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Keywords

Non-majors, Biology, Service learning, Sustainable agriculture

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Abstract

I was interested in whether the inclusion of a service-learning experience would affect students' attitudes and values about the environment. To investigate this question, I incorporated a service-learning project into the laboratory portion of one of the two sections of my non-majors biology course, and kept the lecture portions of the course identical. Several methods were used to assess the impact of the service-learning experience: the New Ecological Paradigm survey was used to measure changes in students' attitudes and values about the environment at the beginning and end of the semester, and reflective writing assignments were used throughout the semester qualitatively assess changes. Students' evaluations of the course and the instructor were also compared. As predicted, participation in a service-learning project was associated with changes in students' attitudes and values about the environment. Students in the service-learning lab were also more likely to positively rate the course and the instructor.

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Introduction

Educators teaching biology to non-majors continually struggle to engage students who fail to see how biology is relevant to either their disciplinary interests or their daily lives. In order to teach any science course effectively, we need to impress upon students that science is more than a collection of facts; it is an approach to thinking about the world. Further, we need to impress upon students that biology is indeed relevant to their other coursework as well as their lives outside the classroom. This requires more than reciting a laundry list of reasons that biology is important on the first day of class. The relevance needs to be demonstrated repeatedly throughout the semester and students need to be provided with experiences that allow them to see the relevance first-hand.

Involvement in service-learning is one way to demonstrate to non-majors the relevance of biology. Service-learning is defined by the National Commission on Service-Learning as a "teaching approach that integrates community service with academic study to enrich learning, teach civic responsibility, and strengthen communities" (Learn and Serve America, n.d.). In optimally designed service-learning projects, volunteerism and learning are combined such that both the recipient of the service and the service provider benefit simultaneously (Furco, 1996).

Research has demonstrated the effectiveness of service-learning projects in biology courses (Brubaker & Ostroff, 2000). Students learn more academic content because they become interested in how biological issues connect to their specific project and they better

understand the importance of biological principles when given the chance to apply these principles to real-world experiences (Kennell, 2000). Additionally, service learning helps students appreciate the interdisciplinary nature of academic knowledge and the diverse career opportunities related to the biological sciences (Kennell, 2000). Kennell (2000) also posits that students better recognize the importance of “scientific literacy, education, and civic responsibility” as the result of service-learning experiences in biology.

Incorporation of service-learning experiences also has the potential to reach a broader cross section of the student body, particularly those with learning-styles better suited to experiential learning. Kolb and Kolb (2005) outline several tenets of experiential learning theory that are shared by prominent scholars of human development and learning. ELT recognizes that learning is a process of creating knowledge, and thus “stands in contrast to the ‘transmission’ model on which much current educational practice is based, where preexisting fixed ideas are transmitted to the learner (Kolb & Kolb, 2005).” The “transmission” model of education tends to appeal to a particular student learning style, not reaching many others students in the class. However, service-learning provides students with opportunities to experience, question, and construct a personal framework in which they can understand the interaction between humans and plants in the context of food production.

As a biology professor, I was interested in exploring whether the inclusion of a service-learning experience affected student learning, particularly that of non-majors. I decided to ask this question in the introductory biology course that I teach for non-majors. This course is titled “Plants and Society: Economic and Cultural Botany” (hereafter referred to as *Plants and Society*). The course typically focuses on the diverse ways in which humans interact with plants, and how such interactions have played, and continue to play, a fundamental role in shaping the world in which we live. Among the topics we explore are the origins of agriculture and the process of plant domestication. In previous semesters, I had taken students to visit and work on a local farm for an afternoon. Prior to the visits I repeatedly detected students’ ambivalence about agricultural issues during class discussions— it did not matter to them where their food came from or how it was produced. However following visits to the farm, this ambivalence was largely replaced with interest that was sparked by new discoveries. I overheard several students mention that they had never seen some of the vegetables any place other than the grocery store so they were intrigued to see them still attached to rooted plants. Some students were even surprised to learn that potatoes grew underground.

The disconnect between people and the food production process is not unique to the students in my course. A study of Kansas students found that they were unable to answer basic questions about agriculture (Horn & Vining, 1986). Nor is the disconnect between people and food unique to the US. The UK Policy Commission on the Future of Farming and Food has stated that there is a critical need to reconnect consumers with the food they eat and the food production process (Policy Commission on the Future of Farming and Food, 2002). In an effort to cultivate a greater awareness of agricultural and environmental issues, I developed service-learning projects that partnered students with a local farmer concerned with sustainable agricultural practices.

The interdisciplinary nature of the sustainable agriculture makes it an ideal focus for a class that consists of students majoring in diverse areas. The sustainable agriculture movement focuses on economic, environmental and social issues as they relate to agriculture. Perhaps most relevant within the context of a biology course are the environmental benefits that

result from sustainable agriculture. Many argue that local food systems are inherently more sustainable because they do not rely on fossil fuels to the same degree that national and global food systems do for long distance transport of products; decreased combustion of fossil fuels results in lower CO₂ emissions (e.g. Pirog, VanPelt, Enshayan, & Cook, 2001). Organic practices, which are often correlated with local food systems, further benefit the environment by leading to decreased use of chemical pesticides, improved water quality, and enhanced soil conservation practices, which in turn, often supports greater biodiversity (Pimentel, Hepperly, Hanson, Douds, & Seidel, 2005).

The local farm we worked with uses the community supported agriculture (CSA) model. In this model, consumers contribute by providing the farmer with the upfront capital required to cover production costs. Additionally, they often assist with farm tasks and coordinate the organizational details of running a CSA farm. In return, the farmer provides members with a share of the weekly harvest. Local food systems such as this one have the potential to promote civic engagement and increase consumers' concern for environmental issues because they shift the emphasis off of production and efficiency toward the relationship between people and land (DeLind, 2002; Lyson, 2000).

During spring 2005 I taught two sections of Plants and Society; each lecture section of the course was accompanied by a three hour laboratory. I incorporated a service-learning project into the laboratory portion of only one of the two sections of the course. The traditional lecture portions of the courses were identical. In order to assess the impact of the service-learning project, I measured changes in students' attitudes and values about the environment at the beginning and end of the semester using a published survey called the New Ecological Paradigm (Dunlap, Van Liere, Mertig, & Jones, 2000). An important component of service learning is structured reflection on the service project as well as discipline-specific content (Zlotkowski, 2001). I used several reflective writing assignments throughout the semester to qualitatively assess changes in students' attitudes and values about the environment. Further, a crucial goal of any non-majors science course is to promote student interest in the field of study so that they become scientifically literate members of society. Students' feelings towards the course and the field of study were assessed by questions in the course evaluations. This paper reports the results of incorporating service-learning projects into Plants and Society.

As the result of participation in a service-learning project on the CSA, I predicted that students would learn more about plants and agriculture, as well as the broader issues impacting agriculture today. An increased understanding of these broader issues (e.g. global markets, pesticide and fertilizer use, and genetically modified crops) could lead to an increased sense of civic responsibility as well as a greater appreciation of the importance of basic scientific literacy. Both of these would indicate progress towards a fundamental goal of any non-majors science course— preparing students to make informed decisions about issues related to science, technology, health and the environment.

Methods

Course Description

This study was conducted at a small liberal arts college in Pennsylvania during spring 2005 semester. I collected data on student learning in two sections of a non-majors introductory biology course titled "Plants and Society: Economic and Cultural Botany." The course is a 4-credit course consisting of three 50-minute lectures and one 3-hour laboratory per week.

Students in both sections of the course were enrolled to fulfill the university's lab science requirement.

Throughout the semester students were introduced to the diverse ways in which people interact with plants, and how such interactions have played, and continue to play, a fundamental role in shaping the world in which we live. The student learning objectives outlined in the syllabus were: 1) to recognize and draw connections between botany, general biology, and the broader liberal arts curriculum, 2) to understand the range of interactions between people and plants, as well as how both people and plants have changed one another profoundly, 3) to explain the origin of agriculture and how it impacts human cultures, past and present, and 4) to understand how natural and artificial selection cause evolutionary changes in plants.

Readings were selected to highlight the interdisciplinary nature of the course topics and to engage students with diverse interests. *Plants and Society* (Levetin and McMahon, 2003), the course textbook, is designed to introduce non-majors to general botany. The authors of the text intentionally employ a multidisciplinary approach as they present information about the relationship between plants and people. Students also read select chapters from *Napoleon's Buttons: 17 molecules that changed history* (Le Couteur and Burreson, 2003), *Guns, Germs, and Steel: The fates of human societies* (Diamond, 1999), and *The Botany of Desire: A plant's-eye view of the world* (Pollan, 2001). Articles from popular science magazines, such as *Natural History* and *Scientific American*, were also assigned throughout the semester.

Laboratory Instructional Techniques

Both lecture sections were taught using the same syllabus (i.e., course readings, exams, quizzes, etc. were identical). However, in one lab section, I incorporated a service-learning project, while in the other section I developed a more traditional lab experience. Students in the service-learning lab section worked with a community supported agriculture initiative located near the university. I worked with the farm manager to develop projects that met the needs of the farm and also supported student learning in the course. Early in the semester, the farm manager came to campus to give students a presentation on the operation of the farm, as well as community supported agriculture and other forms of sustainable agriculture. This introductory presentation was given to both lab sections. In the service-learning lab section, the farm manager also introduced the four projects that we developed for the class. Following the farm manager's visit to campus, students selected a project that they were interested in working on.

In developing the projects the farm manager and I considered ways in which non-science majors could link the projects to their own discipline-specific interests. For instance, one project involved developing activities for a summer program at the farm for at-risk elementary and middle-school age children and was designed to appeal to the education majors in the class. Another project, designed to appeal to graphic design and marketing majors, involved redeveloping the website for the CSA and creating a brochure designed to both educate and attract new members. We also sought to make connections to several of the student learning objectives.

In addition to completing projects, students traveled to the farm during three lab sessions in April. During the first two lab sessions they worked on the farm in whatever capacity they were needed (e.g. tasks such as weeding, fertilizing, spreading mulch, and pruning). On the third visit to the farm, the students presented their final projects to the farm manager.

During lab periods not devoted to the service-learning project, students participated in the same activities as the traditional-lab section.

By explicitly connecting the service-learning projects to both the content covered in class and the interests of students within their major, I expected that the service-learning component of the course would improve student learning in the course. By working on the farm students would be able to experience the connections between botany and other disciplines (history, economy, sustainability, etc.). The parts of the plants would no longer be an esoteric exercise in memorization. Instead students would gain first hand experience harvesting stems, roots, leaves and fruits. They would also be given opportunities to discuss social issues linked to agriculture (the demise of the small family farm, the link between socioeconomic status and diet, the Irish Potato Famine, etc.) Together, we thought these activities along with trips to the farms and discussions with volunteers working on the farm would serve to reinforce all four learning goals outlined in the course syllabus.

Course Demographics

My initial expectation was that the student composition (e.g. class year, sex, academic major) in both the service-learning and the traditional lab sections would be relatively similar, but this was not the case. Aspects of student composition that differed between classes included class year, sex and academic major.

There was a significant difference in course composition based on class year ($X^2=7.7$, $df=3$, $p=0.05$). The majority of students in both lab sections were freshmen and sophomores. However, in the traditional lab section ($N=25$) 32% of the students were freshmen, while in the service-learning lab section the majority of the students were freshmen (74%). In the traditional lab section ($N=19$) there were 48% sophomores, 12% juniors and 8% seniors. The service-learning lab section was comprised of 16% sophomores, 5% juniors, and 5% seniors. While the ratio of male students to female students in the service-learning lab section did not differ significantly from 50:50, in the traditional lab section there were significantly more female students than male students ($X^2=7.84$, $df=1$, $p<0.01$).

The distribution of academic majors was diverse in both lab sections. The traditional lab section included many business and elementary education majors. The service-learning lab section also included students majoring in business and related disciplines (i.e. accounting, human resource management, public relations) as well as students who had not yet declared a major (referred to as undecided). Two students in the service learning section entered the course without a declared major and switched to biology mid-semester.

Assessment

New Ecological Paradigm (NEP) Survey

The New Ecological Paradigm (NEP) survey (Appendix 1) is designed to measure students' attitudes and values regarding the environment (Dunlap et al., 2000). I administered the survey during the first week of class and again at the end of the semester in order to assess any changes in the two lab sections. The New Ecological Paradigm survey is a revised version of the widely used *New Environmental Paradigm* [emphasis added] first published by Dunlap and Van Liere (1978). The revised instrument consists of 15 items that seek to understand students' fundamental beliefs "about the nature of the earth and humanity's relationship with it" (Dunlap et al., 2000). Questions tap into the following facets of what the author terms "an ecological worldview": 1) an understanding of the reality of limits to population growth, 2) a rejection of anthropocentrism, 3) an understanding of the fragility of nature's balance, 4) a rejection of the idea that humans are exempt from processes that

affect the rest of the natural world, and 5) a belief that an ecological crisis is possible. Though the NEP scale has been deemed valid as a single measure, it is also potentially valuable to separately explore the five dimensions specifically addressed by the questions. The revised NEP differs from the original in that it achieves a better balance between positively and negatively worded statements, includes two additional ecological facets (numbers 4 and 5 above), removes outdated gender-biased language, and adds an “unsure” category to the scale (Dunlap et al., 2000).

I was interested in whether participation in the service-learning project led to a more ecologically-friendly worldview as defined by the NEP. Because we regularly discussed environmental issues as they related to sustainable agricultural practices and the service-learning project, I predicted I would see a larger increase from pre-test to post-test NEP scores in the service-learning lab section than in the traditional lab section. The NEP survey was administered anonymously in order to decrease the likelihood that students would bias their answers in order to please the instructor. Because the test was anonymous, unpaired t-tests were used to compare pre- and post-test scores within each lab section. Similarly, unpaired t-tests were used to compare pre-test, as well as post-test, scores across the two lab sections.

Reflective writing assignments about CSA

Structured reflection is a key component of service-learning; it provides students with an opportunity to consider what they have learned as a result of their experience (Eyler and Giles, 1999; Kolb, 1984). Students were asked to complete a reflective writing assignment (Box 1) after the farm manager visited with the lab sections at the beginning of the semester. The goal of this visit was for her to introduce to students the model of Community Supported Agriculture. She discussed the nature of industrial agriculture and how the CSA model differed from that of industrial agriculture.

Box 1. Reflective writing after farm manager's visit to campus (ALL STUDENTS- BOTH SECTIONS)

This reflective writing assignment is based on the assigned article discussing CSA initiatives in general (Thomas 2002) and the farm manager's introduction to the local CSA.

Things to consider in this writing assignment:

- Had you ever thought about where the food at the grocery store comes from? Does it matter to you where your food comes from? How it is produced? Who profits?
- Had you ever heard of CSA initiatives prior to this course? If not, what did you think of the concept following the reading and the farm manager's introductory presentation?

Reflective writing after farm manager's visit to campus (STUDENTS IN SERVICE-LEARNING LAB ONLY):

Have you been involved in a service learning project before? How do you feel about participating in a service learning project as part of the lab portion of the course?

At the end of the semester students involved in the service-learning project were asked to complete a second, more structured, reflective writing assignment (Box 2). The second reflective writing assignment was adapted from “The Three Levels of Reflection” (Cooper, n.d.) In the reflective writing assignment that I used in class, students were first asked to

describe their experience and to consider questions related directly to the experience. In the second set of questions I asked students to reflect on what they learned about themselves as a result of the experience. Students were also asked to consider the overarching issues affecting agriculture today. Finally, students were required to reread their original reflective writing assignment and to consider whether their attitudes, opinions or beliefs had changed as a result of the project. In order to draw conclusions from the reflective writings, I read all of the writings and looked for trends that emerged. The primary purpose of the assignment was to gather qualitative data on how students felt about their involvement in the service-learning project.

Box 2. Reflective writing after service-learning project (SERVICE-LEARNING LAB ONLY)

For this final reflective writing assignment please address EACH OF the following four broad issues below. You do not need to answer all of the questions listed under the four broad questions. They are just added to give you ideas of the types of things you can write about.

I. Describe your experience. What did you do? What would you change about the experience? What have you learned about community supported agriculture? Do you feel your actions had any impact? Does this experience compliment what you're learning in class? How? Has learning through experience taught you more, less, or the same as the class? In what ways?

II. What have you learned about yourself through this experience? Do you have more/less understanding of agricultural issues than you did before volunteering? In what ways, if any, have your values, your sense of "community," or your willingness to serve others, been impacted or altered through this experience? How has this experience challenged stereotypes or prejudices you have/had? Any realizations, insights, or lessons learned? Will these experiences change the way you act or think in the future?

III. From your service experience, are you able to identify any underlying or overarching issues that affect agriculture today? What could be done to change the situation? How will this service-learning experience alter your future behaviors/attitudes/and career? How are local agriculture and the family farmer impacted by what is going on in the larger political/social sphere? What does the future hold? What can be done?

IV. Have any of your attitudes, opinions, or beliefs about CSA changed since the beginning of the semester? Reread your original reflective writing assignment (see Box 1) to answer this question.

Final Exam Essay Question

As part of the final exam, students in both lab sections were asked to respond to an essay question (Box 3) that addressed the ways in which they have achieved, or failed to achieve, the course goals detailed in the syllabus. The question was designed to provide information on whether participation in the service-learning project helped students to better achieve any of the course objectives. Students were given the question one week in advance and students were allowed to complete this question ahead of time and bring it to the exam with them. All but six of the forty-four students (the number of students in both sections combined) chose this option; those six students answered the question during the regular final exam period. I compared answers from the two lab sections.

I read all of the questions and identified in each answer the course goal that students felt they most successfully achieved and the goal that students felt they least successfully

achieved. In some cases, students' reported that they had "most" successfully achieved two or more of the course goals. In several cases students failed to clearly identify a goal that was either most or least successfully achieved. In order to assess the final exam essay questions more quantitatively, I tallied all of the responses and compared how the course goals ranked (i.e. which were most successfully and least successfully achieved) in the service-learning and traditional lab sections.

Box 3. Final Exam Question

Consider each of the course objectives (see Methods-Course Description). Discuss how you have personally met (or failed to meet) the goal. Provide examples to support your answer. What labs or topics in lecture best helped you to achieve each of the particular goals?

Which goal do you feel has been most effectively met? Least effectively met?

How could the course be changed to help you more successfully achieve the course goals?

Student evaluations of instructor and course

At the end of the semester, student evaluations of the course and the instructor were collected using Instructional Development & Evaluation Assessment forms (hereafter referred to as IDEA forms). The IDEA form is a standard assessment instrument, developed by Kansas State University, which is used by all faculty at the university. (For sample form, see http://www.theideacenter.org/sites/default/files/Student-Ratings_ShortForm.pdf). All questions are answered using 5 point Likert-type response options and space is provided for written comments. I compared student evaluations in the service-learning and traditional lab sections.

Results

New Ecological Paradigm (NEP) Survey

The NEP survey was administered as a pre-/post-test in order to determine whether involvement in the service-learning projects led to greater changes in students' attitudes and values about the environment. Students in the traditional lab section scored higher than students in the service-learning section on the NEP survey administered during the first week of class (means = 49.94 ± 1.87 SE and 53.60 ± 1.42 respectively; Figure 1), though the difference was not significant ($t = -1.58$, $df = 40$, $p = 0.12$). The original difference between pre-test scores in the two lab sections decreased by the end of the semester when the post-test was administered (from 3.66 to 1.61 points). The post-scores between the two lab sections were not significantly different. The closing of the gap in scores between the two lab sections resulted from greater increases in the post-test NEP scores in the service-learning section (from 49.94 ± 1.87 SE to 52.71 ± 1.83 SE) than in the traditional lab section (from 53.60 ± 1.42 SE to 54.32 ± 1.44 SE). However, in neither lab section was the increase from pre-test to post-test scores significant.

Looking specifically at statements designed to explore what the survey's author terms the five facets of an ecological worldview (1. an understanding of the reality of limits to population growth, 2. a rejection of anthropocentrism, 3. an understanding of the fragility

of nature's balance, 4. a rejection of the idea that humans are exempt from processes that affect the rest of the natural world, and 5. a belief that an ecological crisis is possible) there was only one significant difference between responses on pre- and post-tests. In response to the set of statements addressing whether students reject the idea that humans are exempt from processes that affect the natural world (NEP statements 4, 9 & 14), scores were significantly higher on the post-test than the pre-test in the service-learning lab section ($t = -3.175$, $df = 32$, $p = 0.003$). The increase in score from pre- to post-test on this set of statements was not significant in the traditional lab section ($t = -1.789$, $df = 48$, $p = 0.08$).

A closer look at the changes in the mean response value for each individual statement reveals increases of 0.5 or greater in four of the fifteen statements in the service-learning lab section, but no increases of 0.5 or greater in the traditional lab section (Table 1). Three of the statements that showed an increase of greater than 0.5 points were related to human exemptionalism (NEP statements 4, 9 & 14). The fourth statement (NEP statement 2), which showed an increase of 0.5 or greater, focused on the rejection of anthropocentrism. Students in the service-learning lab more strongly disagreed with the statement "Humans have the right to modify the natural environment to suit their needs" on the post-test than on the pre-test, though the difference between pre- and post-test responses was not significant.

Table 1. Mean rating of students in traditional and service-learning sections to items on the NEP instrument used to assess changes in students' attitudes and values about the environment.

NEP Statement	Traditional Lab		Service Lab	
	Pre-	Post-	Pre-	Post-
1. We are approaching the limit of the number of people the earth can support.	3.36	3.48	3.53	3.29
2. Humans have the right to modify the natural environment to suit their needs.	3.16	3.24	3.00	3.53* *
3. When humans interfere with nature it often produces disastrous consequences.	4.00	3.52	3.12	3.06
4. Human ingenuity will insure that we do NOT make the earth unlivable.	3.08	3.24	2.82	3.35* *
5. Humans are severely abusing the environment.	3.92	4.12	3.82	4.18
6. The earth has plenty of natural resources if we just learn how to develop them.	2.68	2.40	2.06	2.29
7. Plants and animals have as much right as humans to exist.	4.20	4.56	4.41	4.65
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.	3.84	3.72	3.53	3.53
9. Despite our special abilities humans are still subject to the laws of nature.	4.20	4.56	4.06	4.71* *
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.	3.60	3.80	3.12	3.35
11. The earth is like a spaceship with very limited room and resources.	3.36	3.52	3.18	3.24
12. Humans were meant to rule over the rest of nature.	3.60	3.72	3.53	3.18
13. The balance of nature is very delicate and easily upset.	3.68	3.44	3.76	3.71
14. Humans will eventually learn enough about how nature works to be able to control it.	3.36	3.64	2.65	3.53* *
15. If things continue on their present course, we will soon experience a major ecological catastrophe.	3.56	3.36	3.35	3.12

**Indicates that the increase in score from pre- to post-test was at least 0.5 or greater.

Figure 1. Comparison of pre- and post-test NEP scores between the service-learning and the traditional lab sections. There were no significant differences between the two lab sections, though the service-learning lab section showed a larger increase between the pre- and post-test.

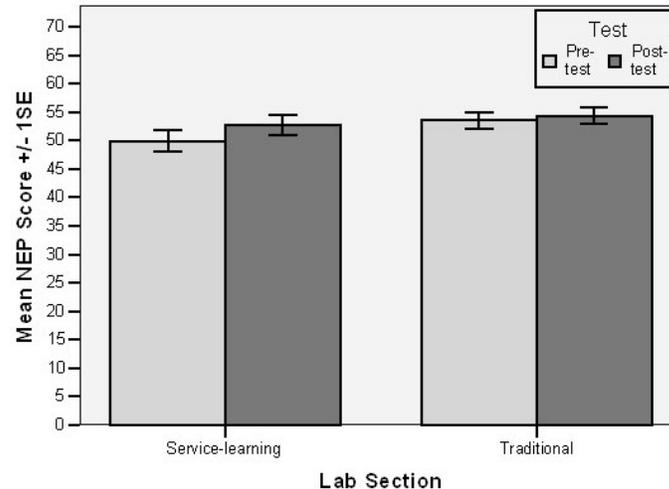
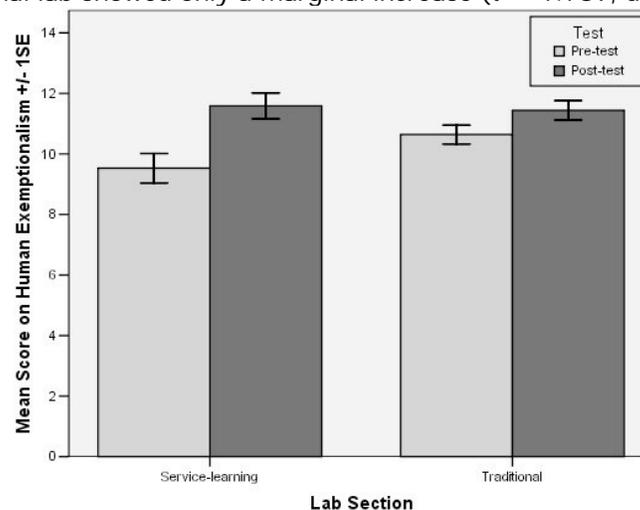


Figure 2. Comparison of pre- and post-test scores between the service-learning and the traditional lab sections on questions assessing students' rejection of the idea that humans are exempt from processes that affect the rest of the natural world. Scores from the service-learning lab significantly increased on the post-test relative to the pre-test ($t = -3.175$, $df = 32$, $p = 0.003$), while scores from the traditional lab showed only a marginal increase ($t = -1.789$, $df = 48$, $p = 0.08$).



Reflective Writing Assignments About CSA

The original reflective writing assignments, written after the farm manager's introductory presentation, asked students to consider whether they ever thought about where their food comes from, how the food is produced, and who profits when they purchase their food (Box 1). They were also asked to give their general impression of the concept of CSA. Excerpts of student responses appear in Appendix 2. In both lab sections, students answered similarly

to the first set of questions; less than 50% of those in the class had ever considered where their food actually comes from before it arrives at the grocery store. Less than 25% of the students in the class had considered how the food is actually produced and even fewer (3 of 44 individuals) had considered who profits when they buy food at the supermarket. Almost all students, regardless of lab section, reported favorable impressions of the CSA concept. One student seemed to have a negative impression of the CSA concept, while several of those who reported a generally favorable impression also noted that time and cost constraints might make it unviable.

Students in the lab that was participating in the service-learning project were asked to write about any previous experiences with service-learning, as well as how they felt about participating in the project as a part of the lab experience. Only three of the nineteen students reported having participated in a service-learning project prior to the course. Several noted that they had volunteered in the past. All students indicated that they were looking forward to participating in the service-learning project.

Following participation in the service-learning project, students wrote a second reflective writing assignment that asked them to 1) describe the experience, 2) discuss what they learned about themselves from the experience, 3) discuss what broader issues affect agriculture today, and 4) consider how their attitudes, values or beliefs changed as a result of the experience (Box 2). Students consistently commented on how difficult the actual farm work was, particularly during our first trip to the farm when the weather was cool and rainy (student excerpts appear in Appendix 3). On that particular day many students were working on preparing the asparagus beds, which involved weeding, aerating the soil, and shoveling compost. The students all commented on how rewarding it was to taste the asparagus during their final visit to the farm, knowing that their hard work had resulted in an observable, final product. Several students also commented that they learned more from their first-hand experience on the farm than from their traditional lecture experience.

The post-service reflective writing revealed changes in student attitudes toward farmers and the agricultural process in general. Students gained an appreciation and respect for the hard work farming entails. Several students acknowledged that prior to the service-learning experience they had thought of farmers as uneducated or unintelligent. This stereotype changed as a result of the service-learning experience; students gained a greater understanding of the knowledge required to manage a farming operation successfully. Another common theme in the post-service reflective writing was an awareness of the pressures small farmers face as they try to survive amidst a corporately-dominated, national and global food system.

Final Exam Essay Question

As part of the final exam, students in both sections evaluated their progress in meeting course goals as they were delineated on the syllabus. The question was designed to provide information on whether participation in the service-learning project helped students to better achieve any of the course objectives. After reading and summarizing student answers to the final exam question, I found that a higher percentage of students in the service-learning lab section of the course felt that the goal "to explain the origin of agriculture and how it impacts human cultures, past and present" was the one that they had most successfully achieved (19% in the service-learning section v. 9% in the traditional lab section. Conversely, 20% of students in the service-learning lab section selected the goal "to explain the origin of agriculture and how it impacts human cultures, past and present"

as the goal they had least successfully achieved; 36% of students in the traditional lab section of the course felt that this was the goal that they least successfully achieved.

Student Evaluations of Instructor and Course

Student responses to the statement, "I really wanted to take this course regardless of who taught it," were not significantly different between the two sections. This is important to stress because differences in reported "desire to take the course" between the two sections could lead to changes in course and instructor evaluations, independent of the service-learning experience.

After establishing that there were no differences in students' desire to take the course, I looked at student assessment of their progress on relevant course objectives. Approximately 43% of students in the service-learning lab section reported that they had made "exceptional progress" on the objective "Gaining factual knowledge", while only 28.6% of students in the traditional-lab section reported "exceptional progress" toward this objective. Regardless of section, no students reported that they made "no apparent progress"; however 4.8% of students in the traditional-lab section reported only "slight progress". In the service-learning section all students reported at least "moderate progress" or higher. These differences between sections in progress on this particular objective were qualitatively interesting but were not statistically significant ($\chi^2=2.995$, $df=1$, $p=0.084$). There were no differences in student responses to progress made on other relevant objectives.

Though the service-learning experience did not appear to have significant effects on students' assessment of their progress on relevant course objectives, there were substantial differences between service-learning and traditional-lab sections in responses to statements related to quality of the course and the instructor. Student responses to the statement "As a result of taking this course, I have more positive feelings toward this field of study" were significantly different depending on lab section (Fig. 3; $\chi^2=4.146$, $df=1$, $p=0.042$). Seventy-six percent of the students involved in the service-learning experience responded that the statement was "more true than false" or "definitely true;" the percentage responding similarly in the traditional lab section was only 57.1%.

Student responses to the statement "Overall, I rate this instructor an excellent teacher" were also significantly different depending on lab section (Fig. 4; $\chi^2=6.225$, $df=1$, $p=0.013$). Of the students in the service-learning section, 57% responded that the statement was "definitely true" and 43% responded that the statement was "more true than false". In the traditional lab section, the percentages were 28.6% and 47.6% respectively. Further, student responses to the statement "Overall, I rate this course as excellent" were significantly different depending on lab section (Fig. 5; $\chi^2=5.993$, $df=1$, $p=0.014$). In the service-learning section, no students indicated that the statement "Overall, I rate this course as excellent" was "more false than true" or "definitely false." Approximately 19% of students enrolled in the traditional-lab section selected one of those two options.

Figure 3. Student responses to the statement “As a result of taking this course, I have more positive feelings toward this field of study.” (1= Definitely false, 2= More false than true, 3= In between 4= More true than false, 5= Definitely true)

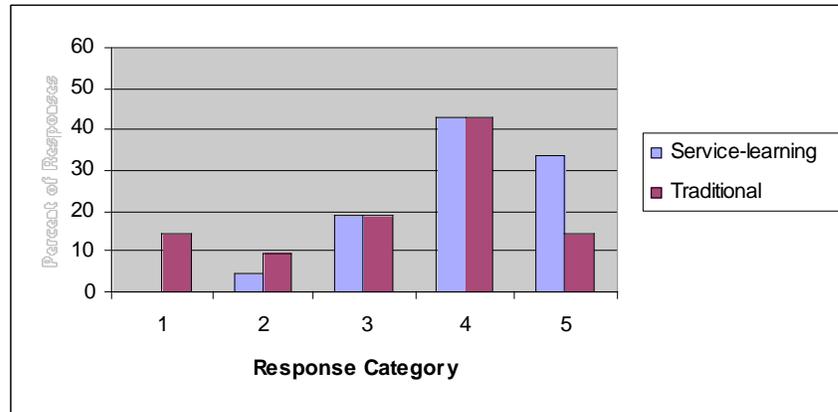


Figure 4. Student responses to the statement “Overall, I rate this instructor an excellent teacher.” (1= Definitely false, 2= More false than true, 3= In between, 4= More true than false, 5= Definitely true)

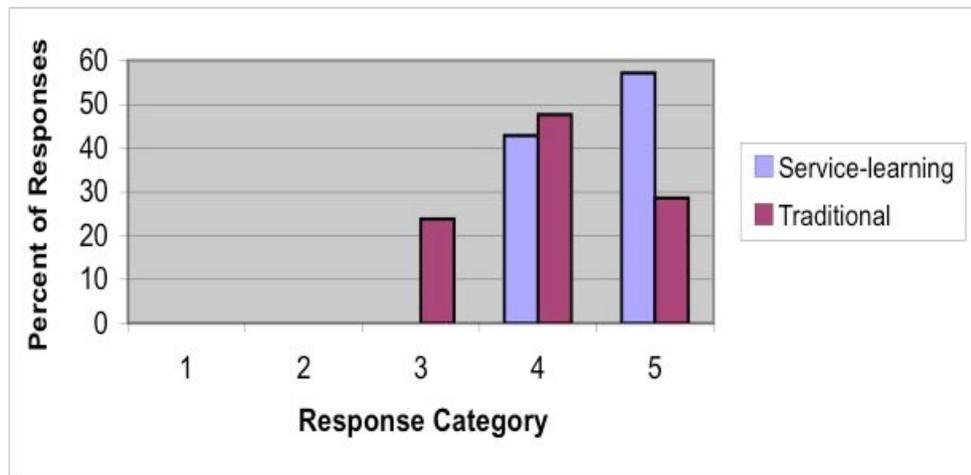
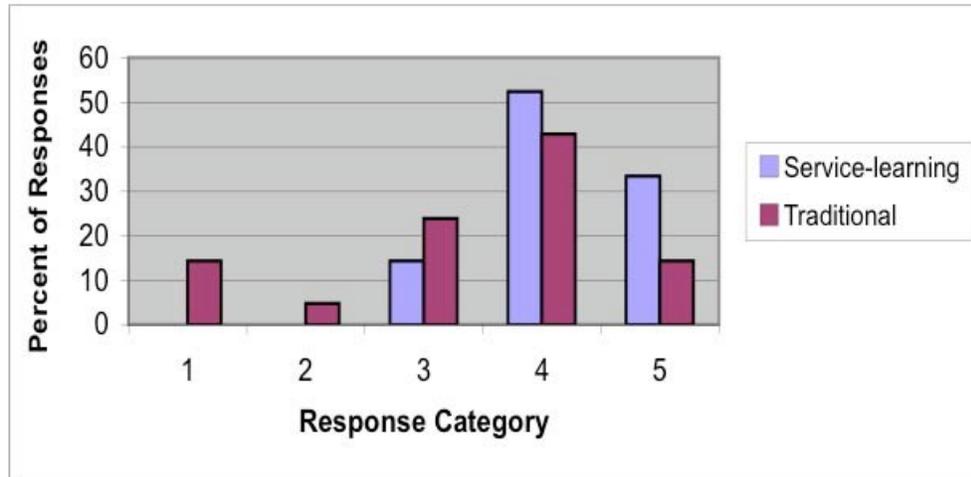


Figure 5. Student responses to the statement "Overall, I rate this course as excellent." (1= Definitely false, 2= More false than true, 3= In between 4= More true than false, 5= Definitely true)



Discussion

This experimental inclusion of service-learning in a non-majors biology course was associated with changes in students' attitudes and values about the environment, and reduced stereotypes of farmers and the farming industry. Students in the service-learning lab section were also more likely to feel positively about the course and the instructor, as evidenced by course and instructor evaluations. Explanations of why service-learning experiences could impact students' attitudes and behaviors about the environment and student evaluations are considered in the discussion that follows. Differences in demographic variables, and how these differences could have affected the results, are also considered.

Students' Attitudes and Values About the Environment

Initial scores on the NEP instrument were marginally higher in the traditional lab section ($p=0.12$). This difference, though not significant, could be explained by differences in the sex ratios of the two course sections. The traditional lab section consisted of 64% female students unlike the service-learning lab section, which consisted of equal numbers of male and female students. There has been a great deal of research exploring the relationship between gender and environmental concern. A review of the relevant literature suggests that female students consistently demonstrate greater concern for the environment than male students (Hampel, Boldero & Holdsworth 1996 and references cited therein). Caiazza and Barrett (2003) found that female students were less sympathetic to business with respect to their impact on the environment than were male students, female students were more likely to view environmental activists positively and less likely to favor spending cuts that would negatively impact the environment than were male students. Thus, it is likely that initial differences in NEP scores were due to differences in the proportion of female students enrolled in each section.

When the NEP survey was administered at the end of the semester, students showed greater gains in NEP scores in the service-learning section than in the traditional lab section. These findings suggest that the service-learning experience led to changes in students' attitudes and values related to environmental issues, as was predicted. The changes observed were primarily in the category of questions related to "human exemptionalism." Students in the service-learning section regularly discussed environmental issues as they related to sustainable agricultural practices and the service-learning project. These discussions most likely had the effect of raising students' awareness of environmental issues, particularly how humans are likely to be affected by future environmental crises.

Students' reflective writings further suggest that participation in the service-learning experience positively impacted student learning and led to changes in attitudes and values about the environment. With respect to the impact of service-learning projects on student learning, students reported benefiting from the opportunity to learn first-hand about agriculture and its relationship to the environment. They were also more likely to report significant progress toward to the course objective: "To explain the origin of agriculture and how it impacts human cultures, past and present." Evidence that service-learning benefits student learning in general is apparent in students' reflective writings. A freshman, who had not yet declared a major, wrote, "I am a 'hands on' learner, so being on the farm and seeing things grow and connect first hand was great for me. I really took pleasure in doing the service learning project...because it got us to think outside the class room." Another freshman, who later declared a biology major, wrote: "Learning through experience always teaches me more than listening to lecture or doing work in class... In going to the farm, I learned just how much work, time, and planning goes into maintaining a CSA..." Comments such as this were echoed by others in the class.

Student reflections on the experience also provide indications that their attitudes and values have changed as a result of the service-learning project. For example, a sophomore accounting major wrote, "My view of farmers and their work has changed dramatically. I have more respect for the hard work and planning that goes on in order to smoothly and efficiently run a farming business." A freshman majoring in business wrote, "I used to take my food for granted, I did not care where it came from or how it was grown but now I would like to find a CSA in my area and purchase my vegetables and possibly fruits from a CSA. I think it is better to support small time businesses than the corporations because the small businesses are more personal, to them you are more than a customer, and you are part of the community." The strongest evidence of changed attitudes can be seen in the writing of another freshman, who stated, "Farmers have the stereotype of being 'rednecks' or uneducated'. I learned this is definitely not the case." Additionally, some students wrote of their intentions to change their behaviors as a result of the project. Many wrote of their intentions to buy more fresh, locally-grown produce; some reported that they planned to grow their own food in the future. Still others indicated that they would consider belonging to a local CSA after graduation.

The most common student reflection is expressed in the following quote by another freshman, who had not yet declared a major: "Upon seeing fruits, vegetables, and other types of produce in the grocery store in the past, I do not think I every really stopped to wonder where they came from or what was done in order to grow them. Now, knowing what a farmer must go through for many months in order to produce that perfect, tasty fruit or vegetable, I may never be able to look at a fruit or vegetable the same way again." Many said that they would consider joining a CSA after graduation.

Service Learning as Experiential Learning

Service-learning is one of many approaches to experiential education (Furco, 1996), making it difficult to differentiate whether the benefits in this case were due to the hands-on nature of the experience or to the service. Kolb and Kolb (1984) outline several components of experiential learning that are instrumental in making this method of learning effective. For example, they note that learning needs to begin with recognition of the student's experience and prior knowledge. In my non-majors biology course, we began with discussion and reflection about what we know about where our food comes from and how it is produced. Experiential learning theory also values the importance of tying the educational experiences to the learner's interests. Together, the farm manager and I worked to make connections between the course material and the student's major explicit in the projects we designed. Kolb and Kolb write that making such connections "kindles intrinsic motivation and increases learning effectiveness (1984)." Based on the comments included in the reflective journals, it seems that the experiential aspect might have been more responsible than the service aspect for changes in students' attitudes and values, though this in no way diminishes the value of the experience.

Effects of Gender on Service-Learning

There is little research examining whether service-learning experiences differentially impact male and female students. However, a study examining the motivations of men and women in the general public to participate in community service found that women are more motivated to volunteer than men (Clary et al., 1998). Students' gender was also shown to be significant in models seeking to predict community service during medical school; female students were more likely to provide community service during medical school than were males. In this experiment, the sex ratio in the service-learning section of the course was not significantly different from the expected 50:50 sex ratio. Thus the benefits of the service-learning experience are broadly applicable.

Student Evaluations of the Course and the Instructor

Student evaluations of the course and the instructor were significantly higher in the service-learning lab section. Markus and colleagues (1993) found similar results in a study that examined the effects of incorporating a service-learning project into a political science course at the University of Michigan. Course evaluations indicated that students in the service-learning sections "were more likely to agree that they had performed up to their potential in the course...more likely than those in the control group to report that they 'learned to apply principles from this course to new situations' and 'developed a set of overall values in this field'" (Markus, Howard & King, 1993).

The composition of students in the two sections of the course differed with respect to class year and sex ratio. Thus one might argue that differences in student evaluations of the course and the instructor were due to differences in the class composition rather than the service-learning experience. Research has addressed the question of how student evaluations of the course and the instructor vary depending on students' sex and class year. Santhanam and Hicks (2002), in a study of student evaluations from a three-year period, found significant differences in evaluations as a function of the student evaluators' class year. Fourth year students evaluated courses and instructors more positively than did students in their first, second or third years of college (Santhanam and Hicks, 2002). In this study, there were significantly more upperclass students in the traditional lab section. Thus, if class year was driving differences in student evaluations, then one would expect higher evaluations in the traditional lab section rather than the service-learning lab section.

Conclusions

In summary, students who participated in the service-learning lab section showed evidence of changes in their attitudes about farming and the environment. Students developed an awareness of the relationship between human activity and the environment. Additionally, negative stereotypes of farmers were replaced by an appreciation of the difficulties of farming, and students learned about where their food comes from. Students who participated in the service-learning projects were also more likely to feel positively about the course and the instructor, which is often a challenge in non-majors courses. Lastly, the service-learning experience is likely to promote civic engagement following graduation if these students seek out opportunities to become involved in local agricultural initiatives, as many reported in their reflective writing assignments that they would do.

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Appendix 1

NEP Survey Instrument (from Dunlap et al., 2000)

Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE (SA), MILDLY AGREE (MA), are UNSURE (U), MILDLY DISAGREE (MD) or STRONGLY DISAGREE (SD) with it.

1. We are approaching the limit of the number of people the earth can support.
2. Humans have the right to modify the natural environment to suit their needs.
3. When humans interfere with nature it often produces disastrous consequences.
4. Human ingenuity will insure that we do NOT make the earth unlivable.
5. Humans are severely abusing the environment.
6. The earth has plenty of natural resources if we just learn how to develop them.
7. Plants and animals have as much right as humans to exist.
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
9. Despite our special abilities humans are still subject to the laws of nature.
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.
11. The earth is like a spaceship with very limited room and resources.
12. Humans were meant to rule over the rest of nature.
13. The balance of nature is very delicate and easily upset.
14. Humans will eventually learn enough about how nature works to be able to control it.
15. If things continue on their present course, we will soon experience a major ecological catastrophe.

*Note: Agreement with odd numbered questions indicates a pro-NEP response, as does disagreement with even numbered questions. Thus the scale is weighted differently for odd and even questions **so that the strongest pro-NEP response is always weighted 5** on a scale from 1 to 5. A higher overall score on the survey indicates greater support of the pro-ecological statements.

APPENDIX 2

Excerpts from student writing AFTER their first introduction to the local CSA

"Just from living on Long Island in the short time that I've been alive, I have seen drastic changes from forest and farmland to concrete and condos... That's why I believe CSA is a great way to build community and value support for farmland to keep contractors and their million-dollar homes at bay." -Sophomore; English and secondary education major

"Farms are an integral part of the history of agriculture and food production and they should be around when students learn this. I actually remember visiting a farm when I was in elementary school. It made the learning much more enjoyable and it is not surprising that I can still remember that moment to this day." -Sophomore; Elementary education major

"CSA is a great concept because it keeps farms in business and local communities happy and healthy by producing good food and helping the community to form friendly relationships by working together." -Sophomore; Elementary education major

"...I never used to consider where it [food] came from, or how far it traveled. I guess its better not to think about it, especially when buying from a grocery store is sometimes, economically, the only option...Sometimes it's just better to be ignorant." -Freshman; Writing major

"In such a materialistic and consumer-driven society, it's refreshing to see anything that allows people to work together towards a common goal in a positive way." -Senior; Music major

"... time is such a precious commodity in our world today that the time necessary to be a member of a CSA would be hard to come by, especially for adults with careers and children. Also, in our society of laziness and fast food, how well can a trend based on hard (although probably enjoyable) work, time and care be expected to catch on?" -Junior; Graphic design major

"While the idea sounds nice on paper, it is so much easier with our busy lives today to just make a quick trip to the grocery store and grab what you want, while avoiding the extra mess of having to go to an actual farm." -Sophomore; Elementary education major

"When I enter my local supermarket...I assume that the fruits and vegetables were picked in nearby farms. Never before has the idea crossed my mind that the crops possibly came from another country." -Sophomore; Major undecided

"I have no idea where my food comes from or who helped plant and pick it." -Sophomore; Elementary education

"While writing this essay, I wondered about CSA farms in New Jersey. I have never seen or been to any of them, so I decided to look them up on the internet. To my surprise, there are ten CSA farms located in New Jersey and one of them is only about a twenty minute ride from my house." -Sophomore; Accounting major

"Until lab last week, I never really thought about *where* the lettuce at Shop Rite came from, it was just...there... I don't think where the food comes from or who profits from it really matters to me...I never really thought about what organic food was aside from hearing the word thrown around by 'health nuts'..." Freshman; Business major

APPENDIX 3

Excerpts from student reflective writing after the service-learning experience

I. Describe your experience.

"The first day, in the rain, we shoveled compost. I must say it wasn't the most thrilling experience, especially in the rain, but after seeing the end result of the asparagus fully grown, it was worth the effort... Even though some jobs were less fun, all of them are necessary to provide for success." -Sophomore; Human resource management major

"It was hard work, but at the end of the lab period, I could really see a difference on the farm through my contributions as well as everyone else's efforts... Though I complained about having to shovel the compost into the asparagus rows, it was a great feeling to eat the fresh asparagus knowing that I had helped produce it." -Sophomore; Accounting major

"My group took care of the display board and brochure... I gained a large amount of knowledge of what crops the farm produces and how the CSA program works." -Freshman; Business major

"My group was assigned to work on setting up the beds... on any other day, this task would have been simple, however, given the rain and the cool temperature, it made the job a lot more painful to complete...Though it was not the most enjoyable of days on the farm, looking back on it I was glad that we got to experience a day such as that one." -Freshman; Major undecided

"...many students may not experience the magnitude of something, in this case farming and agriculture, until they experience it themselves." -Freshman; Major undecided

"...I enjoyed the chance to interact with nature in a way that will help others in the community." -Freshman; Major undecided

"...a good way of seeing what actually occurs on a farm, how vegetables are cared for and how they are cultivated." -Psychology; Associates degree program

"...we learned about individual plants... however, I think that we could have utilized the farm as a resource in learning about other plants." -Freshman; Major undecided (Declared biology major)

"The most specific thing I learned is that asparagus tastes a lot better when it is raw and fresh than when I have had it cooked at home." -Freshman; Marketing major

"At the farm we weren't allowed to work inside like we would if there was football practice on a rainy day, but we had to work in the rain and the cold to accomplish our job. This was a different type of hard work than I was used to, but I was grateful that I was given the

chance to do these jobs... I gained a better appreciation for farmers in general and the endless hours of hard work they do daily." -Freshman; Political science major

"By going to the farm, I learned a lot more than I would have in the classroom." - Sophomore; Business major

II. What have you learned about yourself through this experience?

"Through this experience I have dropped my stereotypes of organic farming." -Freshman; Elementary education major

"I feel as if I had a large impact on the MACC Linkages program, as I helped to develop activities that the children will actually participate in this year. Helping with the physical labor on the farm also allowed me to feel like I had a connection to the farm and to the vegetables grown on it." -Freshman; Major undecided (Declared biology major)

III. From your service experience, are you able to identify any underlying or overarching issues that affect agriculture today?

"The major issue I learned about via this service learning project was how small farms are dwindling and large companies are buying these small farms to become even bigger." -Freshman; Major undecided (Declared biology major)

"Corporate farming involves large farms owned by a corporation growing a huge amount of crop acreage. These crops are then distributed throughout America and sold at cheaper prices than local produce. When one goes to a supermarket, one is more tempted to save the most money... however, locally grown produce not only supports the community and local farmers, but it is also fresher and many times better for one's health." -Freshman; Elementary education major

IV. Have any of your attitudes, opinions, or beliefs about CSA changed since the beginning of the semester?

"I still do not think much about where the food I eat comes from or who profits from it, but at least now if I do ask myself those questions, I know the answers. Most of the food I eat bought at grocery stores or provided by other food companies (Aramark), probably is genetically modified and probably does not come from small farms." -Freshman; Major undecided (Declared biology major)

"Being a fan of bigger corporate farms, I came in thinking that it would be some dinky little farm that wasn't really going to be able to sustain itself for very much longer. However, I was met with the complete opposite; coming out I saw a farm that was built and held together by volunteers and members of the community. I didn't believe that a farm could be run by mostly having volunteers and members working their hours. I believed that the money corporate farms paid their workers was their incentive to do a great job, and I didn't think the volunteers would have enough of a sense of belonging to give a decent effort. I realized that people actually are drawn to something by other reasons than money, like having a sense of a team and being a part of something." -Freshman; International studies major

"If I hadn't participated on a CSA farm, I would still have the same lack of sensitivity and understanding along with [an] unimpressed attitude as I did before." -Sophomore; Accounting major