CASE STUDY PEDAGOGY

Teaching Environmental Policy by Having Students Write Case Studies

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ABSTRACT Instructors, particularly those teaching public policy, often wish to incorporate the development of practical skills into their course assessments. These can range from writing briefs to novel research papers. Instructors also often desire to increase the rigor and utility of these assignments. More often than not, a skill may be developed, but the product is discarded at the end of the course. This article describes the incorporation of writing case studies for *Case Studies in the Environment* into an upper-level undergraduate course that also included graduate students. Students were required to meet the submission criteria for the journal and were encouraged, but not required, to submit their cases for publication after the course ended. While the course was small, and thus the projects manageable, the following discusses how a team approach could be employed in other classes and how students rose to the occasion in creating potentially publishable work.

INTRODUCTION

Developing meaningful class projects is a common challenge for high school and college instructors. Critical thinking and writing skills are common to many, if not all, fields of study, but they are more often than not assessed by term papers that tend to be discarded at the conclusion of a course. Teachers have sought other assessment methods that help students to develop a portfolio of evidence of the skills that they obtained in the course of their studies [1]. Examples of such exercises include, but are not limited to, collaborating with WikiEdu to have students edit and enhance Wikipedia entries [2–4], engaging in service learning projects [5], experiential learning [6, 7], simulations [8], and more. Each of these exercises offers students more than a completed paper at the end of the semester, which can be valuable for future job and graduate school applications [1]. Furthermore, as Eva Whitesman found in her evaluation of community- and research-driven experiential learning, such assignments give students "a greater sense of ownership of the final project" [6].

This case pedagogy article offers another option for increasing the rigor and students' ownership of assignments, while also giving them something that they can use in future job and graduate school applications: writing cases for *Case Studies in the Environment*. While not a completely novel concept [9, 10], this article specifically addresses how case writing for this particular journal can fit into environmental politics and policy coursework. First, the use of this approach in an upper-level undergraduate course in environmental policy is discussed. Second, the advantages and drawbacks of the approach are evaluated. Third, specific lessons learned are presented that can be helpful for other faculty who wish to employ this approach.

CASE EXAMINATION

PUBPL 481 *Seminar in Environmental Policy* is a capstone environmental policy course offered to both undergraduates and graduate students at Penn State Harrisburg. In developing this course for its first offering in spring 2018, the instructor was faced with the dilemma that many faculty experience: assessment. As with many capstone experiences in the social sciences, this type of course typically includes a final project of some significance that demonstrates key skills like research, writing, and public speaking [11]. Ideally, given that the capstone comes at the end of students' college careers, the course should prepare them for the profession that they seek to enter [12]. Capstone undergraduate courses are also well positioned to include graduate students from related, and even

dissimilar, programs. In this case, PUBPL 481 drew three environmental engineering students who sought out the course because their programs did not address the legal and political aspects of the environment. The mingling of undergraduate and graduate students offered an opportunity for undergraduates to learn about graduate school and for graduate students to provide leadership in the classroom.

Serendipitously, *Case Studies in the Environment* launched during course preparation. The journal was thus able to keep up its promise of providing useful and up-to-date case studies for use in the classroom, as students discussed Killeen and Levinson's case study on automobile fuel economy and emissions standards during the module on air pollution [13]. However, the journal also provided an opportunity to offer students an engaging and rigorous final project. Namely, they were required to work in teams to write their own case studies. While submission to the journal was not required, it was offered as a possibility for well-written case studies. The following will discuss how the project was scaffolded and the instructor's role throughout the project.

Scaffolding the Case Studies and Instructor's Role

The course had a total enrollment of nine students, including three Masters of Science students in environmental engineering. Given the small size of the class, students were assigned to three project teams. Each team included one graduate student. The intent was for the graduate students to offer leadership and experience to their teams. They were not explicitly assigned as team leaders, but in each case their leadership emerged organically due to their experience. One class session in the course was spent discussing case studies, their purposes, and the requirements for the project (see included slides).

Table 1 presents a summary of the five scaffolded assignments required for the case study. Each team was first tasked with developing a topic, as well as a week-to-week production schedule that they would follow. This was meant to help them think about how to manage their time and tasks so that they could complete each milestone successfully. Given the public land-grant mission of the institution, students were encouraged, though not required, to choose cases with a connection to Pennsylvania. The instructor provided a varying amount of input and advice as the groups prepared their topics. Two teams asked for input several times before submitting their topic, whereas one team did not ask for any initial input.

Regardless of this early guidance, all teams were provided with written feedback after submitting their proposal.

Once their topic was approved, the teams were expected to begin researching and writing in earnest. A full rough draft, following the journal's guidelines for authors, was due halfway through the course (week 8). Students were encouraged to make these drafts as polished as possible so that the feedback they received would help to elevate the final submission. That said, the cases varied in their degrees of completion and polish. At this stage, the instructor provided written feedback on the full draft and each student was assigned one of the other group cases for conducting their own peer review. This means that each team received two peer reviews of their work, plus a review from the instructor.

At week 15, teams were required to present their case to the class. This exercise had several purposes. First, it was meant to build skills in presenting the case. Second, it was meant to build skills in fielding questions about one's work, which is valuable in many professions. Third, it allowed the entire class to learn about the other cases. Up to this point, students only knew the details of their own case and the one that they had reviewed. Thus, each case served an educational role within the class. All three presented specific content that was not otherwise covered in the course. The three topics included pharmaceuticals in drinking water, radionuclides and shale drilling in Pennsylvania [14], and the invasive snakehead fish [15].

After receiving verbal feedback from their peers and written feedback from the instructor, each team submitted a polished final version of their case study manuscript during finals week. The manuscript was to follow explicitly the case template and author instructions of *Case Studies in the Environment*. Some teams followed the template, while others did not. That said, grading was primarily based on content and the educational potential of the case, not format. Students received an individual grade that was based on their group grade for all of the scaffolded assignments, weighted using evaluations of their individual contributions. Two such evaluations were used. First, the instructors' observations of student participation in projects throughout the semester. Second, through a reflection survey (see Supplementary Materials). Students' responses were private between each student and the instructor. This survey was meant to gather information about each team member's contribution to their project and instill some degree of self-reflection.

TABLE 1. Scaffolding of Case Study Project

Assignment	Due	Description
Topic selection	Week 3	Submit a paragraph description of the proposed topic and a week-to-week production schedule for completing the project
Rough draft	Week 8	Submit a full draft of the case, following the guidelines for authors
Peer review	Week 10	Write a peer review for another group's case
Group presentation	Week 15	Complete a 15–20 min group presentation and discussion of their case
Final case study	Week 17	Submit a polished final copy of the case manuscript

Course Learning Objectives

This project supported all course learning objectives. Students in the course were to gain a working vocabulary of complex environmental policies, including terminology from the physical sciences, learn to critically examine how and why some policies emerge while others fail, and develop skills in writing, oral presentations, and teamwork. The project most directly addressed the final goal of communication skills development, but the cases also helped students to understand the complexity of environmental problems and politics. For example, the snakehead paper focused on how competing interests shape habitats. The Marcellus Shale paper was heavily steeped in geologic and hydrologic material. Finally, the prescription drug paper focused on drawing connections between the problem of pharmaceuticals in water supplies and actionable policy options. This helped students move beyond the macro-level understanding of environmental politics and policy that is the focus of many textbooks, including the one used in this course.

Grading

The team assignment, with all of its stages, represented 30% of students' final grades and the individual peer review accounted for 15%. The remaining 55% comprised of a series of short essay assignments and class participation (see syllabus in supplemental materials). In this iteration, each piece of the team project counted equally toward the team grade. Meaning, the topic and milestones, first rough draft, second rough draft, group presentation, and final product were each 100 points and their grades were averaged to yield a final group grade. The final self-reflection and survey provided the opportunity to increase or decrease an individual student's project grade based on their contributions. When offering this course again, I would make two adjustments. First, I would weight each of the scaffold assignments differently with the final product receiving the most weight [10]. Second, I would include an explicit individual grade that would more directly and transparently penalize students who do not participate [16, 17]. This would be especially useful in larger courses where the instructor may not be aware of each student's individual contributions.

Submission for Publication

Once grades were completed, the teams were given the option of preparing their cases for submission to the journal. Two of the three teams were interested and the instructor's role increased for the next phase of the project. While the instructor had been engaged in early conceptualization and providing feedback throughout the semester, they refrained from being overly involved so that students were completing their own assignments. Thus, the time commitment during the semester is no different than what can be expected from similar teamwork projects. An instructor plays a vital role, however, in crafting the manuscript for publication after grades are submitted. In this way, faculty bring their experience with the submission and review process to bear on the project. This meant substantial editing and formatting on the part of the instructor and students. The instructor spent roughly a week helping students revise the manuscript and another week (total time) crafting a response memo and making revisions for resubmission. This was on par with other faculty experiences with student case publication [9]. One manuscript was less time intensive, as the students were more engaged in making revisions, whereas the other was more time intensive. While difficult to predict, this is a consideration for the instructor's research production. In the end, both manuscripts were submitted for publication, one is published and the other is being reviewed following revision [14, 15].

The review process extended the educational experience for the students who chose to move forward. Both manuscripts required major revisions and the students, particularly graduate student team members, played an active role in responding to reviewers' comments. The instructor took the lead in crafting the reviewer response memo, but did so in a way that students could review its progress and learn that aspect of manuscript publication. This will be discussed further in the lessons learned section, but the review of the manuscripts by experts in the students' chosen topics was incredibly valuable, as the instructor's own expertise in these areas was limited. Given the flexibility in choosing their own topics, students tended to select things that were outside of the instructor's primary expertise. Thus, while the instructor could provide feedback on the style, flow, and educational possibilities of a case, expert reviewers needed to comment on much of the content. In both case studies, important details were overlooked in the initial submissions that were addressed by reviewers. That said, the process served to extend the educational experience of students in a valuable way.

INCREASING ASSIGNMENT RIGOR

Before discussing lessons for future implementation by educators, it is necessary to take stock of how the case study assignment affected the rigor of the final assignments. Other research has found modest motivational effects of publication potential [9]. Based on the instructor's observations over the course, there is anecdotal evidence that the assignment motivated some students to engage in a stronger manner with the material. There was a distinct difference, for example, in the engagement and ultimate products between the two groups that submitted their case studies and the one that did not. While the group that did not submit had a compelling topic, their work did not come together with a strong case-based focus. They also did not follow the format of the journal when drafting. It was evident even before the end of the semester that they would likely not follow through with publication. The other two groups, however, were more responsive to feedback from the instructor and engaged in multiple additional discussions to help refine their topic. They also chose topics that were particularly engaging for the members.

Students were asked for some feedback regarding the effect the case writing process had on their learning experience:

The case study was a bit overwhelming at first, as I never before had to do one. However, once researching, studying and gathering the knowledge, it became an opportunity to put into practice raising an environmental issue for public awareness. It felt like a real life project that meant more than a grade; but also public awareness for environmental change.

The case study helped me put together my thoughts on an engineering practice (wastewater treatment in the natural gas industry) where new challenges are emerging from both a science and public policy standpoint. Consolidating a case study allowed me to more clearly see what are the ideas that bridge the gap between science, engineering, and policy and how those disciplines are related. I have gained a clearer understanding of what occurs in the editing process to publish in a journal. Being aware of a higher level of writing directly correlates to my capacity and efficiency with my current engineering job.

In both cases, students noted the practical skills they developed in writing the cases and following through with journal submission.

LESSONS LEARNED FOR FUTURE APPLICATION

All told, this experience in a capstone course was fairly successful. The cases were engaging and helped with student ownership of their work. That said, there were several aspects of the process that should be addressed if instructors wish to reproduce this project in their own courses. These issues revolve around the development of case slides, use of presentation time, choice of topics, and scalability to larger courses.

Case Slides

One of the assets of *Case Studies in the Environment* is the development and publication of case-related slides. In fact, slide cases can be published separately from article cases. Slides and additional teaching materials can also be published as supplements to article cases. In this implementation, students were not required to follow the journals' slide design guidelines when preparing their group presentation. Thus, their slides tended to suffer from common problems with the use of technology like PowerPoint: too much text on pages, reading of slides, and more [18, 19]. Published slide cases offer quality examples of using slides to teach environmental cases [20], but they were not well

incorporated into this offering of the course. Requiring students to produce slides that can be included in the submitted article cases would increase the rigor of the class presentations. Of course, spending additional instructional time on designing effective slides would also help. Furthermore, instructors will need to commit additional time providing formative feedback for the slides and preparing them for submission to the journal as supplementary material to an article case.

Using Presentation Time Effectively
In this iteration of the course, students used a typical presentation format. They delivered their case content and the audience was then able to ask questions and make suggestions for improvement. What was missing was any use of each team's discussion questions, which is an important component of article cases. Students had to create these questions, but they were never discussed. In hindsight, this was a missed opportunity to increase the educational aspect of the team projects. Other teams were able to learn about each of their peers' projects, but they did not engage with the material in the way that they would when a case is discussed in a class. Not using the questions was also a missed opportunity for additional feedback. Future implementations should consider structuring the group presentations as if students are teaching their case, including leading a discussion of the case questions. Granted, this will increase the time that teams need to spend presenting (more on this below).

Topic Selection
There are trade-offs to allowing students free reign in choosing their case topics. One substantial strength is that it increases buy- in and motivation to work on the project [21]. That said, previous research suggests that having a list of suggestions can be helpful to students who are new to a subject area [9]. Students in this course were at times downright excited about their topics, particularly individuals who played a larger role in shaping their team's project. Nonetheless, this created challenges when submitting the cases for peer review. Because the topics fell largely outside of the instructor's expertise, students were relied upon to become experts. As any expert is well aware, it takes time and study to know a topic deeply enough to write about it at a level where it is publishable. Students were able to do quite impressive work by the end of the semester, but they still missed important details that the

instructor could not always point out. Thus, the gracious feedback of reviewers was relied upon to fill in those gaps. On one hand, this provided an additional learning experience for students, but on the other it increased the burden on reviewers. Fortunately, *Case Studies in the Environment* appears to be fostering a collegial and supportive reviewing culture, but this burden remains a problem. One alternative is for the instructor to offer students choices of topics that are (1) within their expertise and (2) they deem useful for a case study approach. This allows the instructor to provide deeper feedback on the topic, but also limits the range of topics and might affect student motivation. Such an approach creates a potential trade-off in the ability of the instructor to provide feedback and the student's degree of project ownership.

Scaling Up
This implementation benefited from the fact that the capstone course only had nine registered students. A small course allowed for a manageable number of small groups. Such a project may be more challenging to incorporate into a larger course, especially if many students wish to follow through with submission for publication. In addition to the expected workload of providing feedback on scaffolded assignments, several days were spent helping students to prepare their manuscripts for submission and responding to reviewer feedback. There is career value to engaging in this work, but it also takes time from other faculty projects. Thus, there is an opportunity cost for the faculty member in supporting student publication.

There are several potential options for addressing this issue. The first solution to this challenge for larger courses is for instructors to not encourage, or only selectively encourage in private, submission to the journal. This has some pedagogical disadvantage, even disregarding the additional value of mentoring students through the peer review process. Namely, it reverts the project back to one that is limited to a single semester and discarded at the end. Thus, it is possible that the increased rigor and engagement is lost. A second solution could be to prepare an in-house publication or repository of student cases that could be used in future iterations of the course and also referenced when students are submitting applications for employment or graduate school [22]. In this case, perhaps the instructor, or even the class through a vote, could choose the best case to move forward to journal submission. Regardless, students who did not publish in the journal are still self-published.

There is a third possible solution that is not advisable. That is allowing students to submit the articles to the journal on their own without any faculty support. Students who have not engaged in peer review previously should not be encouraged to go through the process alone. Their papers at the end of the semester are not ready for submission, needing both grammatical and factual revisions. Submitting the papers directly is likely to be discouraging for the students and places a high burden on reviewers that must respond to weak manuscripts.

CONCLUSION

Developing a capstone project that not only builds students' skills, but also their professional portfolios can be challenging. To some extent, it is easier to use once-and-done assignments that do not have a life outside of the course. The advent of *Case Studies in the Environment* offers an additional option for developing a final project that contributes to professional portfolios. This article presents one such experience, as well as lessons applicable to future implementations. While the evidence herein is largely anecdotal, and the lack of a systematic survey evaluation is a limitation, the intent of this article is to encourage instructors to consider case study projects in their courses. Instructors should think about not only the pedagogical components of the work they assign, but also the potential value beyond their classroom. Helping students create and potentially publish quality case studies in environmental science, law, or policy can serve the career interests and incentives of both faculty and their students. Furthermore, the potential for submission and dissemination beyond the instructor's inbox at the end of the semester elevates the stakes of the assignment and can thus motivate students to produce quality work.

AUTHOR CONTRIBUTIONS

This is a singly authored piece, meaning the author contributed to all aspects of conceptualization, writing, and revising.

SUPPLEMENTARY MATERIALS

The Case Study Approach Slides. Pptx
Self Reflection Survey. Docx

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