Acting Locally

Concepts and Models for Service-Learning in Environmental Studies

Harold Ward, volume editor
Edward Zlotkowski, series editor
Memorial Note

One of the intended contributions to this volume does not appear due to the untimely death of its prospective author, on October 6, 1996, at age 39.

Julie Roque received her undergraduate degree in chemistry at the University of California, San Diego. She completed a master’s in chemistry (with an environmental specialty) and a special doctorate in environmental risk policy, both from Brown University. She was a postdoctoral fellow at the University of North Carolina, and then joined the faculty of the School of Public Policy and Social Research at the University of California, Los Angeles as an assistant professor of urban planning. At UCLA she was a co-founder of the UCLA Pollution Prevention Education and Research Center, and served as associate director for research for the Lewis Center for Regional Policy Studies.

Julie took a leave of absence to work as a senior policy analyst in the Office of Science and Technology Policy in the White House during 1994-95. At a ceremony to plant a tree in Julie’s memory in the White House garden, John Gibbons, the assistant to the president for science and technology, said:

*Julie was an influential force in evaluating and devising policies related to regulatory reform, the impacts of toxic substances on human health and the environment, and risk assessment and management. She was an established leader in the field of environmental justice, and worked with experts in other federal departments and agencies to guide the Administration’s policies in this important area of environmental policy.*

Julie Roque was a strong environmental advocate, and in her own work and in her teaching was a vigorous proponent of service-learning. This volume is dedicated to her memory.
The Challenges of Integrating Service-Learning in the Biology:Environmental Science Curriculum at Colby College

by David H. Firmage and F. Russell Cole

Over a number of years, we have developed a course that provides a capstone research experience for senior majors in our Biology:Environmental Science program and does so through the mechanism of service-learning. A service-learning course should both meet community needs and give the student an understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility (Bringle and Hatcher 1996). We believe our course fits this description very nicely.

The purpose of this chapter is to describe the nature of our Problems in Environmental Science course, to discuss the problems and pitfalls we faced in its evolution as a service-learning experience, and to present some of the solutions we have found to those problems and pitfalls. Additionally, we will describe ways in which service-learning concepts have helped us to accomplish our course goals.

Biology:Environmental Science is an interdisciplinary program that helps students acquire a strong background in biology with an emphasis on ecology and environmental science. The capstone course in this curriculum is the practicum Problems in Environmental Science. This required course was created when we initiated our biology/environmental science major in the fall of 1979. Our experience with service-learning has been gained through the evolution of this course rather than through the development of a new course specifically designed to provide a service-learning opportunity for our majors. We incorporated service-learning into the course as a technique to help us accomplish our goals and to add for our students relevancy to the research experience. Initially, the practicum consisted simply of a collection of independent research projects with no common theme other than being environmentally related. As the number of majors grew and our ability to supervise myriad and varied projects was taxed, we changed from that approach to one utilizing a group project with a common theme.

In 1980, the Problems in Environmental Science class investigated causes for the eutrophication of a nearby lake. The student report that resulted from this study stirred the interest of lakeshore owners and provided impetus among landowners to organize a lake association. Several years after our first lake project, one of us (Firmage) worked with an environmental consulting firm as part of a sabbatical leave. This experience and the back-
ground this provided led us to the idea that we could treat the Problems class as if it were itself a consulting firm. We believed that this approach would enable us to provide the course with more structure and better organization, but still encourage students to serve as the driving force behind project design, implementation, and write-up. We also sought to simulate a real-world context by “contracting” with the consulting firm to study the environmental problem we identified.

The studies conducted by students in this class quickly caught the attention of local community groups. Because the professional-quality reports the students generated included considerable useful data, we soon began to receive requests for our class to work on specific environmental projects. It was at this point that our Problems class really entered the realm of service-learning. As we learned more about the benefits and techniques of service-learning through discussions with colleagues at other institutions and through literature reviews, we discovered that our course met many of the criteria that others have set for service-learning programs. We believe that this outcome is testimony to the success of the service-learning process, and it demonstrates that the academic goals of a course can blend very effectively with those of service-learning.

Course Goals

The goals for Problems in Environmental Science evolved along with the course as we gained a better understanding of what could be accomplished by the students within the framework of a semester, as we developed more efficient and accurate methodologies, and as we discovered new possibilities in interacting with state and local agencies and offices. The current goals for this course include these:

- To provide a research experience for students. We wanted students to be very involved in the planning process and to work independently on some component of the project.
- To apply knowledge learned in other courses to the study of a local environmental issue. We expect students to apply their general background in ecology, experimental design, and data analysis to investigate the environmental issue assigned as the class project.
- To become acquainted with a specific methodology related to the assigned project and typically used in the field of environmental science. This course provides a means of expanding student exposure to field and laboratory techniques, as well as encouraging them to draw on knowledge gained in previous courses.
- To enhance oral presentation skills. We wanted to provide communication opportunities that stretch students beyond their typical coursework.
- To become better acquainted with literature-searching strategies and typical sources of environmental data. Beyond the standard bibliographic sources, students should be able to locate relevant technical reports and government documents published by federal, state, and local agencies/offices.

- To enhance writing skills. Students prepare and edit text, tables, and figures for the class report.
- To understand some of the state and local regulations related to specific environmental issues and how these regulations are applied. Students have little exposure to specific regulations and their implementation prior to this class.
- To learn about the role and capabilities of state and local agencies and offices. Students consult and work with people in offices and agencies such as the Planning Board, Code Enforcement Office, the Council of Governments, and the Department of Environmental Protection.
- To gain perspectives on how consulting firms and government agencies function. Students are provided with at least a glimpse of what such work is like, as they consider career opportunities. Students also learn the advantages and disadvantages of team research and the importance of group dynamics to the success or failure of a project.
- To understand better the interactions of public and private landowners with groups attempting to address environmental issues. This course is designed to enable students to interact with the public and observe interactions in public and private meetings to help them gain a broader understanding of the diversity of opinions on a particular issue.

Choice of Projects and Community Involvement

Several years ago, community leaders and local residents began to make requests of us to undertake projects of local interest. In addition to identifying possible projects for the class, the requests provided several pedagogical advantages. First, they heightened student interest in the projects by creating the realization that student work could have real application and effect in the local community. Many student learning experiences prior to this class taught concepts and methodologies without involving original work. By tackling a project requested by citizens in the local area, students know there will be people outside the college who will be eager to hear and read their report.

Over time, the Department of Environmental Protection (DEP) has developed confidence in our data-collection and data-analysis procedures, and it adds data our students obtain to the DEP databases. The acceptance by DEP has developed through our strict adherence to methodologies delineated by the state and the U.S. Environmental Protection Agency and by duplicate testing of our water quality samples in DEP laboratories. The DEP has suggested some projects for the class and works with us to provide background
data. DEP personnel serve as resource consultants for the students. Responding to local requests has also meant that the students receive greater cooperation from local officials (e.g., town managers and selectmen, town office personnel, code enforcement officers, and plumbing inspectors). This good working relationship has developed because of a shared interest in projects and the pattern we have established of providing objective assessments based on empirical evidence. Such individuals have become tremendous resources for our students, because they can often explain procedures and regulations as well as specific implementation methods beyond an instructor’s personal knowledge.

Our students also have won increased cooperation from interested residents, who have allowed them access to study sites and boat launches. The support of local lake associations and their leaders has been invaluable in developing this relationship.

Finally, student work on local environmental projects has generated greater interest in the final product on the part of both the college administration and the local press. Reporters frequently write articles describing class projects near the beginning of a semester and then go on to cover final presentations. This press coverage has enhanced student appreciation of the importance and relevance of their work; it has also motivated them to increase the quantity and quality of their work.

Our class has conducted a variety of research projects over the last 15 years. Projects have included a natural resource inventory of a National Natural Landmark, a site evaluation of a potential wildlife preserve, the design of a greenway trail for the town, evaluation of potential environmental impacts of a proposed gravel mining operation, several waste load analyses of a local stream used for the outfall of a town sewage treatment plant, and numerous lake watershed studies. The last includes several investigations of the lake that provides drinking water for most of the local towns.

The service-learning component of the course appears in several forms. Because the chosen project has been requested locally, the entire focus of the students' work is on providing a service to others. Students work with groups such as town councils, clubs, private associations, town office personnel, regional and state agencies, and private landowners. The students provide a service to these groups and individuals, as well as learn from them. Almost every year, some students who complete our Problems in Environmental Science course continue specific or related aspects of their study by working directly with state or local agencies during the January mini-term or spring semester.

Course Components

As the last observation implies, Problems in Environmental Science is offered in the fall semester (but not in the spring, due to weather constraints). There are a four-hour laboratory session and two 75-minute or three 50-minute lecture/discussion periods per week.

We have developed a number of course components to accomplish our pedagogical goals, all of which we believe are important in order to make a course of this nature successful. Over the years, we have increased the effectiveness of these components by responding to problems we recognized and to suggestions made by students on course evaluations. The actual environmental problem investigated is different from year to year. In recent years, the course has investigated the impact of land-use patterns on lake water quality for several local watersheds, so in this chapter we will illustrate the importance of selected course components using a local watershed study.

Organization

Many of the necessary materials (e.g., various maps, overlays, aerial photographs, specific types of equipment) are gathered during the summer so that these critical resources will be available during the initial planning stage of the project at the start of the semester. Contact with resource people outside the college who are willing to work with the students is also typically made during the summer. Summer preparation is critically important and may be the single most important factor in determining the success of that year’s project.

Study Area Orientation

Although the project and its location are chosen by the instructors, the students are asked to develop the project’s specific work plan, so we have found it necessary to provide them with an initial overview of the study area and the issues to be investigated. During the first laboratory period, we take the class to the study area for a “reconnaissance.” We provide U.S. Geological Survey topographic maps of the area, local road maps, and any vehicle or boat transportation needed. We begin with a brief orientation at sites that provide broad views of the lake and watershed areas, which we follow by a statement of the environmental problem and a description of possible contributing factors. After the orientation, the class is divided into small groups for an examination of the lake and watershed. Student groups travel over assigned portions of the watershed identifying and describing conditions to be explored in more depth (e.g., problems in erosion control, areas with a high density of development, industrial operations). They also label all fire roads to summer cottages and lakefront homes on maps provided and
examine the lake shoreline from boats to identify potential problem areas, as well as locate significant tributaries for future sampling. These experiences help to make the project "real" rather than an abstract concept. Our next class period is devoted to discussing what they found and teaching them how to develop a work plan.

**Writing the Work Plan**

Students are asked to prepare a work plan (including a time schedule), detailing what they will do during the semester and how each component of the project is to be accomplished. The components of the work plan include the study objective, summary of relevant background data obtained, results of the reconnaissance, proposed study sites, and proposed field tests and measurements. The work plan document, once accepted, becomes their "contract" with us, as their clients. To save time, the work plan is written in outline form only. It is also orally presented to us during one of the lecture/discussion periods.

**Visiting Lecturers**

Early in the semester, we invite outside experts (e.g., from DEP, the Fish & Wildlife Service, the regional planning commission, local conservation groups, private companies) to speak to the class. These lectures provide relevant information and introduce students to people willing to serve as informational resources. The information and advice the students receive help them avoid pitfalls that others without prior experience would typically encounter. Students also learn that projects are often complex and involve multiple branches and levels of government. Some lecturers visit our class almost every year. The contacts made during these visits to our classroom and in our subsequent visits to agency offices can also be helpful to the students when they begin their job searches.

**Techniques**

This course is designed to incorporate a number of advanced techniques students may not have encountered in previous classes. Although these vary somewhat from year to year, they typically include the following:

- **GIS (Geographic Information Systems)** — mapping soil types, elevation, land use, slope, and drainage and using these to create other maps (e.g., septic suitability).
- **Land-use mapping** — designating areas by use type (e.g., agricultural, industrial, urban, grassland, forest type, roadway).
- **Aerial photography** — using photographs from state agencies, survey firms, and sometimes our own flyovers in constructing land-use maps and trends.

- **Computer modeling** — using models appropriate to the specific project. Our watershed studies utilize a phosphorus-loading model to obtain future loading projections based on specific growth assumptions.
- **Water** (including storm event) sampling.
- **Water chemistry analysis** using EPA standard methods.
- **Map reading** — interpreting and utilizing topographic, tax, road, soils, and wildlife maps.
- **Road surveys** — helping to refine a survey method developed for the state to determine the quality of dirt camp roads leading to shoreline areas and their potential for phosphorus loading into the lake.
- **Searching local records** for information on things such as buildings, septic systems, and lot sizes.
- **Computer graphics** — using figure production, drawing, and photo scanning and manipulation in producing the class report.

**Job Assignments**

Division of work responsibilities using job assignments is important and beneficial in three ways. First, job assignments help to identify and divide the work equitably among class members so that a sizable project can be completed. Second, they give the students defined responsibilities that are theirs alone and provide them with ownership of a portion of the project. Third, job assignments help the faculty to define the scope and evaluate the quality of each student's work with regard to a grade.

Assignments are made in the following way: Job descriptions are posted for assignments in two major areas: field/laboratory work (e.g., GIS supervisor, land-use analysis supervisor, chemical analysis supervisor) and report construction (e.g., table and graphics editor, science editor, preliminary and final draft editors). Students must apply for these, stating their reasons and qualifications. In fact, students list four choices in each area and rank them by interest. We then review these applications and "hire" each student for a job in each area. Most students receive their first choice, and only rarely does one not get his or her second choice. This procedure allows us not only to divide the workload but to do so based on each student's preferences, talents, and experiences. At times, we may initially not place students in jobs for which they are most experienced in order to encourage them to expand their horizons. A full listing of the jobs assigned for the past year with their duties and qualifications can be found on the course webpages (http://www.colby.edu/biology/BI493/BI493.html).

**Report Process**

The report is based on an outline established by the class and submitted in stages. Students choose or are assigned to write certain sections of the
report. We review and edit early drafts of that material when requested by individual students. Each student submits his or her text to the student editors for consistency, accurate science, format, and prose editing. The report sections are then put together based on the report outline and the first draft is submitted to us for detailed editing. Typically, there are a few areas of analysis that are not complete at this point and are not included in the first draft. After we make extensive comments on the first draft, the process begins again. At least one full and several partial reviews of selected sections occur before the final report is produced at the end of the semester. During our January mini-term, we employ one or two students to complete the final corrections and necessary formatting before the report is published and distributed. The faculty are actively involved in this process as well. Approximately 50-60 copies of the report are distributed, including copies for the laboratory and library.

Oral Presentations

Students are asked to make several oral presentations during the course. Near the beginning of the semester, we provide a list of background topics for the study and allow each student to choose an area of interest to him or her to report on to the class (10 minutes). If the class is large, we create teams for this effort, but everybody eventually presents a report. Near midterm we have the students present progress reports on their work. These progress reports not only provide more opportunities to present material before a group but also help to keep the class informed about all aspects of the project. Additionally, the presentations and resulting class discussions encourage students to evaluate critically the information they have gathered and to identify areas for further work.

At the end of the course, students are asked to make a formal oral presentation describing their findings and recommendations. This presentation is open to the public, and special invitations are extended to people who have served as resources for the project, members of local groups that are associated with the project area (e.g., lake associations), interested landowners, college officials, and the local press. In recent years, students have used computer-enhanced presentation methods and have achieved very professional results. The presentation typically lasts two hours with a refreshment break in the middle. Depending on class size, students may be divided into topic groups, each of which works on one aspect of the presentation, though only one student in each group actually presents the material. The class is made aware of the final presentation on the first day of the course so that students know their work will have an impact and they will need to be accurate in conducting their study and reporting their findings.

Problems Encountered and Suggested Solutions

The Problems in Environmental Science course is different from the traditional science course in its service-learning design, providing numerous advantages but also several challenges. During the years since the inception of the course, we have found a number of ways to help overcome many of the problems presented. Six problems are identified below, with the solutions that have worked for us.

Grading

One challenge we have faced is evaluating student work fairly when assigning grades. This problem is exacerbated by the fact that many assignments are completed by small or large groups, not individual students. We have had to identify ways to evaluate the work of each student. The job assignments discussed above include individual responsibilities that can be evaluated. We also evaluate the oral presentations given by each student during the semester; informal progress reports given periodically as updates to the class are not graded. The project report is submitted first as a draft and then as a final report, and each of these is graded. Individual students write assigned segments of the report and their names are kept with their sections until the final report is produced for distribution, allowing us to assign individual grades. Finally, there is a grade for participation. Students complete written self- and peer evaluations of their performance in each of their respective field- and report-related assignments. We assign a participation grade to each student based on this information and our own observations of his or her performance. These four project categories, providing seven grades during the semester, give us adequate information to assign a course grade to each student.

Overseeing Multiple Independent Projects

It is difficult to monitor the progress of each subgroup of students effectively and to correct problems successfully before they consume too much time. One way we address this problem is through in-class progress reports. Another way is by dividing oversight responsibility for different aspects of the class project. This approach requires coordination between teaching faculty, as well as the ability to orchestrate multiple student groups. We hold frequent faculty discussions so that we can point students in the right direction regardless of their assigned group. We also schedule frequent meetings with each group to discuss its progress in addition to the time we spend with students in the field and laboratory on regular meeting days. Finally, we provide the class with email addresses of all students at the beginning of the semester and require them to use email. As groups send messages about
organizational matters, we receive copies. In this way, we can follow group activities effectively and correct inaccurate information quickly.

Landowner Concerns

As students gather information throughout the watershed, landowners sometimes become concerned about the activity, particularly since the timing of this activity coincides with the closing of summer cottages and the movement of seasonal residents south for the winter. Landowner concerns may be expressed through conversations with student field teams and telephone calls to the college, or by reports to local police and county sheriff departments. Some residents are uncomfortable just having an "environmental group" working in their area.

We attempt to address potential landowner concerns in several ways. Publicity prior to beginning our study can help. In the case of watershed projects, we attend summer lake association meetings to explain the components of our project and outline the potential benefits to the community. In addition, we alert the press to our proposed project, often resulting in the publication of a newspaper article near the start of the project. The Department of Environmental Protection also informs interested groups of the class project and possible benefits. We ask lake association officials to inform the county sheriff's office of our planned activities, just before the watershed surveys begin, we re-contact local and county officials to remind them of our project. Outreach programs to local school and community groups have enhanced community awareness, as well as educated some youth regarding lake eutrophication issues. Finally, we instruct students to be very respectful of private property and courteous to people they meet during their work. All students wear blaze orange vests to appear as obvious as possible.

Work Load Levels

To design and complete a research project, produce a professional-quality report (often approximately 200 pages), and organize a public presentation requires a heavy work load for one semester. In the early years, we probably tried to accomplish too much, especially in years with a small class size. To reduce the student work load, we send labor-intensive water quality tests (e.g., BOD) to a local laboratory for analysis. We collect maps and existing data from the appropriate agencies so that the students will have access to them at the start of the class rather than having to seek out this information.

The class report includes a background section that provides general information for readers lacking experience with the project issues. Originally, this section was newly written each fall, but now we treat this section as property of "the consulting firm." Students are allowed to use this background material from prior reports, modifying it as needed for their own report. This procedure allows students to concentrate on the project design, data collection and analysis, data interpretation, and formulation of recommendations.

Team Research

The class project is tackled by a team of students with different abilities and interest levels. This is an advantage in that diverse views may generate more ideas if the group members do not get along. We stress the importance of good group dynamics throughout the course. Nevertheless, occasionally interpersonal disagreements arise. Typically, these issues are resolved quickly by the class members, but there have been times when the faculty needed to counsel individual students. Constant faculty vigilance is necessary to help identify potential problems and work with students to resolve them.

Space

Over the years, we have found a need for dedicated space for the varied types of laboratory work conducted (e.g., water quality, reading of aerial photos, and mapping) and the computer work (e.g., report writing, graphics, GIS, and database management). We have also needed a staging area for organizing equipment to be used by student teams in the field. Thanks to the construction of a new science center, we now have dedicated space providing a large laboratory with substantial bench space and computer stations, a chemical analysis room, and a data analysis center designed specifically with this course in mind. This space has made an enormous difference in student morale and productivity. The new spaces also serve as gathering and studying locations, helping our majors build group solidarity.

Benefits of the Course

- Students have an intense research experience.
- Students become familiar with team approaches to research problems.
- Student participation in a research project may encourage interest in graduate school.
- The team approach helps to build solidarity within the major.
- The course experience provides a good topic for job interviews.
- The service-learning component strengthens student interest in local affairs and attracts campus-wide attention to the course.
The Fit With Service-Learning Goals

The Alliance for Service-Learning in Education Reform (1993) has produced a list of “standards of quality” in service-learning. We believe these standards state nicely what service-learning should accomplish. We regularly review the 10 pertinent standards below and evaluate our course in their light:

1. Effective service-learning efforts strengthen service and academic learning. We believe our course has accomplished both of these objectives.

2. Model service-learning provides concrete opportunities to learn new skills, think critically, and test new roles in an environment that encourages risk-taking and rewards competence. Service-learning is not an end in itself but an effective means to learn new skills. Our students learn new skills and gain experience through their contacts with community leaders and professionals besides providing real service to the community. They “take risks” not found in the traditional classroom by having their work scrutinized by members of the local community. Additionally, the rewards that come through recognition and gratitude from the community outweigh those provided in the usual pedagogical structure.

3. Preparation and reflection are essential elements in service-learning. The early part of the course uses lectures, discussions, and readings as well as visits by outside experts to provide students with the background they need. Students are forced to reflect on what they have found and describe in a logical manner their findings and conclusions in both the oral presentation and the final report.

4. Students’ efforts will be recognized by their peers and the community they serve. The publicity generated by the press and the public final presentation help to bring recognition to the students and the course. The course’s reputation also means that peers, college administrators, and people in the community give the students positive feedback.

5. Students are involved in the planning. While they do not choose the project itself, students develop the work plan and are encouraged to take the initiative in all phases of the study. The faculty provide guidance when needed, but the project is student-driven.

6. The service students perform will make a meaningful contribution to the community. The information and recommendations students make are important both to the local community and to state agencies that receive the report. Many of the recommendations from past studies have been implemented by local or state organizations.

7. Effective service-learning integrates systematic formative and summative evaluation. Our own assessment of the course during the semester and at its conclusion along with student feedback through interviews and course evaluations have brought about many changes.

8. Service-learning connects the school and its community in new and positive ways. There has been a very positive benefit in terms of town/gown relations, with a greater respect for what the college is accomplishing and a better feeling about the college’s concern for the local area. Local agencies have hired students to gather the summer data to be used in the next fall’s course and to implement some of the recommendations made in the previous year’s report.

9. Service-learning is understood and supported as an integral element in the life of a school and its community. The college has recognized the value of the course both to the students and to college/community relations and has funded it adequately. The dean of the college typically attends the final presentation and sends a letter of commendation to the students. Articles describing the course and students’ efforts have appeared in college publications.

10. Skilled adult guidance and supervision are essential to the success of service-learning. Over the years, we have been able to develop a pool of experts on environmental issues as well as administrators who are willing to help us work with the students during the semester.

In short, our experience with this course has proved to us that service-learning is an extremely effective tool for teaching environmental science and developing skills in students that will aid them greatly in postgraduate pursuits. Students have enthusiastically endorsed the service-learning component of the course and consequently have been eager participants in our environmental investigations.

References
