

Using team service-learning projects in environmental science

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Abstract *This paper describes the rationale and means used to guide students in developing, presenting, and assessing civic engagement projects done as teams. Team projects and other forms of groupwork are effective tools for improving student learning. This paper presents a ‘roadmap’ of different environmental courses with descriptions of possible group products, evaluation schemes for effective grading, and forms of student feedback. Team learning promotes creative, dynamic responses to community opportunities. The result of team learning enhances student performance and skills, in addition to benefitting the community.*

Keywords: *groupwork; civic involvement; environmental science; service learning; assessment guides.*

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The traditional approach to science education has undergraduates memorize and recall specific scientific facts and principles that bear little similarity to the question-guided and collaborative manner of 'real' science (Hawkins and Pea, 1987; Lave, 1990; Lave and Wenger, 1991). Superficial learning is just replication through short-term memorization; as educators, our job is to foster 'deep style' learning by creating transformative experiences (Bain, 2004). Students are more likely to learn when we have a question that can be posed (and answered) in a stimulating environment--an environment that has intrigue and risk, but also an element of safety. Internships and course-based civic engagement experiences can provide stimulating environments.

Since its formation, our environmental science department has depended on internships as a way for all students to gain experience exploring careers. We also use other extracurricular options to connect our students with the outside world. Like my departmental colleagues, I was trained in science rather than in education and have been challenged to assimilate the many terms associated with providing solid learning experiences outside the classroom. The variety of definitions of civic engagement, civic responsibility, and service learning bring out rather subtle distinctions (see for example Jacoby & Ehrlich, 2009). From a teaching perspective it appears most effective to use a general, pragmatic sense of these terms (Gottlieb & Robinson, 2002). Civic engagement is acting upon a moral and civic identity. As such, it is a manifestation of a student's cognitive and moral development in which the student turns outward to the community for experiential learning as a civic responsibility. Service learning is a specific form of civic engagement in which an intentional academic course component takes the student out of the classroom for an educational experience that provides benefit to both the student and a nonprofit or government entity, brings that experience back into the classroom, and involves a contemplative or reflective element. Civic involvement in a greater community is not new to college students.

Many college students have already had civic engagement experiences beginning in middle school. Surveys of high school students revealed a sense of disconnect and powerlessness, a lack of commitment between self and the larger community (Berman, 1990), so even though civic engagement has begun in the earlier grades, its role in student education is not finished. High schools commonly have a civic engagement and

service learning component as a degree requirement. Civic engagement has been identified as a critical area for middle and elementary school student learning (Boston, 2005). Greater connections between students and the community also supports the more pragmatic approach to university-community relations espoused in current notions and concerns for crafting 'the indispensable university' (a concept in which the university is a key community partner, playing a critical role in the economic development of the surrounding community and region, as espoused by Trani and Holsworth, 2010).

Accepting that, as a whole, civic engagement and service learning are by now time-tested and valuable tools in promoting student learning across curricula, age groups, and settings, and that team learning (groups of two or more students collaborating on a project or experience) has been found to be a useful pedagogical approach, one wonders what the added benefits might be in having students work as teams in civic engagement. Since many environmental studies and science programs require internships or service learning projects, these types of experiences seem to be a useful area in which to explore the use of student teams as small-group or paired interactions between students and the community.

The student-team approach represents one of three primary strategies for student placement in the community for engaged learning. Students who work in pairs or small groups gain peer reassurance plus the creative elements of interaction (Harris, 2009). Such experiences prepare students in four major aims of liberal education: developing intellectual and ethical judgment, expanding horizons, cultivating democratic and global knowledge, and preparation for a dynamic and evolving economy (Schneider, 2002). Warshawsky (2003, p. 205) identifies six overlapping areas of benefit for students who work in teams on civically engaged projects: collaborative learning, greater sharing of views and knowledge, approximation of real-world working conditions, diverse interests, improved coping, and having preconceptions challenged.

Group learning and inquiry-based pedagogies are especially important components in crafting effective interdisciplinary environmental science programs (Bryant, 1992). Cooperative working in pairs or small groups has a powerful, positive effect on learning (Marzano *et al*, 2001). Students tend to show significant achievement gains across the curriculum when they are organized into collaborative

groupings (Zemelman et al, 1998). Small groups were also found to increase student performance, enthusiasm, attendance, and retention in large geoscience general education classes (McConnell et al, 2003). Further research is needed to articulate the degree and nature of these improvements for students in STEM fields in general. The research results may be able to help educators decide how to most effectively set students up for increased success through engaged learning.

Environmental science represents an applied and interdisciplinary field of study, lending itself to active learning and having a strong potential for student involvement with a broad sense of community. In environmental education, an environmental connection is sought--a true sense of place that transcends a particular social community and creates its own community within the participants. For example, Edward Abbey wrote about the desert, lived in it, and derived community from it. In his writings we can see how he progresses from awareness to anger to action (notably in *Desert Solitaire*, 1968). As an instructor, my job is to foster student acquisition of tools and experiences for awareness and action in the context of creating community. Thus, environmental science falls within the paradigm of environmental education, and the four levels of increasing knowledge development espoused by Hungerford (Hungerford et al, 1980)—Ecological foundations, Conceptual awareness of issues and values, Investigation and evaluation, and Environmental Action skills—are all relevant for civic engagement in environmental sciences. The ecological foundations are necessary to form the basis for knowledge to inform action. Policy and issue framing are the context for environmental action. Investigation and evaluation are the guiding steps for how and when the action occurs. Action skills involve collaborating with and inspiring others, especially in bringing about social change in the community. Collaboration is recognized as one of the most effective ways to engage in ‘action research’—a proactive method of bringing students and faculty into the community to solve problems (Stapp et al, 1996).

Collaboration is modeled outside the classroom and among different academic institutions through state Campus Compacts (Campus Compact is a national coalition of over 1,100 college and university presidents committed to fulfilling the civic purposes of higher education, <http://www.compact.org/>) and organizations such as SENCER (Science Education for New Civic Engagements and Responsibilities—an NSF-

funded program to connect science and civic engagement by teaching ‘through’ complex, capacious, and unsolved public issues). Campus compacts and SENCER facilitate use of civic engagement and service learning strategies in an action-based context. Students who take a SENCER course find that civic engagement and dealing with complex policy questions enhances their understanding of science and their perceptions of its value to them in collaborative action (Weston et al, 2006). Many institutions of higher learning have civic engagement coordinators, and maintain banks of host sites, documentations of work experiences, and training and resources for participants. These support structures enhance the opportunities for students to connect with each other and with host community organizations.

Peer evaluation of group learning

Having made a mid-life shift into academia, I carried an outsider perspective—I was interested in what higher education could do for the community, but I was also interested in what the community could do for students. Accordingly, I set about incorporating civic engagement and service learning into my environmental courses. My goal was to have every course reflect the value of civic engagement and to have the type and amount of civic involvement and service learning which is appropriate to the learning outcomes for each course. ESP 101 Fundamentals of Environmental Science and its co-requisite laboratory course (ESP 102) serve the general education curriculum as core courses and are recruitment courses for my department. The service-learning component of ESP 101 is only about ten percent of the course grade, but it provides an opportunity for students to apply knowledge gained in the course. Students bring this knowledge to a communications project or environmental awareness event that serves the public. They have the opportunity to work alone or in small groups of their own creation. Consistently, students tend to choose to work in groups on projects that involve public clean-ups (mainly parks, beaches, and trails), public awareness posters and You-tube videos that address local food, healthy eating, the environmental fate of chemicals, and other environmental topics.

As a result of these civic engagement projects and course evaluations

I have made the learning outcomes more concrete and tied into specific components of learning assessment. For example, part of the evaluation for groupwork includes making sure the final written project flows seamlessly so that a reader cannot tell that one section of the write-up has a different author. Rather than have the writing be done by just one person, team members peer review each other's sections, use one student as final editor, and fill out an evaluation in which they assess the amount and quality of their own work. Making these expectations (and forms) available at the start of the course keeps things open and clear. After the introductory course, students in the environmental planning and policy major continue with a course in environmental planning, which has a service learning and civic engagement component that can be done individually or in small teams.

The syllabus for ESP 200 Environmental Planning describes the major project that comprises half of the final grade for the course. Students must prepare an environmental management plan for an undeveloped or a developed tract of land that contains a natural community type (for example, bog, upland forest, rocky coastland). Almost half the class elects to work in small teams. The project must provide a service to a government or nonprofit entity.

The students are able to select their own team, project, and 'client.' I do have a 'bank' of potential community partners from which students can pick, but they can find their own 'clients' because this forms part of the learning experience. I and the class help the students define the project if necessary—we brainstorm potential projects early in the course. Students submit an evaluation form in which they rate the amount and quality of their own work, and assess the work of other team members. Members of well-functioning groups tend to provide consistent ratings on the amount and quality of work they do.

Since we are a small department that emphasizes active learning with a high degree of field-based and laboratory-based courses, we get to know our students fairly well. I find that high-achieving students will do excellent work whether alone or in small groups. But I also find that the teams tend to produce consistently high quality products, even if they have one or two members who are not known as high-achieving students. An obvious concern is whether or not the high-achieving student is 'carrying' the weaker members of the group. Over the years I have learned how to tinker with my assessments and directions, finding

the value of sample-editing small sections of the plan, working steadily with the groups, and providing good examples from previous teams. By keeping the groups small, interacting with them, and providing formative and summative evaluations, I find that the small groups optimize the individual talents each student can bring to the team and therefore there is greater equity in high-quality projects. Thus, the weaker student makes appropriate contributions while improving his or her skills and finds the benefit of a group project that has meaning to a community outside of the classroom.

My 'blended' (mostly on-line) Community Planning Workshop course (ESP 305) is for students after they have taken ESP 200. It allows students to work as individuals or in teams of two or three on one major project for 80 percent of the final grade. Students are asked to provide comments from the host organization. Each student prepares a 'memorandum of learning' under the categories of 'descriptive,' 'analytical,' 'affective,' and 'reflective.' Although some students initially confuse the categories, I keep them because their use helps the student to see the many potential facets of assessment, and to bring out critical thinking about the learning experience. In keeping with current thinking on civic engagement and service learning (for example, Colby et al, 2003; Arches and Apontes-Parez, 2005; Jacoby and Ehrlich, 2009) I want them to think about what they did, how they did it, why they did it, how they feel about it, what they learned, and what might it inspire them to do next. Below are quotes from the most recent student group member responses.

Descriptive

For our community planning project we developed a proposal to utilize a brownfield by placing a community garden on mill number five in the Bate Mill Complex located in Lewiston, Maine.

I was responsible for working with the town of Old Orchard Beach to update the Comprehensive Plan. My duties fell under the first part of the update process, the public process. As part of the public process, a survey was conducted amongst residents within the town.

This semester, we developed an incentive program for Portland, Maine residents to install rain gardens and rain barrels.

I prepared an online survey and emailed it to this sample population using Kwik Surveys, a free online survey site.

Analytical

To accomplish this goal, a community garden was proposed to provide the local community with fresh, nutritious and cheap locally grown goods. This project fits into the Community Planning Workshop curriculum because the project would be beneficial to the community in terms of economics, environment and history.

The project fit into my chosen field in more ways than one... it also allowed me to have an environmental 'twist' on the planning field, which was done by looking at how different land-uses within the town could affect environmental medium.

This memo is an assessment of the fit or congruity between this project and the needs of the Peaks Island community. This project also fits well with my program of study—environmental planning and policy. I hope to develop a career in community planning and this project was a valuable hands-on experience.

Affective

This project was affective in teaching me the importance of developing sustainable communities for the future. I learned that self-reliance can go a long way in protecting the environment as well as providing a cheap and healthy inflow of goods to the local economy. I feel that this project could be a viable alternative for the re-commissioning of mill five in the Bates Mill Complex.

The experience taught me a lot; I was able to utilize the skills learned as ... an Environmental Science major and contribute to the community.

I enjoyed the opportunity to contribute to my community and work with several of our community leaders. I am proud to have been able to meet a real community need.

Reflective

This experience taught me the importance of developing communities to be

sustainable as well as self-sufficient. As a nation we are extremely wasteful, simple techniques like urban agriculture and green roofs can go a long way in reducing waste. Community gardens ... invoked a new understanding of the importance of self-reliance within a community.

From this experience, I was able to learn what it means to be a town planner. A town planner must wear many hats and incorporate information from many fields.

One of the things I love about Maine is that we have so many small communities where it is easy to get involved and actually get something done. Peaks Island is simply one of these communities. So many residents are active in the community and I enjoy being a part of that.

I teach ESP 401 (Environmental Impact Assessment), the capstone course for the environmental science major, and which meets the capstone requirement for the university's general education curriculum. A capstone provides opportunity for students to apply prior knowledge to a large-scale problem. At the federal level under NEPA (National Environmental Policy Act), environmental impact assessment must be done by interdisciplinary teams. Accordingly, students work in teams of between three and five members. They learn how to apply Tuckman's (1965) classic first four stages of group development (forming, storming, norming, and performing) through group management, including allowing time to process through the stages, setting objectives, developing a work plan, and knowing what the product will be. For many students, there is a benefit in simply knowing that there are stages in group development, because that is a first step in overcoming problems. I explain about the stages and about the necessity of teamwork in most environmental careers. Students are able to reflect on their team work at the end of the course (see Appendix).

Conclusion

I feel I am still in the exploratory stages of using groups for civic engagement and service learning, although I have been doing it for more than a few years. The act of preparing this paper has made me realize I need to be more systematic about civic engagement and service

learning. I need to collect more students' experiences and document their perceptions of the opportunities and constraints of working in teams on project, and of groupwork in general. Further, I need to be more direct in assessing how the host organizations feel about the student projects. Since these projects are not the results of internships, many of the hosts or 'clients' do not have a formal process of interaction and may in fact have only minimal contact with the students. Although I provide advice and structure on an *ad hoc* basis for each group, perhaps I need to provide more guidance on how and when students interact and certainly I need to do more outreach with community partners. I also need to share more with my colleagues in the department and at the university because others do excellent work in fostering service learning and civic engagement. The more we share and support each other the more consistent and strong is the message to the student and the community. Fortunately, placement of our majors in the community is fairly strong. Our recent inventory found a little over 80 percent of our environmental science graduates working in an environmental field within a year of graduating. Former students tell us they have benefited from making real-world connections and from learning how to work in groups. Ideally, I would like to see if such experiences do indeed create more actively involved, caring community members. I think it is a fairly safe bet.

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Appendix

Forms used for civic engagement/service learning components of environmental science courses

Excerpt of civic engagement service project grading guide for ESP 101 Fundamentals of Environmental Science. The guide handed out to students includes a description column for "proficient" projects in addition to "exemplary" and "partially proficient," and provides the point spread for items 1 through 5 under each column entry.		
Project Criteria ESP 101 Student(s): _____ Project: _____	Exemplary	Partially Proficient
1. Project summary. Includes a description of the project— why chosen, how it fits with the book selected, what the student intended to accomplish, how the project accomplishes the objectives, and the student's assessment of the project's strengths and weaknesses.	Clear and appropriate description. Efficient and complete summary. Rationale for selection of the project is clear. Summary is well-written, no grammatical mistakes. Assessment of strengths and weaknesses in carrying out the project is realistic.	Identification and description of progress is not thoroughly developed. Lacks specific references and/or relation to learning objectives. Is not an accurate reflection of student's semester performance. Poor or missing discussion of strengths and weaknesses.
2. Quality. Project is quality work as per syllabus.	Project format is appropriate to the goals and rationale. Project is neat, organized, and attractive. Project is creative, original, and appropriate to the objectives.	Project format is appropriate to the goals and rationale. Project is deficient in neatness, organization (composition). Project is sloppily assembled or documented. Project poorly related to objectives
3. Service. Be able to design a project that provides an environmental service or benefit to the public.	Project is clearly useful and meets a local, logical, identified need or benefit to the public. Student has clearly articulated the benefits.	Not able to tell if project is useful. Illogical or unclear documentation of need or benefit to the public
4. References. Student has consulted appropriate authority in crafting the project	The project summary or content has references to suitable articles, people, and other sources. These references are sufficient to ensure credibility for the project.	Project relates to book chosen, but no references or inappropriate ones (e.g., Wikipedia)
5. External review & validation. Supporting material, including comment letters as appropriate from people in a position to evaluate the project.	One or more comment letters from an appropriate source that gives a very positive evaluation	No comment letter, or comment letter that is not relevant or supportive

<p>ESP 200 Self/group evaluation. This will be kept confidential by the instructor</p> <p><i>If you worked in a group, please evaluate the members and do the self-evaluation, if you worked on your own project, then just complete the overall self-evaluation at the bottom.</i></p>					
Name of Group Member					
% of work on this project contributed by the group member					
Overall quality of work contributed by each member (A, B, C, D, F)					
Timeliness of work contributed (always on time, sometimes on time, rarely on time—it was like pulling teeth)					
Comments					
Suggest a grade for each person					
<p>Overall Group Evaluation: I would give our group the following grade: _____</p> <p>Overall Self-Evaluation: My effort <u>and</u> quality in this group has been: <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Adequate <input type="checkbox"/> Inconsistent <input type="checkbox"/> Inadequate <input type="checkbox"/> Poor <input type="checkbox"/> Awful</p> <p>Print: _____ Sign: _____ Date: _____</p>					

Excerpt from the project evaluation guide for ESP 305 Community Planning Workshop. The guide handed out to students includes a description column for "proficient" projects in addition to "exemplary" and "partially proficient," and provides the point spread for Part 1 and Part 2 under each column entry. The student memorandum on learning pertains to individual knowledge and experience whether in groups or not.

Project Evaluation ESP 305	Exemplary	Partially Proficient
Part 1. Memorandum on student learning a. descriptive (what did you do, when, and how, what resources did you use), b. analytical (how did the project "fit" into the community, the course, your chosen field of study, and other relevant organizations and institutions; what did it accomplish), c. affective (how did you feel about the experience), and d. reflective (what did you learn from the experience, including the readings).	Responses to all four areas document what was achieved through this learning experience. Rationale for selection of the project is clear. Project is a good fit. Well-written; no significant grammatical mistakes. Student affective and reflective pieces show good gains in learning. Student expresses cogent thinking about the experience.	Three areas are addressed. Identification and description of progress is not thoroughly developed; Is not an accurate reflection of student's semester performance; Discussion of strengths and weaknesses not fully developed. Reflections not clear
Part 2. Project meets Course Objectives a) Be able to apply land use & environmental planning concepts to an existing community land use problem or issue in Maine. b) Be able to conduct a community resources inventory to address a particular planning issue or problem. c) Be able to independently design and document a major project. d) Be able to assess the fit or congruity between a proposed project and the needs of a community.	Project format is clearly appropriate to the goals and rationale for the four objectives. Project is organized, and attractively assembled. Project is clearly useful and meets a logical, identified need or benefit to the public. This project would be an excellent example to show other students and faculty interested in service learning and civic engagement. Project is creative, original.	Project format is appropriate to the goals and rationale of at least two objectives Project is deficient in neatness, organization (composition). Project is not well assembled or documented. Not able to tell if project is useful. Illogical or unclear need or benefit to the public Not able to tell if project is creative & original.
Part 3. References and supporting material. Student has consulted appropriate authority in crafting the project	Has references to suitable articles, people, regulations, and other sources. These references ensure credibility for the project. One or more comment letters/emails provided from an appropriate source that gives a positive evaluation.	Few references or inappropriate references. No comment letter, or comment letter that is not relevant or supportive

ESP 401 EIA Project grading guide. Project and team: _____

Checklist of major factors in evaluating the project
Code: + if very good job, √ if acceptable, - or blank if poor or missing

___ Overall Appearance. Is the report well-organized and professional? Can I tell what the team set out to do? Does the project report stand as a good portfolio piece?

___ Critical thinking. Does the report show evidence of critical thinking? Is it clear that the authors have worked together to integrate a piece of professional work? Are words just slung in there or does the writing show evidence of clear, logical thought & work.

___ Coordination. Did the team stay in touch and submit progress reports? Was I shown draft sections? (No need for this if the writing and approach are simply wonderful & unassailable.)

___ Learning. Is it clear that the team learned about environmental assessment from doing this project?

___ The report. Does the report contain elements of a Phase I study and the outlined approach of a full EIA for an EA or EIS? Some of the items I ask for below would not necessarily be in a Phase I EA or an EIS but I ask for them to help document the learning done for this project. Are the following elements properly present in the report and its appendices?

- ___ A description of the project, including assumptions about client, design, size, dates, etc). Are the assumptions reasonable for the scope of the project and assessment?
- ___ Statement of relevant laws & regulations with proper citations.
- ___ A job plan for carrying out the assignment - a "who will do what when" plan, as if responding to a request for a proposal (an RFP).
- ___ Is there a site location map so an external review knows where to find project in Maine?
- ___ A flow chart and checklist for analyzing impacts. Does this show good critical thinking and scoping?
- ___ Sketch of the project on draft paper. Did they examine the site and assemble a base map?
- ___ Proper identification of stakeholders
- ___ Data collected/documentated from the field. Are major categories of impact considered?
- ___ A completed assessment form (use the form NY issues for its SEQR process: <http://www.dec.state.ny.us/website/dcs/seqr/forms/longeaf.pdf>).
- ___ An analysis of the major environmental impacts of the project. Does the analysis show where to go for more information and what approach to take for further research?
- ___ Site visit report. Is the setting adequately described?
- ___ If certain mitigation measures or alternatives are obvious, are they referred to in the discussion section?
- ___ Overall professional packaging. One copy to be kept by me. Are maps, figures, data, references properly titled and incorporated into the text?
- ___ Was the report submitted in a timely manner?
- ___ Individual confidential memorandum in which student assesses own role in the group project (percentage of work, and caliber of work) & what they learned by participating

___ Presentation. Did the group invite a stakeholder to attend? Did the presentation generate interest in the audience? Was it factual, useful? Can I tell the students learned?

Overall grade for this lab project: _____

ESP 401 **EIA Group Project presentation evaluation.** **Evaluator:** _____

Project title _____

Project team members _____

1. Was the description of the project clear and easy to understand?
2. Was the reason for the project explained? Why did this group choose to do it?
3. Were the major laws and regulations that apply to this project clearly identified?
4. Was the process of collecting information, assessing it and creating the report clearly identified?
5. Who are the major stakeholders affected by or invested in this project?
6. Identify the major impacts of this project in terms of
 - a. biological
 - b. water resources
 - c. historical/cultural/archaeological
 - d. geological/earth
 - e. transportation
 - f. Social
 - g. economic
 - h. air quality
 - i. energy production and consumption
 - j. aesthetics/visual
 - k. climate change & sustainability
7. Comment on the nature of participation. Did all students in the group participate in the assessment and in the presentation? Were they enthusiastic communicators?
8. Comment on the quality of the PowerPoint and the presentation as forms of communication.
9. What questions and suggestions do you have for this group?

ESP 401 Environmental Impact Assessment self/group assessment.

CONFIDENTIAL

Name _____

Project title: _____

Names of other members in my group _____

My estimation of the percentage of the group's work that was contributed by me: ___%

My estimate of the quality of the work that I contributed: _____ (use terms such as "excellent," "very good," "good," "fair").

Was the presentation well organized?

What were the most interesting points? What did you gain from working on the project?

What areas needed more work?

Comments: