PROJECT REPORT

Interdisciplinary Course Collaborations in Community-Based Learning

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Abstract

Teaching undergraduate science courses through the lens of local community issues has the potential to help students connect more strongly to the sciences and to the communities near the university. In considering the construction of such courses, it is clear that even community issues that have strong science cores—water quality, viral and bacterial disease vectors—are inherently multidisciplinary, with scientific and technological considerations in balance with the economic and social factors that inform public policy. The fundamental challenge is, then, to develop ways to teach complex and multidisciplinary community issues within the context of science courses. Here, we report on a pilot study of a course structure designed to address this challenge. Cohorts of students from different disciplines were paired, and a strategy was developed that required the students to work together to teach one another about a community issue from their discipline's perspective. This model was applied to cohorts of chemistry and interior architecture students studying local brownfield redevelopment efforts.

Introduction

Context of the Project

Application-based service learning (ABSL, www.ABSLnews.net) is a recently developed pedagogy that infuses laboratory science courses with five of the high-impact educational strategies endorsed by the Association of American Colleges and Universities: learning communities, writing intensive courses, collaborative assignments and projects, undergraduate research, and service-learning (Kuh 2008). A unique aspect of ABSL is that the undergraduate research and service-learning activities are both linked to a shared local community issue (Wei and Woodin 2011). Thus, a strength of this teaching method is that it shows students the application of science to community problems. As a result, it provides the opportunity to teach community awareness and engagement in the science disciplines, where such perspectives are not traditionally emphasized (Dostilio et al. 2013). The National Science Foundation (NSF) funded initial development of ABSL (CCLI Grant #0717685) and subsequent expansion and refinement of the pedagogy (TUES Phase II Grant #1226175). As part of the effort to expand ABSL, a team consisting of a chemistry professor at the NYC College of Technology of the City University of New York (City Tech, CUNY) and an interior architecture professor at Chatham University (Pittsburgh, PA) began creation of ABSL versions of chemistry laboratory courses and partnered interior architecture courses, both focused on the issue of brownfield redevelopment.

A brownfield is "a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant" (United States Environmental Protection Agency 2015). As brownfield redevelopment is at the nexus of environmental chemistry, architecture, economics, politics, and social justice, development of an ABSL chemistry course focused on brownfield redevelopment should include perspectives from non-science disciplines. This made the choice of partnering with the Green and Sustainable Design course from the Interior Architecture program at Chatham a logical one. On the other hand, the Chatham Interior Architecture program's interest in teaching students about brownfields derives from its long-standing focus on sustainability. This program has won awards from the American Society of Interior Designers for its work in sustainability education, and Chatham has made sustainability a university-wide educational focus.

While the utility of interdisciplinary collaboration in ABSL course development is clear, a critical question must be answered: What strategies can be used to foster meaningful interdisciplinary collaborations when science and non-science courses partner to study a community issue?

Results and Discussion

Interdisciplinary Collaborations through a Shared Slide Presentation Project

At the beginning of the spring 2015 semester, a General Chemistry II laboratory course and a Green and Sustainable Design course were chosen as paired cohorts to develop and enact strategies for interdisciplinary collaboration in community-based teaching. Wherever possible, the core concepts of both courses would be taught through the lens of understanding a shared brownfield redevelopment site, the Gowanus neighborhood in Brooklyn. Chemistry students would perform in-class water quality laboratory experiments and out-of-class community service relating to the canal. Design students would use the canal as a case study. For the chemistry students, an in-class lecture and discussion about brownfields would provide an initial introduction to the issue. Then the class would take a walking tour of the canal, seeing brownfield development in action as sites previously occupied by chemical processing and heavy industry are transformed into residential neighborhoods and retail spaces. For the architecture students, brownfield issues would be introduced through an overview of environmentalism, then through specific investigations into environmental history. Students would also study seminal texts related to sustainability and building, tour local "green" buildings, and view presentations on green building certification programs.

To provide a chemistry perspective to the design students, and a design perspective to the chemistry students, the paired cohorts would co-produce a narrated slide presentation about sustainable development in the Gowanus neighborhood. For the chemistry students, this co-produced slide presentation relates to the learning outcome that students be able to communicate about science in written, oral, and visual forms to a range of different audiences. For the interior architecture students, the slide presentation connects to the learning outcome that students demonstrate an understanding of the concepts, principles, and theories of sustainability as they pertain to the built environment and its inhabitants. The presentation gives students an opportunity to construct a product that illustrates this gained knowledge.

Because the cohorts were located in different cities, met at different times, and followed semester schedules that included only seven overlapping weeks, the students' co-production was structured so that it could be achieved through virtual interactions. Figure 1 shows how the Spring 2015 cycle of slide presentation production, feedback, and response formed the basis of a second round of slide presentation production, feedback, and response to be performed by the next semester's cohorts of General Chemistry II and Green and Sustainable Design (Fall 2015).

Thus, through time, paired cohorts of different disciplines worked together to create increasingly refined versions of the slide presentation. Even though this model of presentation production, peer response, and feedback was developed for courses running in the same semester, the cyclical nature of the interactions means that even cohorts operating during different semesters could engage in such a collaboration model. The current presentation draft is uploaded to the ABSL website (Trun 2015).

We note that the structure of using feedback from one cohort's presentation to inform the next cohort's work was critical to pairing courses at Chatham and NYC College of Technology because the universities have such different semester schedules. Chatham begins the spring semester in early January and ends by the third week in April while NYC College of Technology begins the spring semester at the end of January, recesses for two weeks in April, and then ends the spring semester in late May. However, for universities with more compatible schedules, it would be useful to test a different interaction model, one that would ensure that students receive and act upon feedback from their partner discipline before the end of the course.

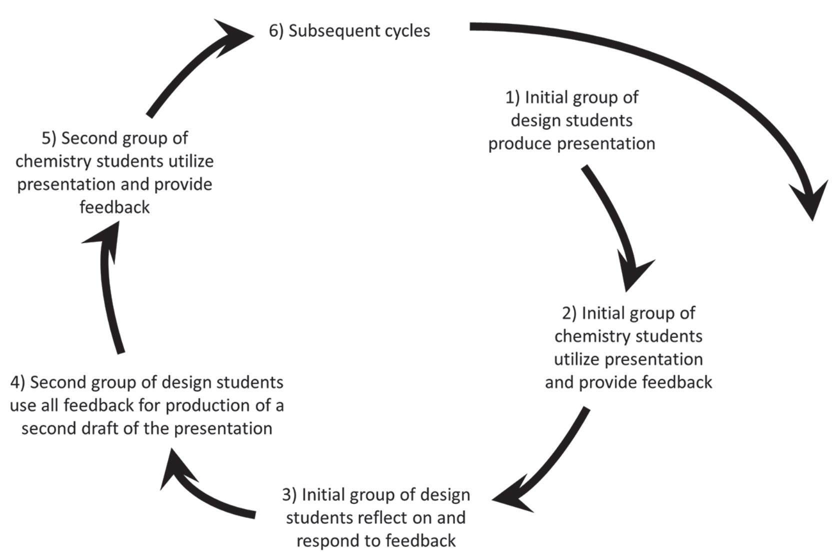

FIGURE 1. Cycle of presentation preparation, feedback, and response, as enacted by paired chemistry and design cohorts.

Structuring the First Round of Student Slide Presentation Production

For the first round of presentation production in Spring 2015, the instructor of Green and Sustainable Design introduced students to the issue of the Gowanus neighborhood redevelopment and discussed the nature of the peer-to-peer collaboration with the chemistry students. The instructor used principles of problem-based learning (PBL) to facilitate the design students' structuring of their first presentation draft (Duch et al. 2001). In accord with PBL, the instructor stated the problem (creating an informational slide presentation), provided access to relevant information, and acted as a facilitator for the student-driven conversations. Using categories of goals, ideas, information, and learning needs, students identified the content and organized the structure of the presentation. Using the structure they devised, students determined their own learning outcomes, established individual and team responsibilities, and defined areas where they needed to expand their knowledge. The students spent a total of two weeks planning and creating the presentation and providing feedback to one another. For the design students, this strategy mimics the project management skills they will use in their professional careers.

Details of Student Interactions to Refine Presentation

The Spring 2015 design students produced the first draft of the slide presentation approximately one week before the chemistry students were to begin water sample collection for their in-class research. The chemistry students watched the slide presentation at home, prior to the sample collection field trip. As an ungraded assignment, the chemistry students provided written feedback about the slide presentation to the design students. In the feedback, chemistry students answered the following prompts:

- Describe three things you learned from this video.
- What subject(s) presented in the video was (were) most interesting to you?

- If you were making a video about Gowanus Canal development, what aspect(s) do you think needs (need) additional investigation?
- Do you have any additional comments for the student videographers at Chatham University?

The chemistry students were surprisingly engaged in this feedback exercise. Despite that fact that watching the presentation and providing feedback were ungraded activities, eighteen out of twenty-one students provided feedback. All students who provided feedback gave detailed responses, most in the range of 120 to 205 words.

In their feedback, many of the chemistry students reported learning about or becoming interested in the land use concept of zoning, the design concepts of reverse engineering, and Leadership in Energy and Environmental Design (LEED) building practices. Students further reported learning about and becoming interested in specific buildings that are part of the Gowanus neighborhood redevelopment. Finally, students reported becoming particularly interested in the technologies of remediation and sustainable engineering such as combined heat and power systems. While all of the above-described concepts, from brownfields to zoning to environmental remediation, would require entire courses to cover in detail, the slide presentation provided an initial exposure for the chemistry students.

In addition to reporting that they had gained exposure to ideas of neighborhood development and sustainable design, the chemistry students commented on aspects of development that they had not previously understood. For example, students commented that they had learned about the level of detail that goes into planning a building. Another student commented that while he or she was familiar with the concept of reverse engineering in the field of computer science, it was a surprise to find that the same concept could be applicable to environmental issues.

After the chemistry students completed their feedback forms, names were redacted, and the forms were sent to the design students. By the time chemistry students had completed the feedback forms, the design students' semester had ended, so the design students received the feedback forms via email. In the email, the design students were asked to review the forms and provide written responses in consideration of the chemistry students' feedback and in consideration of the experience of making a slide presentation for a partner class. The design students were asked to respond to six prompts, including

- What responses were most similar to what you anticipated?
- What responses did you find most unexpected?

Despite receiving the chemistry students' feedback after the completion of the course, six out of the nine design students provided written feedback. Responses to the above prompts provided insight into the way design students view the learning style and knowledge background of science students. For example, some of the Green and Sustainable Design students said they expected that the science students would report being interested in the factual aspects of design (LEED, brownfields, and sustainable design technologies), but were surprised that chemistry students requested more information about the types and origins of pollution in the Gowanus neighborhood. In essence, the design students had expected that chemistry students would already have a full chemical understanding of the canal, even though such an understanding would require quite extensive and advanced laboratory work. In addition, the design students expressed surprise that the chemistry students commented on the design aspects of the presentation in particular, suggesting more visuals and less text in future versions of the presentation. Providing design students with insights into scientists' knowledge and communication styles was an unexpected outcome of the peer-to-peer collaboration activity, and it may be helpful as designers and environmental scientists frequently work together during a building project.

Conclusions and Path Forward

Incorporation of peer-to-peer interdisciplinary activities into an ABSL course provided a means to expose students to a complex community issue from a different perspective. A serial collaboration between separate cohorts of chemistry and design students was developed, but other disciplinary pairings are also possible, as are other work structures like simultaneous virtual or in-person collaboration or mixed discipline teams. Students' level of engagement in the peer-to-peer activities, as evidenced by their willingness to participate in ungraded exercises, was high. It is hypothesized that two factors contribute to the observed student engagement: the increased ownership students feel when participating in projects they have structured through problem-based learning; and the greater authenticity of generating work to be used by peers as opposed to work that is simply viewed by an instructor. These hypotheses will be investigated through continued use of interdisciplinary peer-to-peer learning projects in future ABSL courses.

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