# Service Learning in Non-Majors Biology: Learning Outcomes and Lessons from the Field

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## ABSTRACT

I investigated how student performance differed in five differently-structured service learning projects in a non-majors plant biology course. I addressed how cognitive and affective gains from these projects differed with different levels of student ownership, preparation, community involvement, and instructor-provided scaffolding. Projects met with varying levels of success in accomplishing both context-specific educational goals and the broader aims of service learning. Students felt more positively toward STEM disciplines when provided academic-level-appropriate structure. The largest determinants of meeting student engagement aims of service learning were: 1) involved community partner, 2) appropriate match between student level and instructor-provided structure, and 3) student ownership.

Keywords: STEM, Conference Proceedings, Hands-on Learning, Continuous Improvement

## INTRODUCTION & BACKGROUND

Service learning provides students opportunities to apply classroom content knowledge to help solve problems in their communities (Speck, 2001). The intent of most academic service learning is to increase student gains in the affective and cognitive domains by engaging them in projects that are meaningful to the community yet simultaneously promote student learning (Shumer et al., 1999). At the college-level, these types of projects can be especially transformational in non-majors STEM courses in which students have difficulty connecting course content to their lives (Lee, 2002). However, how scaffolding, community partner involvement, and student academic preparation interact is not well-documented.

## METHODOLOGY

Five service-learning projects were taught and assessed over the course of four years in non-majors biology courses (BIO101 is Introductory Biology, BIO141 is Plants and People, Table 1). The projects ranged from instructor-prescribed with few educational goals and little community partner involvement (e.g., eradicating invasive plant species) to student-prescribed with multiple educational goals and community partner involvement (e.g., identifying problems and solutions for a local community-supported agriculture (CSA) operation, Table 1). Projects A and B consisted of a range of student levels, and students simply removed invasive plant species from a community area after learning about them in class. The results from the remaining projects and three semesters of BIO141 were more intensively analyzed for a separate set of survey questions (Table 2). Project C consisted of freshman living learning community students assisting the Friends of the Red Cedar State Trail in their invasive species removal efforts. Project D consisted of a mixed-level student population assisting a Community-Supported Agriculture operation with different needs. Students were given positive feedback from the CSA, and negative feedback from the Friends of the Red Cedar (Table 1). Projects E and F consisted of students developing propaganda to get other college students to care about invasive plant species. Project F was an Honors section.

**Table 1: Characteristics of courses and service projects. IPS = invasive plant species. Mean student level: 1 = freshman, 4 = senior or above.**

| Code | Course | Mean Student Level | Project type | Community Partner | Problem Identification | Target |
|---|---|---|---|---|---|---|
| A | BIO101 | 1.89 | IPS Removal | None | Instructor | Environment |
| B | BIO141, S2010 | 1.46 | IPS Research & Removal | None | Instructor | Environment |
| C | BIO141, F2010, 001 | 1.00 | IPS - Friends of Red Cedar | Yes | Student | People |
| D | BIO141, F2010, 002 | 2.52 | Community-Supported Agriculture | Yes | Student | People |
| E | BIO141, F2011, 001 | 2.75 | IPS Propaganda | None | Instructor | People |
| F | BIO141, F2011, Hon | 1.83 | IPS Propaganda | None | Instructor | People |

## FINDINGS

The projects met with varying levels of success, largely due to differences in student preparation, community involvement, and instructor-provided structure. In response to the statement, "I believe it is someone else's job to fix the environmental problems we are facing," students in the A and B sections were significantly more likely to agree (ANOVA, $F_{5,151} = 2.85$, $P = 0.017$), indicating that more active roles in helping people help the environment empowered students in the other sections. In the other sections, students were more motivated to learn more about plants and felt that they had made a real contribution to their community when they were engaged in projects that resulted in positive feedback from community members or were in the Honors section (Table 2). Students also felt more positively toward STEM disciplines when the level of instructor scaffolding matched their academic preparation (Tables 1 and 2). Instructor-provided scaffolding was especially important to the success of students with little preparation or motivation.

**Table 2: Student responses to survey questions in four sections.** IPS = Invasive plant species, CSA = community-supported agriculture. 1 = strongly disagree, 5 = strongly agree. Significantly different means have different superscripts (ANOVA, Tukey's HSD).

| Project | IPS Red Cedar | CSA | IPS Propaganda | IPS Propaganda | |
|---|---|---|---|---|---|
| Section | F2010-001 (n=23) | F2010-002 (n=21) | F2011-001 (n=25) | F2011-HON (n=21) | *P-value* |
| This activity made me more aware of community needs. | 3.64 (0.18) | 3.76 (0.21) | 3.48 (0.17) | 3.70 (0.21) | *0.735* |
| I think this project made a difference in my community. | 2.96 (0.18) | 3.19 (0.16) | 3.04 (0.14) | 3.10 (0.15) | *0.773* |
| I worked with community partners on this activity. | 3.74 (0.20)$^{A}$ | 3.52 (0.19)$^{AB}$ | 2.96 (0.23)$^{B}$ | 3.48 (0.19)$^{AB}$ | *0.050* |
| This class should do this project again in the future. | 3.43 (0.19)$^{B}$ | 4.25 (0.16)$^{A}$ | 3.20 (0.23)$^{B}$ | 3.52 (0.20)$^{AB}$ | *0.004* |
| I had a voice in shaping this activity. | 3.43 (0.21)$^{B}$ | 3.90 (0.17)$^{AB}$ | 3.52 (0.21)$^{AB}$ | 4.19 (0.15)$^{A}$ | *0.021* |
| This activity helped me better understand what we were doing in class. | 3.18 (0.25) | 3.76 (0.12) | 3.38 (0.21) | 3.60 (0.18) | *0.192* |
| Plant biology is relevant to my life. | 3.09 (0.27)$^{B}$ | 3.95 (0.20)$^{A}$ | 3.44 (0.22)$^{AB}$ | 4.00 (0.14)$^{A}$ | *0.010* |
| I am interested in learning more about plants in the future. | 2.96 (0.24)$^{B}$ | 3.86 (0.21)$^{A}$ | 3.40 (0.19)$^{AB}$ | 3.90 (0.18)$^{A}$ | *0.005* |

## SUGGESTIONS FOR BEST PRACTICES, CONCLUSIONS & FUTURE WORK

Maximum gains from service learning projects come when community partners are invested with clear expectations, students are helping people and receiving positive feedback for that help, and the instructor provides an appropriate level of structure for the students. Surveys in other types of courses, including upper-level majors courses will improve understanding of the role of scaffolding in courses at different levels. The process of continuous assessment each semester will continue to help improve the student experience to achieve the cognitive and affective learning gains that are the promise of academic service learning.

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