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Activity

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Student-Led Engagement of Journal Article Authors in the Classroom Using Web-Based Videoconferencing

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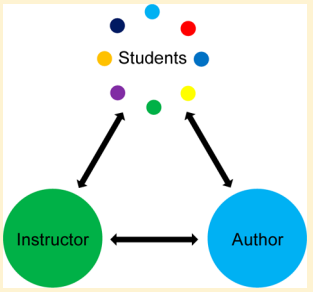
Supporting Information

ABSTRACT: The learning environment described here uses Web-based videoconferencing technology to merge the traditional classroom journal article discussion with student-led interviews of journal article authors. Papers that describe recent applications of a given technique are selected, with the author engagement occurring at the end of a three or four week module covering the technique and its applications. Students prepare for the author engagements by reading the paper, discussing it as a class with the instructor, and developing a set of consensus questions to provide a framework for their conversation. Authors do not make formal presentations to the students, but instead answer questions. The smaller class sizes of upper-division undergraduate courses provide an intimate setting for these student-led conversations. Author engagements are designed to improve critical thinking skills in the content areas studied, improve interactive scientific communication skills, build scientific self-confidence in young scientists, and expose students to established scientist role models. The student−author interactions described here provide a cost-effective mechanism to expose students to diverse areas of chemistry and to bring expert scientists into the classroom. In situations where videoconferencing is not available or permitted, teleconferences provide a reasonable substitution.



KEYWORDS: *Upper-Division Undergraduate, Interdisciplinary/Multidisciplinary, Communication/Writing, Internet/Web-Based Learning*

The use of the Internet in chemical education is diverse and widespread. This includes video-based instruction in distance learning,[1,2] MOOCs,[3] flipped classrooms,[4,5] and hybrid courses[6] and the use of online discussion boards[7] and poster sessions.[8] Web-based video has also been used as an assessment tool,[9] and Webinar and blogging technologies have been combined to broaden the diversity of seminar speakers and learning experiences in a very cost-effective fashion.[10] The activity described here uses Web-based videoconferencing technology to merge the traditional classroom journal article discussion with student-led interviews of journal article authors. Journal article discussions provide a critical thinking learning experience that requires students to apply textbook-derived knowledge to chemical and biochemical research. At the same time, students are exposed to diverse topics that might not be covered in their course work. Similar learning experiences can be obtained by hosting seminar speakers or by sending students to conferences, but at significantly greater expense. The author engagements described here require active participation by the students and are best carried out in the context of advanced, upper-division undergraduate courses.

The pedagogical goals of this learning activity were (1) to improve critical thinking skills in the content areas studied, (2) to improve interactive scientific communication skills, (3) to build scientific self-confidence in young scientists, and (4) to expose students to established scientist role models. Students develop critical thinking skills by reading and evaluating about 20 journal articles as homework assignments each semester in advanced chemistry courses (5−10 students) that I teach. However, most of these articles are only discussed within the class. The handful selected for author engagements take this a step further and bring the author into the classroom. The primary focus of scientific communication skill training in the undergraduate curriculum is the delivery of information by verbal and written means. This typically involves individual or group oral presentations, poster presentations, lab reports, and term papers. Scientific discourse is experienced mainly in the form of being questioned by professors and other students at these presentations, and in the occasional questioning of seminar speakers. Author engagements complement these activities by providing a focused, small-group setting for students to practice interactive communication with established research scientists. The scientific self-confidence gained is invaluable as the students move beyond the classroom and laboratory. As the students peel back the layers of the journal article, they often learn how the author dealt with ambiguity and developed new approaches to surmount obstacles. Students also observe the author's passion for their research.

■ ARTICLE SELECTION

The biophysical chemistry and biochemical NMR spectroscopy advanced courses are structured as chalk-talks and literature paper discussions. Both courses meet once per week for 2.5 h during the 15-week semester, thereby allowing plenty of time for in-depth discussions as well as flexibility in scheduling author interviews. On four occasions in each course, I schedule

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a videoconference (or teleconference if video is either not possible or not permitted) with an author of one of the papers that the class has been discussing. The papers are selected as examples of recent applications of a given technique where the senior author is one of my professional contacts. The author engagement activity typically takes place at the end of a three or four week module covering the technique and its applications. I contact the author several months in advance with a proposed date and journal article, and, if he or she agrees to participate, I design the rest of the module with this end point in mind. On at least one occasion, the senior author enlisted the graduate student that carried out the research to participate along with him.

STUDENT PREPARATION

The paper is posted online about 3 weeks in advance. Students read the paper and develop a list of five questions that they would like to ask the author. I ask the students to spend at least 2 h reading and understanding the paper. The list of questions is a graded homework assignment during the week leading up to the author engagement.

The paper is discussed as a class for about an hour before the videoconference begins. This is carried out in a journal club format that I lead. Students are encouraged to ask their "five questions" during this discussion. Depending on the background and interests of the student, questions involve clarification or more details about the experimental methods, data processing and analysis, data interpretation, and conclusions drawn. In many instances I have an idea about how to answer these questions, but, rather than speculate, I work with the students to develop a set of 10−15 consensus questions for them to ask the author. These consensus questions are written on the whiteboard and each student claims one or two questions to pose to the author. It works well if the questions are arranged to follow the flow of the paper rather than skip around. Students are typically curious about information that cannot be obtained from reading the paper, such as why the authors did not do a particular experiment, what the authors have done since the paper was published, and whether similar methods could be applied to other systems. Ask the author!

AUTHOR ENGAGEMENT

Authors are brought into the classroom using either Web-based videoconferencing (or its voice-only counterpart) or landline-based teleconferencing. Skype[11] videoconferencing, which is a free service, was used, including one instance where two authors in two different locations were engaged simultaneously using Skype's group video calling feature. An excellent description of audiovisual considerations can be found in the technical description of the Webinar setup given in ref 10. The videoconference can be viewed on the screen of a laptop computer, but a better experience is created by routing it through the audiovisual system of a classroom for projection onto a full screen. The video camera built in to most laptops can be used to send video of the participants to the author. The small group setting of my advanced courses also allowed the author to view the students with higher clarity than might be possible with the larger audience of a seminar setting. This activity should be suitable for larger class sizes with the caveat that each student may not get to ask a question depending on the time available. Some industrial authors were not allowed to use videoconferencing for intellectual property reasons and thus were brought into the classroom using a Polycom SoundStation2[12] plugged into a landline. This worked efficiently, but I found that the students were more engaged when they were looking at the person with whom they were speaking.

The author engagement begins with me thanking the author and providing a brief biographical sketch of the author. The authors have been informed of the format ahead of time, and also of the general level of understanding expected from the students. The author does not give a presentation during these sessions. Rather, the sessions are student-driven based on their questions, and the students are asked to introduce themselves the first time that they speak to the author. Thus, after the brief introduction the students begin to engage the author using the consensus questions as a framework. The framework questions increase the comfort level of the students. Comments by the author either lead directly to other questions on the list, or lead to unplanned follow-up questions. In the latter case, the consensus questions provide a place for the students to return to. The instructor can participate in the session if desired, but I have found the students quite capable of carrying on a conversation with a logical flow. The sessions typically last 30−45 min, and conclude with a few questions from me asking the speaker to discuss graduate schools, the job market, or important skill sets for college graduates.

I do not formally assess the students during the author engagement. However, at the start of the first class period following the author engagement, I select one question from each student's original question list and ask them to explain the answer. These questions are selected to reinforce key concepts of the technique that were an interesting aspect of the author's input. Another possible assessment would be to have students write a reflective, summary paper. Finally, some homework assignments and exam questions involve translating methods used by the authors to a novel system that the students have not encountered. Examples are provided in the Supporting Information.

DISCUSSION

The opportunity to engage authors provides a high-impact learning experience by stimulating higher-order thinking in a similar fashion to what has been described when virtual guest speakers facilitate online discussions.[13] Students practice scientific communication skills while digging into the scientific aspects of a paper and hearing about its ambiguities and back story. Interacting with an established expert moves them outside of their comfort zone but ultimately improves their scientific self-confidence. Hearing the perspective of the author complements and reinforces the course instructor's presentation. Students also have a great opportunity to learn about academic or industrial research. On the occasion where the senior author was joined by a graduate student, the generational gap was palpably reduced and the students were excited to hear two different perspectives on the research project. This "dual engagement" is something that I intend to incorporate more often.

The instructor and hosting institution benefit from the absence of travel costs or honoraria associated with these experiences. The instructor also benefits by having external experts participate in teaching the course. The benefits for the author are significant as well. The time commitment is minimal, since a formal presentation does not have to be prepared and

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there is no travel involved. The author is afforded an opportunity to further disseminate their work and to potentially recruit undergraduate students to their institution. Also, this service to the chemical community can be noted on the author's CV, where it may be especially significant for tenure-track faculty, postdocs, and graduate students. Feedback received from the authors during follow-up conversations indicates that they enjoyed and benefited from the experience. Comments received include the following:

- I enjoyed the discussion. You have established some good teaching methods that should make the material interesting.
- I had fun as well. Thanks for the opportunity.
- It is great what you are doing for the students.
- I had fun!
- It was an honor for me to participate at this lecture. I hope that at least some of my answers were sufficiently clear. Thank you for having given me the possibility to interact with your students.
- Very sharp kids, I really enjoyed it.
- I finally get around to thanking you for the wonderful opportunity to speak to your students. It was really a pleasure and I hope the participants got something out of the whole event. I hope we do this type of thing again sometime.

Students indicated that they greatly preferred videoconferences to teleconferences. Putting a face on the authors seemed to complete the experience for the students. Anonymous student feedback provides evidence that the students enjoy these engagements and that at least some of the pedagogical goals were met. Comments received include the following:

- The structure of the course was a format I had not yet experienced. Dr. Stockman's experience in industry gave him accessibility to several very interesting individuals whom contributed to the journal articles we studied. Although the material was difficult to understand, as the course went on I found myself knowing more and more about NMR as I read new material and was able to ask better questions about it.
- Conference calls were very helpful about understanding papers.
- It was nice to interact with researchers from around the world that were applying these techniques to diverse projects.
- I liked having a face to a name. I also liked thinking that this was where my career could be going, and how what I was learning is actually applied in real life circumstances.
- The best part were the conference calls and talking to different researchers.
- I enjoyed the videoconferences because when I did not understand something I was able to talk directly to the researcher that did the work.
- It was neat when they talked about data that was not in the paper especially some of the stuff that did not work like they thought it would.

The articles and authors chosen for the Web-based videoconferences described here are listed in the Supporting Information. Although the authors were selected for their focus on biophysical methods, this classroom activity is broadly applicable to diverse topics in chemistry. Willing authors can be found by mining professional contacts as was done here, by reaching out to former fellow graduate students and postdocs, or by sending an invitation just as is done when soliciting seminar speakers. All of the authors engaged in my courses have been more than willing to share their research and experience with undergraduates. I think that this will be generally the case, and that the advantages of minimal preparation time and no travel commitment will be compelling. Courses taught primarily from the literature can be kept evergreen by selecting recent articles from the same or different research groups. The interaction between students and scientist role models is a tremendously engaging experience when carried out in the intimate setting of an upper-division undergraduate course. Web-based videoconferences provide customizable, unique learning experiences, and can be one component of a distinctive chemistry education.[14]

■ ASSOCIATED CONTENT

Supporting Information

List of articles and authors selected for the Web-based videoconferences and teleconferences; sample author invitation letters; student consensus questions for two author engagements; and the syllabus, exams, and sample homework assignment for the Biochemical NMR Spectroscopy course.- This material is available via the Internet at http://pubs.acs.org.

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Notes

The authors declare no competing financial interest.

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