

ARTICLE

Service Learning in Neuroscience Courses

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Incorporating service learning (SL) components can be a very powerful way to engage students, add relevance, and develop community-building skills. SL experiences can play important roles in neuroscience classes, although the roles can be different depending on the needs of the classes. In this paper, we will present two models of incorporating service learning into neuroscience courses. The first model gives an example of using SL in a non-majors course, and the second model gives an example of

using SL in a neuroscience class for neuroscience concentrators. After describing the two sets of experiences, we summarize the positive aspects and the challenges involved in creating SL components in neuroscience courses, develop some keys to success, and then provide a list of additional resources.

Key words: Community involvement project, Concentrators, Majors, Neuroscience, non-majors, Service learning, Volunteering

Integrating service learning (SL) experiences into an undergraduate course can be a valuable tool for student learning outcomes. Research into the effectiveness of SL courses has shown that undergraduates who engage in SL activities have increased awareness of the social disparities within a community and show increased confidence in their ability to assume subsequent roles as leaders (Simons et al., 2011). Moreover, in addition to developing possible career interests, SL experiences can result in changes in attitudes, skills and knowledge related to the needs of local communities (e.g., Pinzon-Perez and Perez, 2006), especially when the SL activities are integrated with what occurs in the context of the classroom (Markus et al., 1993). Service learning has been viewed by some as “enlivening one’s sense of agency” (e.g., Snyder, 1990) by directly engaging students in work that takes place outside of the classroom.

Service learning components can vary widely, depending on both the subject matter and the needs of the classes. In undergraduate neurosciences courses, for example, students can become involved in outreach programs to underprepared local high students (e.g., The University of Pennsylvania’s “Pipeline” program; Edlow et al., 2007), or can work with other community populations in other ways. In this paper, we will describe two models of SL in two different neuroscience courses. We will describe the format and structure of each course, the characteristics of the students enrolled in the course, and the SL project(s) in which students participated. We then provide quantitative and/or qualitative feedback from our students regarding the value and impact of the SL projects. Finally, we offer our readers an assessment of the strengths and weaknesses of our SL projects, considerations regarding the make-up of the classes (majors, non-majors), and provide resources available for those considering integrating SL into their undergraduate course in neuroscience.

COURSE DESCRIPTIONS

The first course that will be described is a non-majors course called Sex, Gender, and the Brain (SGB). This course combines three hours of class and three hours of lab per week, for fourteen weeks. It is cross-listed between Biology and Women’s studies, and typically fills with a variety of majors. The course begins by broadening the students’ understanding of sex and gender through the discussion of complex non-human mating systems (Roughgarden, 2004; Zuk, 2003). Then, after an introduction to neurons and the brain, the course addresses topics such as the spectrum of physiological variation along the male-female continuum, focusing on the anatomy and physiology of the male and female brain, and the interaction of environment and social status with the brain (Hines, 2004). Throughout the course, students grapple with the primary literature and become conversant with experimental design, basic statistics, and hypothesis testing (Mead, 2009). Despite being beginners at science, they bring analytical skills developed in other courses to bear on this new and challenging material. Typically, the associated lab includes “wet lab” observations and experiments based on the brain, physiology, and gender (see Mead [2009] for some examples). In the Spring 2010 version of the course, the last six weeks of lab was replaced with a SL component involving brain outreach to second graders. This SL unit consisted of a cluster of learning activities (crafts and games) relating to the brain and to sensory physiology. We spent two weeks preparing and practicing the activities, and then divided into groups of four and visited six second grade classrooms in Newark, Ohio each week for a total of twenty-four classroom interactions (see Mead [2010] for more details).

The learning goals for the college students during the SL outreach were 1) to develop their knowledge about the brain, and 2) to theorize and to test hypotheses about gender-based responses to different types of learning

activities. For instance, we read studies suggesting that boys and girls prefer different types of toys, with boys gravitating to balls, blocks, bikes, trucks, cars, weapons, and male figurines, and girls gravitating towards board games, puzzles, crayons, and dolls (Berenbaum and Hines, 1992, Hines, 2004, Berenbaum et al., 2008). Theory suggested that boys would spend more time on rough and tumble games (Fabes et al., 2003; Hines, 2004), although some deviation from these patterns was acknowledged (Sandberg et al., 1993), with many factors influencing the gender-specificity of play (Hines, 2004; McHale et al., 2004; McHale et al., 2005).

Given these studies, we hypothesized that girls would be more engaged than boys with the brain puzzle, that the sensory activities (mystery socks, jelly beans, mystery noises) would be gender neutral, and that the running around and competitive activities (message transmission, neuron chain tag) would be more engaging for boys than for girls. We collected data for our hypothesis testing by monitoring student engagement multiple times over each of the activities and by comparing the engagement of boys and girls. Students were considered engaged when they watched the Denison students leading the activity, followed directions, interacted with peers when instructed (as in the tag and message games), and worked independently as assigned (as in the brain puzzle, see Fig. 1), etc. Students were considered unengaged when they were not looking at the students leading the activities, were talking out of turn, had their head down on their desk, or were otherwise not following directions. Briefly, we found that girls were indeed more engaged in the brain puzzle, but were also more engaged in some of the sensory physiology activities (which we had expected would be gender neutral), and the competitive and running around games were gender neutral, rather than biased towards the boys. More details on our methodology and our results are given in Mead (2010).



Figure 1. Denison students leading second graders in brain puzzle activities.

Most Denison students (78%) thought that the

experience of teaching about the brain enhanced their understanding of the content material, because they had to simplify it, explain it, and answer questions. Furthermore, students successfully made the connection between articles read in class and the behaviors of the second graders. The students who did not feel that service learning helped them directly with course content acknowledged that they learned more about learning styles, but typically didn't make the connection to the underlying theory. 87% of students said that they had developed a greater sense of themselves as agents of change, 91% of students said that the experience gave them more tools for solving community problems, and all agreed that it was important to engage in the community.

The other neuroscience course with a service-learning module is, by contrast, a course required for neuroscience concentrators called Introduction to Neuroscience (Neur 200). Introduction to Neuroscience is a 200-level "entry level" course to the Neuroscience concentration at Denison. The course meets for three hours per week of lecture/discussion, with an additional three-hour per week laboratory. Historically, the course enrolls students at the sophomore and junior levels who plan to pursue the Neuroscience concentration, complementing a major in either Biology, Psychology, or (more infrequently), Biochemistry. Students are required to have completed courses in Introductory Psychology and Introduction to the Science of Biology prior to enrolling in Neuroscience 200. In the spring of 2011, a service-learning requirement (termed a CIP, for Community Involvement Project) was piloted in the course. Two of the weekly labs were dedicated to the CIP project, but the rest of the CIP project took place outside of class time, either in group meetings with the course instructor, or on site visits by the students. Fifteen students were enrolled in Neuroscience 200 in the spring of 2011. Early in the semester, students were provided with an overview of the semester long projects, and were given the opportunity to designate their "top choices" for the available projects. Working with the Alford Center for Service Learning on campus, four possible off-campus sites were deemed to both meet Neur 200 learning goals while having needs that could be met by the students: Students worked in small groups (typically, four students per group) on their CIP projects, which were as follows:

Four students worked with the YES Clubhouse, an afterschool program in Newark, to develop a presentation to teens about alcohol and recreational Ritalin's effects on the brain. They used a jeopardy quiz-show format, with candy prizes, in addition to spending time with the teens and creating brochures that provided information about how Ritalin works in the brain, the general physiological effects of stimulants like Ritalin, and the potential effects of Ritalin abuse. They found that the YES Clubhouse teens had very little factually correct information about Ritalin and about recreational drugs in general. The teens responded well to the presentation and the prizes.

A second group of students worked to collect the most recent information about sports concussions, and created a presentation for local high school coaches about short-term

and long-term brain responses following concussion. These focused on the importance of sleep, now thought to aid in recovery, and on the value of baseline monitoring. After a number of scheduling problems, the coaches were receptive, and felt validated regarding their current use of the ImPACT test, a computerized cognitive assessment used by athletic trainers to collect baseline data of the athletes' mental performance prior to any injury.

A third group of students worked with the Chapel Grove retirement facility to create a resource guide about keeping the aging brain healthy. The students worked with the staff to develop materials in support of a four-pronged approach. The four main tenets were: 1) a healthy and nutritious lifestyle including anti-oxidants, omega-3 fatty acids and a balanced diet (Singh et al., 2011), 2) the role of physical exercise in supporting favorable changes in neuronal structure including dendritic spines, the dentate gyrus, the hippocampus and the entorhinal cortex (Stranahan et al., 2007), 3) cognitive exercise, which is thought to reduce the risk of Alzheimer's disease (Friedland et al., 2001), and 4) psychological well-being, including social support, religious involvement and personal meaning (Fry, 2000). In addition to the presentation and resource guide, the students created multiple copies of an interactive book containing mental exercises that residents could practice (See Fig. 2). These books remained in the facility for use by residents.

The final group of students worked with the Newark Health Care Center to create a presentation for family and medical caregivers of Alzheimer's patients about the potentially dangerous stress-related effects of care giving, role of support, etc. The information shared included the immunoprotective role of social support (Bodnar and Kiecolt-Glaser, 1994), the importance of becoming informed about Alzheimer's care and institutional support and the resultant reduction of stress, the role of exercise in combating oxidative stress and thus psychological distress, and the positive effects of artistic and sporting outlets



Figure 2. Sample image from interactive flip book, accompanying question: *If this is a mirror image, is this a right or a left hand?* (Miyazaki et al., 2001). Students worked on their projects in phases throughout the semester, guided by pre-

determined deadlines established at the beginning of the semester. During the month of February, students engaged in the planning and research gathering phase of their projects. They met with the course instructor as often as needed for feedback and guidance, prior to the site visit. During the month of March, students completed their on-site visits (one on-site visit per group), and began the creation of an informative brochure based on their projects to be distributed at a local health fair. Students in Neuroscience 200 participated in Denison's "Big Red's Big Day," a community outreach event (Fig. 3), and attended the Licking County Health Fair in early April, where they interacted with health fair visitors from the community, talked with community members about their topics, and distributed their created brochures. Finally, students presented their projects as a Power Point to peers and to members of the Neuroscience faculty on the last laboratory meeting day of the semester (early May).



Figure 3. Neur 200 students at Licking County Health Fair along with brochures and pencils with brain erasers.

Students were asked to provide responses to three questions generated by the Office of Service Learning at Denison: 1) *Did your service to the community in this course enhance your learning of the class's subject matter?* 2) *As a consequence of your community service in this class, did you increase your awareness of social, economic, or political issues that face our community? If so, what are those issues? Can you give a summary sense of what you learned about this issue?* 3) *What possibilities are there for the beneficial application from this course to address problems in the Licking County community?* In general, students responded positively to their CIP experience. Comments included: "I was proud of the mere idea that I would be completing a service project as part of my college neuroscience course." "The CIP projects were an excellent opportunity to apply neuroscience outside of the classroom." "The project reminded me to refocus. It also made me prioritize and remember that these are the people that my future research in neuroscience could help." "This neuroscience project taught me that is not just my job to be a critical consumer of information, but it is also my responsibility to distribute this information to the community." "The CIP was one of the most rewarding semester long projects I have been a part of at Denison." "I met people in our class that I

normally would not have gotten a chance to work with....I felt proud that we contributed to the everyday lives of the Chapel Grove residents." "At the beginning of the semester, I will admit that I was slightly skeptical as to the educational value of a CIP in a neuroscience class. However, I now agree that community service can be an invaluable tool to promote active learning in any academic department." "Having the opportunity to participate in the CIP has been an uplifting, rewarding, and educational experience."

GRADING AND ASSESSMENT

The SL projects counted for 15-20% of the final grades in both courses. For the sex, gender, and the brain course, the 15% was broken down into 3% for their presentation of proposed activities, 4% for four weeks of journal entries about the process, 5% for leadership and participation during the outreach events, and 3% for answers to essay questions relating neurophysiological theories to their observations and analyzing the data on the final. The Neur 200 students were assessed on their attendance and participation in group meetings with the course instructor, their work with other group members on the two laboratory days dedicated to the project design and to their oral presentation at the end of the semester, and on peer evaluations from other group members. Peers evaluated fellow group members on overall attendance and participation at all group meetings, on their contribution to the project (research, brochure creation, and on their overall "team effort").

Ideally, the SL projects should also be assessed in terms of how they facilitated progress toward learning goals and in terms of outcomes for the community partners. As described above, most students reported that the SL experience advanced their learning goals. In future iterations, we will assess students learning directly via pre- and post-tests.

Assessing the effects of our SL projects on the community requires more thought. Some of the populations that we worked with were protected populations, with the result that direct surveys of increases in knowledge might take more planning before they are approved by our human subjects review board. For example, working out questions that would both accurately assess increases in brain knowledge or interest in second graders and be answerable in five minutes will be challenging. However, the creation of pre- and post surveys at the Licking County Health Fair is more tractable, and should be done in the next iteration of CIPs in Neur 200. Furthermore, even if we can't parse out the effects of each community visit, we might be able to consider the role of multiple interventions as the campus-community relationships continue. As multiple Denison groups visit the YES clubhouse or the elementary and middle schools, we could ask if rates of recreational drug use decrease and graduation rates increase.

DISCUSSION

While the service learning experience resonated with both male and female students, the link to community service may have struck a deeper chord in female students,

especially in the non-majors course. Despite Denison's campus being fairly evenly male and female, 76% of the students in the SGB class were female, possibly suggesting that more females than males were attracted to this type of class. The majors neuroscience class was also predominantly female. The preponderance of female students in these service-learning classes is supported by an unpublished survey documenting volunteering in 2009 at Denison (Fisher, *unpublished*). Nearly twice as many female students as male students participated in service learning classes in 2009 (206 vs. 113), and the women who participated gave more than 1.5 times more hours to their service learning projects than the men gave to theirs (19.8 vs 12.6 hours). When activities outside of the classroom are included, 78% of females versus 69% of males participated in some philanthropic activity in 2009, and female students spent nearly 2.5 times more hours volunteering than males did (28.2 hours vs. 11.4 hours). Looking beyond our campus, this type of gender difference in altruistic behaviors is supported in some areas (Andreoni and Vesterlund, 2001; Themudo, 2009; Trudeau and Devlin, 1996), but not universally (Wilson, 2000).

These observations suggest that service learning components might attract more women to neuroscience courses. This could be partly because many of our female students already have experience with service learning or other forms of volunteering, so that the service learning portion of the laboratory experience seems comfortable and familiar, even if the topic is new and challenging. Furthermore, the service learning model of introductory biology allows students the opportunity to engage in problem-solving outside of the classroom. According to Yang (2010), college women who are not science majors are more likely to want to engage in science problem-solving outside of the classroom rather than within the classroom. Also, college women who are not science majors are apt to see science as only moderately or hardly relevant to life, rather than highly relevant to life (Yang, 2010). Service learning experiences are likely to give the scientific content a more meaningful and relevant context for these students (Bhattacharyya, 2009; George and Brenner, 2010; Reynolds and Ahearn-Dodson 2010).

While service learning can play an important role in many types of neuroscience courses, different goals and pressures surface in courses for non-majors versus courses for neuroscience concentrators or majors. Required courses for majors or concentrators tend to contain more content pressure than courses for neuroscience majors. This can be dealt with via judicious choice of community partner, or by planning the service learning activities outside of class or lab time. This latter solution can make group meetings difficult, and can lead to over-scheduling, but may be a good way to initiate small-scale SL projects into a neuroscience program. All students are likely to experience the service learning component as an important preview of real-world neuroscience. For majors, this experience may lead to the identification of future topics for graduate school. For non-majors, the preview is more in the nature of a case study for how science is done, and how neuroscience in general

can relate to social issues. In both groups, service learning can help the students form connections among their classes, whether within the science division or among all divisions.

Working out the logistics may be difficult and time-consuming. However, SL gives introductory students an opportunity to see neuroscience in action, and links class material to the real world. Also, SL may create more comfortable learning environment for some students. If serving a diverse student population is part of the mission of your institution, SL can be a potent tool for motivating and retaining students. SL benefits the community by providing access to important information. Linking universities to their communities is especially critical for both partners in a poor economy. In addition, SL gives students opportunity for self-reflection. As a consequence of their SL experiences, nearly all of the students realized the importance of education, were more aware of their position of privilege, and realized the importance of working in the community. Students also remarked upon the benefits of peer interaction, both within their SL team or group, and with their community partners.

While there are many benefits to engaging in SL activities, there are also some distinct challenges. For most faculty members, it is easier to support meaningful SL activities in small classes of 25 students or fewer. While it is possible to engage in SL activities independently, it is much easier, less time-consuming, and more likely to lead to long-term, sustainable benefits for all parties when institutional support is present. Ideally, this support consists of a service learning center, administrative awareness that SL is a valuable activity, and a budget. We have provided an appendix of resources should this support be lacking.

Some SL models require additional time outside of class; this poses a potential burden on already busy students. If SL occurs within the class-time framework, this may take time away from other potential neuroscience class activities. Students vary in their need for guidance. Lastly, it is important for all participants to remember that academics and community members often operate on different time-frames, needs, and budgets. Flexibility is required.

Given these opportunities for benefits and the possibilities of challenges, we have developed several keys to success. First and most important, make sure that you are addressing a real community need, and not imposing on community members or institutions that may already be stretched to the limit in terms of staffing and mission (Bowers-Sipe, 2001; Butin, 2006). This is where any campus or community service learning center can be invaluable in terms of connections, experience, and community assessment. It is also essential to start early: even if a campus service learning center is available, it is best to start planning early in the semester prior to your anticipated SL launch, both to make sure that you and your community partner are on the same page and are prepared, and to be able to provide accurate course descriptions ahead of registration deadlines. Without a service learning center, it may take 2-3 years to develop

relationships with community partners before engaging in any type of meaningful exchange. However, given the broader impact and outreach components required by many funding sources, there may be campus colleagues already engaged in this type of effort. Finding ways to engage with partnerships already in existence both speeds up the planning process and can increase the robustness and longevity of the relationship. It is also practical to start small, with a limited number of projects.

In our current educational climate, it is a good idea to plan for assessment of learning goals, and to consider assessment of service learning goals from the point of view of your community partner. Many direct surveys will have to go through campus human subjects review boards. If possible, plan for collection and analysis of data (publish in *JUNE!*).

Once you have identified your project, it is important to get your colleagues and your students onboard. Explain the value of service learning for both the students and the community. If your community partner organization can spare the personnel, ask if someone can speak to your students about what they will be doing, and why their assistance is critical. If no one is available, perhaps someone from the service learning center can speak more generally about the value of this endeavor.

Often even really gifted students need extensive guidance about their role and their interaction with community. Especially students who have not participated in the workforce will need to know about professional behavior, including the importance of promptness, dress code, respect for all of the people with whom they interact, and appropriate thank-yous. Most students will need guidance about working with protected populations, such as minors or clients at health care centers, as well as site-specific regulations about photographs, survey instruments, activities, etc.

Despite these challenges, the benefits of SL cause these authors to remain convinced that SL courses add valuable experiences for both our non-major students and our Neuroscience concentrators. In fact, we think that the interdisciplinary nature of neuroscience may lend itself particularly well to enriching SL opportunities. We both plan to continue to offer SL experiences, and hope to refine our methodology as we learn more about this activity ourselves!

Anyone interested in a copy of the brochures created by the Neuroscience 200 students should contact Susan Kennedy. Additional resources can be found below:

General Information

1. <http://www.compact.org/wp-content/uploads/resources/downloads/aag.pdf> (this is an excellent, annotated study of what is known about service learning and its effect on students and on the community)
2. <http://www.learnandserve.org/> (a link to the National Clearinghouse for Service Learning)
3. <http://www.service-learningpartnership.org/site/PageServer> (This site provides a network of over 10,000 individuals involved in service learning, including educators, parents and policy makers.)

4. <http://www.aee.org/> (another site connecting educators to timely research findings and resources in service learning)

Syllabi in SL

1. <http://www.compact.org/syllabi/> (Access to hundreds of sample syllabi across disciplines for those wishing to incorporate service learning into their classes)
2. http://www.servicelearning.org/instant_info/fact_sheets/the_facts/discipline/ (Access to sample syllabi in service learning courses, including syllabi from courses that include interdisciplinary perspectives)

Working with a community

1. <http://www.cbprcurriculum.info/> (Offers a model for working with members of the community in order to facilitate service learning)
2. <http://ctb.ku.org/> (A detailed resource offering information on the skills necessary to effectively build community and create change)

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