular laboratory period but in a classroom equipped with computer technology. Students used PowerPoint presentation software and a projector. There was a short question and answer period at the end of each talk. Students were instructed to prepare their oral presentation directed to a lay audience and many students found this difficult owing to the technical nature of most of the physical chemistry laboratory experiments. The chemistry instructor, teaching assistants, and communicating science instructors evaluated the student presentations and the students were provided with the written comments on their oral presentations.

Role of Communicating Science Instructors

The communicating science sessions were presented by a professional in communicating science and a communicating science teaching assistant who had taken a similar biology course (molecular genetics laboratory) during the prior semester. These two individuals were instrumental to the success of the communicating science module. Their combined expertise and perspectives (nonscientist and biologist) enriched the experience for the chemistry students in the course.

Student Evaluations

Students were asked to complete an evaluation of the communicating science module at the end of the course. The survey consisted of 8 questions (scale 1–10 with 1 = no, 5 = some and 10 = definitely yes) and 3 essay questions. Overall, student responses about the module were very positive; for example, when asked whether the communicating science module should be used again next year in the course, the average of the student responses was 7 ± 2 (95%, n = 7). Students also answered positively when asked whether they found value in the poster session, 8 ± 2 (95%, n = 7), and the oral
A presentation session, $8 \pm 2$ (95%, $n = 7$). In written comments, a student noted that “the more times I explained, the better I myself understood it.” Another student commented that it was difficult “taking complex equations and theories and breaking them down completely.” Another student stated that “the emphasis put on the above ideas (power of analogy, defining terms, audience analysis) helped greatly with my presentation” and “I know I’m a better speaker thanks to this class.”

Conclusions

An integrated communicating science module was introduced into an advanced undergraduate physical chemistry laboratory course. The content of the communicating science module was described in detail and included topics such as communicating science to different audiences, development of oral and poster presentation skills, and interviews with the press. The module was integrated into the course such that students received formal instruction in communicating science interwoven with the chemistry laboratory curriculum; this strategy enables the communications component to reinforce the teaching in the discipline with very little need for additional, valuable course-time.

Acknowledgments

We would like to acknowledge the students in the Physical Measurements class during the fall 2004 semester and the teaching assistants, Jennifer Schuttlefield (chemistry), Lin Wang (chemistry), and Kelley Foreman (communicating science). This project was generously supported by the Office of the Provost and the Graduate College through The University of Iowa Communicating Science to the Public initiative and by the NSF through grant CHE-0204847 to SCL.

Supplemental Material

Examples of student work are available in this issue of JCE Online.

Literature Cited