JOURNAL OF CHEMICAL EDUCATION

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Providing Students with Interdisciplinary Support To Improve Their Organic Chemistry Posters

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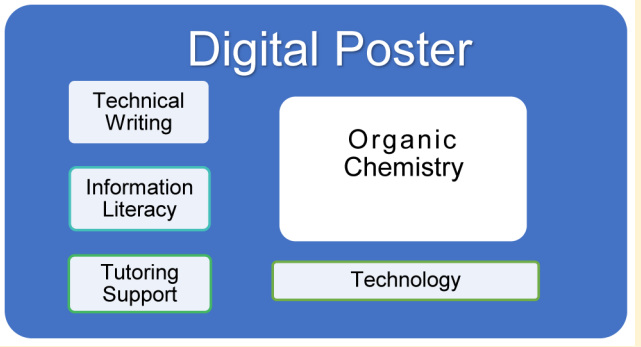
Supporting Information

ABSTRACT: A two-semester-long interdisciplinary support effort to improve student posters in organic chemistry lab is described. In the first semester, students' literature search report is supported by a workshop conducted by an Instruction Librarian. During the subsequent semester, a second workshop is presented by the Instruction Librarian, an English professor, and the Assistant Director of the college's Learning Center. In that workshop, the students are shown PowerPoint applications to enable them to produce digital posters. They also learn the conventions of scientific poster layout and design, scientific writing style, use of graphics, and correct ACS documentation. The interdisciplinary support culminates in a poster competition at the end of the second semester. The digital posters created not only exemplify professional scientific design and content; they are also easily transported, presented, and stored and eliminate the expense of printed posters.



KEYWORDS: *General Public, First-Year Undergraduate/General, Second-Year Undergraduate, Interdisciplinary/Multidisciplinary, Communication/Writing, Student-Centered Learning, Internet/Web-Based Learning*

Both interdisciplinary collaborative teaching and the implementation of poster sessions have received considerable attention in the recent science education literature.[1−9] Different approaches to interdisciplinary teaching have been described in the *Journal of Chemical Education* (JCE), including using research projects with interdisciplinary topics, incorporating examples from different subjects into chemistry courses, and integrating chemistry into the curricula of other sciences.[1−3] In addition, at our institution, University of Cincinnati Clermont College (UCCC)—a regional two-year college of a research level-one university—one of the authors has previously successfully collaborated with an English professor to give undergraduate chemistry students an introduction to scientific writing.[4] However, the interdisciplinary support we describe in this publication is unique in that it involves professionals from multiple disciplines in the same institution participating in a collaborative, student-centered effort to improve student poster presentations in organic lab courses.

The use of posters as a learning tool dates back to as early as 1929 when Charles H. Stone used posters in education, especially to increase student interest in chemistry.[10] The first American poster session took place at a national scientific meeting in 1974.[11] Since then, many educators have emphasized the importance of posters in enhancing student learning,[5,6] assessment,[7−9] and promoting the study of chemistry.[12] Sisak describes using poster sessions to create enthusiasm in students faced with learning difficult concepts in a biochemistry laboratory course.[5] More recently, faculty from different universities report integrating poster assignments into analytical chemistry laboratory courses, and cite the subsequent learning opportunities, from enhancing communication skills to fostering students' ability to draw statistically sound scientific conclusions.[6] In-class poster presentations have also been used as the primary evaluation for assessing students' laboratory grades.[7] Menke explains the value of online poster sessions for evaluating student work in online courses and as an alternative assessment strategy for large face-to-face classes.[8] Poster sessions have also been implemented as an alternative to written examinations.[9] Finally, the visual nature of posters lends itself to promoting chemistry as an interesting and rewarding field of study; Sullivan describes an annual poster contest for high school students that also functions as a recruiting tool for his department.[12]

The methods used for creating and presenting posters have also evolved with the advent of computer technology,[13] allowing students to create digital posters with easily accessible software such as PowerPoint.[8] The creation of digital posters offers opportunities not possible with paper posters: they can be transported easily and presented virtually in an online environment.[8] The interdisciplinary project we describe here arose out of the need to improve the quality and professionalism of student posters in our chemistry courses by requiring students to create digital posters. Our project differs from those previously reported in that it utilizes digital

Published: October 30, 2015

DOI: 10.1021/acs.jchemed.5b00020
J. Chem. Educ. 2016, 93, 93−97

Table 1. Participants Involved with the Project and Their Role

Team Members	Represented Expertise	Participation in Project
Chemistry Professor	Organic chemistry	Facilitated choice of project topic and hypothesis development; accepted project proposal; oversaw student experiments in lab; managed peer review; examined organic chemistry content of student writing and checked for chemical accuracy; provided expert support for scientific poster design and American Chemical Society (ACS) documentation.
English Professor	Technical writing	Introduced professional scientific poster writing style, scientific poster layout and design, and American Chemical Society (ACS) documentation style; team-taught workshop on poster design; created handouts to support poster development.
Instruction Librarian	Information literacy and technology	Provided workshop and facilitated literature search; demonstrated how to use PowerPoint to produce digital posters; team-taught workshop on poster design; developed handouts to support poster development.
Assistant Director of The Learning Center	Student support	Reviewed and supported scientific writing, poster layout, and design; answered questions about technology.

posters with a face-to-face student presentation: digital posters are projected on screens instead of being printed, allowing easy portability and eliminating the prohibitive expense of printed posters.

The production and presentation of posters has been a long-standing assignment in both general chemistry and organic chemistry laboratory courses at our institution. Posters were typically submitted on poster board with elements cut-and-pasted, not digitally developed and printed, and frequently had an amateurish appearance. UCCC students are predominantly first-generation college students with limited incomes; all commute to the campus, and many are not as technologically savvy as their counterparts at other institutions. Some do not have access to a computer or the Internet at home. These factors are disadvantages that they must overcome in order to produce a digital poster assignment successfully. To address our students' needs we began a collaboration among faculty and staff from the chemistry, English, library, and Learning Center areas at the college. The team envisioned improving poster quality by teaching digital literacy, scientific writing, and poster design within the organic chemistry laboratory classroom and then supporting the students' efforts outside the classroom with a dedicated tutor from The Learning Center at UCCC. An additional unique element of the collaborative effort was that all first- and second-year chemistry students were involved in a final campus-wide poster competition that promoted chemistry to the entire campus community. Our approach specifically modeled how scientists share data in a poster session format. In addition, we designed this approach so that it could be replicated by chemists with relatively minimal multidisciplinary experience. Our goal here is to share both our experience and the framework of our collaborative project to enable chemistry teachers to utilize similar projects in their courses.

POSTER PROJECT IN CHEMISTRY

Since UCCC is a regional campus of a research level-one university, it offers only two years of chemistry study before students enter their majors, mostly biology, medicine, or pharmacy. When the collaboration described here was begun, UCCC first-year, general chemistry lab students were required to complete an independent project and produce a poster at the end of the academic year. The second-year, organic chemistry lab students worked on an organic chemistry lab poster project throughout the year. As part of the project, students in each organic chemistry lab class were required to identify a project topic, conduct a review of the literature, develop a hypothesis, test that hypothesis in the lab, write a report about their project, submit the report for review, revise the report, and create a poster (see Supporting Information, "The Tasks We Asked Our Students to Complete"). Both first- and second-year chemistry students presented their posters to the college community during an annual poster competition at the end of the spring semester. Since the 2012 fall semester, a group of faculty and staff have collaborated on improvements to the organic chemistry students' learning process as they prepared their posters. From that semester, the organic chemistry students moved from developing paper posters to producing completely digital ones. The general chemistry students did not receive interdisciplinary help and were given the option to create either a paper or digital poster to represent their projects.

IMPLEMENTATION OF INTERDISCIPLINARY SUPPORT

The Team

The organic chemistry lab poster training was team-taught by a chemistry professor, an English professor, an Instruction Librarian, and the Assistant Director of The Learning Center of the college. Each specialist brought different skills and performed different supporting roles to help students develop their project posters (Table 1).

The multidisciplinary approach involved coordination among the four faculty and staff participants. All four members of the collaborative team met with the students in a computer lab midway into the fall semester.

Preparation Work for Poster Creation

In the fall semester, students chose a general topic (see Supporting Information, "Some Past Poster Topics") for their projects under the supervision of the chemistry instructor. Training in how to conduct a literature search was provided by the Instruction Librarian. Then students were expected to ask specific questions and develop a hypothesis based on their literature searches. A project proposal, which included topic, hypothesis, methods, safety considerations, and sources and requests for materials and equipment was due at the beginning of the spring semester. Students were asked to keep the project procedures limited to the availability of the college's lab equipment and supplies. After the students' project proposals were accepted by the instructor, they worked in the lab individually or in groups of two or three during two lab periods. Students were required to write a project report that included abstract, introduction, methods, results, and conclusion sections, along with appropriate in-text citations and a reference list in ACS documentation style. The project report text was used later as the basis for the text of a scientific poster. Students were provided writing assistance by the English faculty and by

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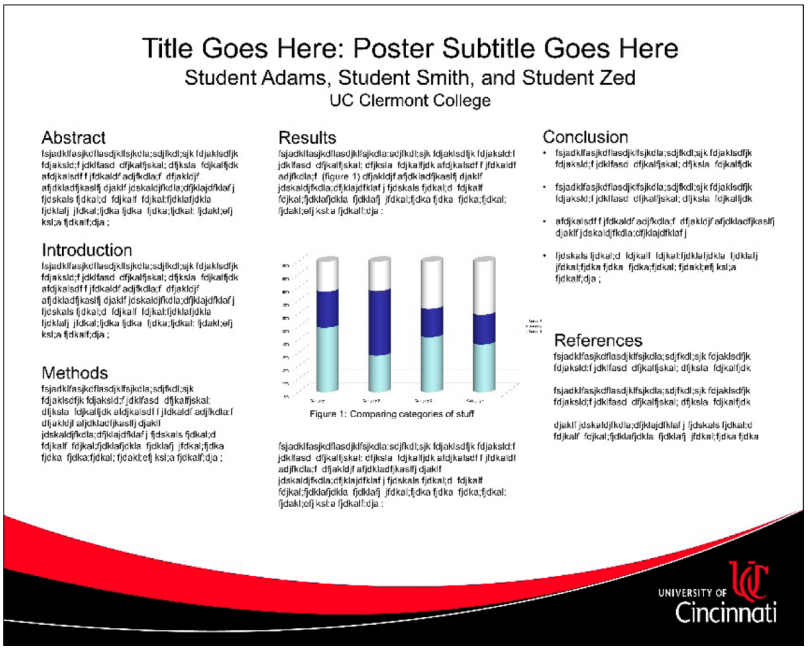

Figure 1. Sample poster layout. Basic poster layout shows use of white space, chunking techniques, and placement of visuals.

the Assistant Director of The Learning Center. The writing assignments were also anonymously reviewed by peers from another section of the organic chemistry lab course (see Supporting Information, "Checklist for Peer Review of Poster Text") and checked for organic chemistry content and chemical accuracy by the course instructor.

Scientific Poster Writing Style, Layout, and Design

While the students in the organic chemistry lab class had experience writing chemistry lab reports, writing a review of the literature, and creating a poster from their general chemistry course, few, if any, had been instructed how to compose text for a scientific poster. Therefore, one of the important tasks was to introduce the basic conventions of scientific and technical writing and relate them to the task at hand: composing the text that described the students' projects for the posters. This was accomplished with a PowerPoint presentation which outlined the required text sections of the posters (Introduction, Methods, Results, and Discussion), and emphasized two important concepts: (1) the importance of focusing the text on essential content in order to fit the limited space of a poster; and (2) the importance of composing accurate, clearly written text. Examples taken from student poster submissions from previous years were used to demonstrate these concepts. Similarly, basic layout and design conventions were presented, including font types and sizes, use of white space and chunking techniques (e.g., margins and paragraphing), and presentation and placement of visuals (Figure 1). Students were instructed to use a sans serif font (e.g., Arial or Tahoma) for their headings, with the title font 100 points or larger, and the first-level heading font in the 70 point range.[14] They were advised to use a serif font in the text of the poster (e.g., Times New Roman or Palatino), sized at least 24 points so that it could be read from a distance of three to five feet.[14] They were also instructed on the placement, labeling, and textual requirements for graphics in terms of size (8.5 by 11 in.), and the need to refer to and briefly explain the graphic in the text of the poster.

Again, anonymous samples taken from previous student posters were used to illustrate layout and design techniques. Instruction on the accurate use of ACS citation style was interwoven throughout the workshop, including correct use of in-text and visual citations, and correct presentation and placement of the reference list. The PowerPoint workshop presentation and all handouts were posted on the college's course management system, giving all students access to all of the materials for the duration of the course.

Digital Poster Technology

After the students compiled these poster elements—text, figures, tables, and images—the digital poster design process began. Though students have access to Adobe Creative Suite and other professional-grade design software on our campus, our team elected for students to use PowerPoint as a canvas for their digital posters. The rationale behind utilizing PowerPoint was 3-fold. First, students were already familiar with using PowerPoint in traditional contexts and required only minimal instruction to use it as a poster platform. Second, PowerPoint is available on every student PC on campus, and the Microsoft Office Suite (which includes PowerPoint) can be purchased at the school's bookstore for a discounted price if students wish to install it on their personal machines. Lastly, the University offers several branded PowerPoint templates, which translate nicely into branded posters with a very professional look.[15]

The Instruction Librarian created an information session for students, using a modified version of a tip sheet from our University's Health Sciences Library[14] (see URL link in reference for complete tip sheet). So that students could focus more on the writing and scientific portions of the project, the collaborative team offered fewer creative design choices, mandating use of University-branded PowerPoint slides, poster size (44 in. by 56 in.), and final file output (PDF). Once students selected templates and resized the slides to poster proportions, the Instruction Librarian guided students through creating textboxes and manipulating images to create the prescribed sections and columnar arrangement. When the slides were complete, students saved their final versions as PDF files for maximum digital fidelity and easy translation to print (if applicable).

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Learning Center Support

The Assistant Director of The Learning Center was present throughout the poster lab session, helping students as they began applying what they learned, but also reinforcing the importance of the role of The Learning Center in the project. She explained that representatives from each poster project (most of the projects were group projects) were required to meet with a writing specialist in The Learning Center before submitting the text of their writing assignments and poster projects to their instructors. For the literature review and poster text, this meant bringing a complete draft of their work to The Learning Center and then, together with the writing specialist, reading the information for context, continuity, grammar, and documentation issues that might interfere with reader comprehension. Utilizing a writing specialist instead of a chemistry professor at this stage of the composing process enabled the students to clarify chemistry-related jargon and syntax issues. Poster feedback followed a similar review, allowing the writing specialist to comment on the visual and technical aspects of poster design: both the writing and the graphic presentation of the information. The Learning Center's role in this process proved useful in helping chemistry students more effectively communicate both the design and content of their work to an audience outside of the chemistry field.

■ STUDENT POSTER COMPETITION

The project culminated with both organic chemistry and general chemistry students presenting their projects with their posters at an end-of-semester competition. The students convened in a large, stadium-type classroom, with easels provided for those general chemistry students who had opted to produce paper posters and large flat screens connected to computers to display the digital posters. The IT department of the college provided essential support both before and during the digital presentations, adding another layer of collaboration. Students with digital posters were required to submit their posters electronically to their professors so that the posters could be uploaded on the classroom computers in advance, streamlining the presentation process on the day of the event.

Students with digital posters were called to one of two screens, each with a different poster, and presented their work to two different sets of judges. The students stood by their posters for 15 min. The judges, composed of chemistry staff and science faculty other than the grading professor, gave the students the opportunity to talk about their projects and to answer the judges' questions. The judges worked from a scoring sheet that guaranteed consistency and included a category on poster design (see Supporting Information, "Sample Scoring Sheet"). Winners were selected based on highest score. Scores were used solely for ranking posters in the competition and did not factor into the students' grades for the course. (It should also be noted here that the students were not trained in the oral presentation of their posters. The authors plan to add presentation skills to future workshops.)

While waiting for their turn to present to the judges, students distributed small printed versions of their posters to facilitate discussions with the audience, which included other chemistry and biology students, staff, and UCCC faculty. At this time, students had the opportunity to speak informally about their projects and exchange their ideas with others.

The 2014 poster competition included organic chemistry topics such as "Extraction of Limonene by Steam Distillation", "The Analysis of Coloring Agents in Lipsticks", and "Comparing Coconut Palm Sugar to Brown Sugar and Sucrose". Prizes were awarded to the top three winners in both courses (see Supporting Information, "Poster Competition Prizes"). In addition, the competition was enhanced by the support of members of the Chemistry Club, who provided drinks and snacks, lending an air of celebration to the occasion.

■ CONCLUSIONS

Faculty members from chemistry and English joined with an Instruction Librarian and the Assistant Director of the college's Learning Center to create digital writing opportunities for UCCC organic chemistry students. It was evident that students had moved from simply designed posters to more professional looking digital ones as they progressed in their chemistry education at UCCC. The interdisciplinary support improved student posters by assisting them with planning, designing, and creating their posters. In addition, it helped students develop their writing and critical thinking skills, exposed them to the writing style of chemists, and gave them experience with technology in an educational setting conducive to fostering their future success in science.

All of the students expressed satisfaction with the poster competition. Especially enthusiastic were the students who won ribbons and prizes. Both chemistry faculty and students benefited from the students' creation of inexpensive digital posters that saved the students hundreds of dollars in printing costs. In addition, electronic posters are easily collected, shared with faculty and students, stored, and transported.

■ ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available on the ACS Publications website at DOI: 10.1021/acs.jchemed.5b00020.

Tasks for students, past poster topics, peer review checklist, and scoring sheet (PDF, DOCX)

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Notes

The authors declare no competing financial interest.

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