ARTICLE
Integrating Service Learning into a Neuropsychopharmacology Course

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Incorporating service learning (SL) experiences into undergraduate courses can be a meaningful way to engage students and connect course content to the real world. Neuropsychopharmacology courses are often popular amongst undergraduate students, but it can be a challenge to find ways to connect the theoretical issues discussed in the classroom to the real world, and convey the complexities of research on substance use. This article describes a partnership between a 300-level "Drugs & Behavior" laboratory course and a local not-for-profit anti-drug coalition focused on drug education and prevention. A series of semester-long service-learning projects were developed that met instructional objectives and coalition goals. Briefly, students applied critical thinking and analytical skills to survey data on substance use, collected from local 6-12th grade students, that would inform coalition programming. By the end of the semester, students had produced scientific reports of the data, developed informational summaries for community distribution, and wrote a mock grant proposal incorporating proposed improvements to the study. During the semester, students reflected on the SL experience and took surveys on SL outcomes. Findings suggested that this SL opportunity helped students make connections between course content and the real world, enhanced skills or awareness in ways that added value to the course, challenged them to understand a problem and generate solutions, and expanded their thinking regarding their ability to help tackle substance use-related issues in the community. Suggestions for implementation and refinement of this experience are offered.

Key words: service learning; substance abuse; addiction; pharmacology; neuroscience; undergraduate; data literacy; laboratory activity

BACKGROUND

Over the past decade, undergraduate STEM education has emphasized the importance of cultivating a deeper understanding on the relationship between science and society (American Association for the Advancement of Science, 2010, 2015). Guiding principles of undergraduate neuroscience curricula include an understanding of the societal relevance of neuroscience (Wiertelak et al., 2018) and the ways that neuroscience might "contribute to the discovery of solutions to vexing problems confronting society" (Ramirez, 2020). Consistent with these goals, it is valuable to identify learning experiences that enable students to apply their knowledge and skills to help understand and mitigate pressing public health issues, such as substance abuse.

Service learning (SL) is an effective way to cultivate this socially responsive knowledge. SL projects connect curriculum to community goals in ways that engage students "in direct, academically based problem-solving on social issues" (Altman, 1996). By structuring civically minded learning experiences in ways that develop knowledge and skills, SL experiences can enable students to make a difference in the local community in ways that are consistent with curricular goals and institutional values (Seifer, 1998; Ehrlich, 2000).

There are many dynamic ways that neuroscience programs have incorporated SL experiences, including experiential opportunities at community sites (Yu et al., 2013), educational outreach with community members (Stevens, 2011; Mead and Kennedy, 2012; Fox, 2015), and advocacy work (Fox, 2015). To date, few SL opportunities have involved data collection and/or analysis (Mead and Kennedy, 2012), skills that contribute meaningfully to scientific literacy (American Academy of Medical Colleges-Howard Hughes Medical Institute, 2009; AAAS, 2010, 2015; AAMC, 2010). Further, given the success of these experiences, it seems valuable to identify SL projects with more extended (semester-long) timeframes.

Neuropsychopharmacology courses hold promise for SL opportunities. These courses are common to undergraduate neuroscience, psychology, and biology curricula, and are often popular amongst students. Common topics in these courses include drug action, tolerance and withdrawal, and substance use disorder (SUD). Incorporating SL opportunities into neuropharmacology courses seems like a valuable way to (a) deepen students' understanding of the theoretical issues discussed in the classroom, (b) offer insight into the complexities of studying substance use in the real world, and (c) allow students to apply their critical thinking, research, and analytical skills to help address a public health goal in the community.

This paper describes a semester-long, laboratory-based SL project that we developed to enhance a 300-level "Drugs & Behavior" course (PSYC350). While a rich set of SL resources exist, Marshall Welch's framework for developing, implementing, and assessing SL projects (Welch, 2010) offers a useful structure and rubric for conceptualizing meaningful and sustainable projects. The mnemonic O.P.E.R.A. (Objectives, Partnerships, Engagement,

Reflection, and Assessment) reflects five objectives based on best practices in pedagogical literature. We have used Welch's O.P.E.R.A. model to frame our discussion of this SL project.

OBJECTIVES

There were two objectives for revising PSYC350 that seemed compatible with a SL project. These objectives are also aligned with core competencies (Kerchner et al., 2012) and guiding principles for undergraduate neuroscience education (Wiertelak et al., 2018; Ramirez 2020).

1. Connecting Classroom Learning to Students' "Place."

In "Drugs & Behavior" courses, there are many opportunities to draw connections between class content and the real world. Currently, the classroom portion of PSYC350 relies heavily on neuroscientific content, including mechanisms of drug action. I currently use Meyer and Quenzer's *Psychopharmacology* as a textbook, and incorporate news articles, documentaries (e.g., *Chasing Heroin* 2016), interviews (e.g., Gross, 2016; 2019), and case studies (Herreid, 2007; Wiertelak et al., 2016; Nagel and Nicholas, 2017) to help students connect course content to real world issues. It seemed valuable to identify additional ways to help students cultivate a nuanced and complex understanding of a real-world issue over a more extended timeframe (e.g., full semester).

Second, a place-based project seemed like a valuable way to explore substance-related issues specific to our local community. While substance use is prevalent amongst adolescents and young adults across the United States (e.g., Johnston et al., 2015, 2016), there are many micro- to macro-level factors that vary importantly based on geographical region (e.g., Keyes et al., 2014). While neuropsychopharmacology content often prioritizes micro-level factors (e.g., drug properties, genetic vulnerabilities), macro- and local context-level factors such as local perceptions, attitudes, and worldviews, also impact etiology (Keyes et al., 2014). The benefits of place-based education, which emphasizes learning through engagement with community-based issues, are well documented (Sobel, 2005; McInerney et al., 2011). Engaging with local community issues also has the potential to contribute to stronger "town-gown" relations and greater diversity in the perspectives that undergraduate students might normally be exposed to, particularly at primarily residential colleges.

2. Incorporating an Inquiry-Driven Research Project

Course-based research experiences that include inquiry-driven projects and authentic datasets can be used to meet key core competencies in neuroscience (Kerchner et al., 2012; Wiertelak et al., 2018; Ramirez 2020) and enhance undergraduates' ability to describe and interpret data as a crucial aspect of scientific literacy (AAMC-HHMI, 2009; AAAS, 2010, 2015; AAMC, 2010). The data produced and/or used in these experiences can vary in complexity (e.g., size, "messiness") in ways that engage higher-order cognitive skills of analysis, synthesis, and evaluation (Bloom, 1956). For instance, the size of datasets often increases from lower- to upper-division courses, in order to appropriately scaffold students' analytical skills (Kastens et al., 2015). Datasets can also vary in their "messiness," or the amount of variability, presence of outliers, and/or missing values (Kjelvik and Schultheis, 2019). In particular, the process of exploring, curating, and analyzing "messy" data can engage higher-order cognitive skills (Bloom, 1956; Gould et al., 2014; Kjelvik and Schultheis, 2019). As "messy" datasets more closely approximate laboratory experiences that students will encounter in real-world research settings, this work also enhances students' preparedness for many post-baccalaureate positions in research and medicine. For these reasons, I was interested in adding an inquiry-driven research project with an authentic "messy" dataset to "Drugs & Behavior."

PARTNERSHIP

There are various ways for faculty to find, connect, and build relationships with potential partner organizations in their community. Welch (2010) describes a partnership as a "joint effort of sharing resources and expertise to meet mutually defined goals." An ideal community partner will have goals that align with your instructional objectives, but also present an opportunity for students to help meet the partner's goals.

Anti-drug coalitions (ADCs) are not-for-profit organizations dedicated to reducing rates of substance abuse and addiction in their local community. While some ADCs provide direct services, such as educational programs for schools, ADCs coordinate and mobilize community stakeholders to develop collaborative approaches to reduce substance use in ways specific to their community (Community Anti-Drugs Coalitions of America, 2012). ADCs can range in size and composition but are often directed by local representatives familiar with community goals.

Over 5,000 community ADCs around the world are currently represented by the Community Anti-Drug Coalitions of America (CADCA, 2012). As of 2018, the Office of National Drug Control Policy has awarded over 2,800 grants to ADCs (ICF International, 2020). The Grundy Safe Communities Coalition (GSCC) serves Grundy County, Tennessee, a rural Southern Appalachian county with a population around 14,000 (Rural-Urban Continuum Code: 8; USDA Economic Research Service, 2020). The GSCC was established in 2011 and is directed by Ms. Chasity Melton; recently, her work has been supported by an AmeriCorps VISTA.

We first met at a monthly meeting of our county health council. Ms. Melton hoped to identify evidence-based curricula for drug prevention education in the local schools. We were both interested in collecting data from local schoolchildren on their perceptions, attitudes, and experiences related to drugs and alcohol, that could ultimately be used to inform prevention and education programming.

Needs Assessments

We met with local elementary and secondary school principals and teachers during district meetings and teacher in-service days. There, we conducted informal needs assessments that informed our survey goals and questions.

For instance, teachers were asked about their biggest concerns related to substance use in their students, and what misperceptions about drugs/alcohol they heard from their students.

Collecting Data for the SL Project

A full description of the survey-based study that produced the data for the SL project is beyond the scope and focus of the current paper. Briefly, survey questions were informed by needs assessments at the schools and designed in collaboration with the ADC. Importantly, questions focused heavily on perceptions and attitudes related to substance use, to enhance participants' sense of privacy and encourage honest responding (see "Required IRB Approvals," below). Teachers at participating schools volunteered to distribute/collect study materials (e.g., informed consent forms), read recruitment scripts, and administer the survey in class. Participating students were eligible for a gift card raffle. The final data included over 120 student responses and were stored as a password-protected SPSS file.

Ongoing interactions

Ms. Melton visited the PSYC350 class on the first laboratory session of the semester, to introduce the GSCC's mission, describe her work, and discuss the engagement experiences (below). PSYC350 students visited the GSCC office mid-semester for feedback on their data analyses and informational handouts (see below). Ms. Melton rejoined our PSYC350 class toward the end of the semester to discuss her steps forward and future iterations of the survey project.

ENGAGEMENT

The SL experience in "Drugs & Behavior" is built around a large, data-driven project. Two additional, supplementary projects – an informational handout and a mock grant proposal – are described briefly. The scope and content of these projects are constantly being refined based on feedback from students, community partners, and colleagues; notable changes are identified below.

1. Data Analysis Project

PSYC350 students processed and analyzed the large, "messy" authentic dataset collected in the school survey on adolescent substance use. Briefly, students worked in small, randomly assigned teams (3-4 students) to critique the study design, formulate hypotheses, organize, curate, and analyze chosen subsets of the dataset, and interpret and present their findings. Sample learning objectives are listed in Figure 1.

Teams worked toward these objectives via a combination of mini-lectures by the instructor, full-class and small-group discussions, team work on highly structured, stepwise guidelines (consistent with the TILT approach; see https://tilthighered.com/transparency), and modified tutorial sessions with the instructor. Students worked on this project during most lab sessions of the semester.

This project culminated in a formal data report that consisted of two parts. The first part contained a brief introduction to the research topic that cited relevant literature read in the course, followed by the team's general methods for data organization and curation (e.g., removal of incomplete data, criteria for identifying and dealing with response sets). The second part contained subsections that each described a specific hypothesis, approaches to data organization and analyses of the variables in question (e.g., calculation of a total score variable), reporting of results in APA format and in a figure or table, critique of the advantages and limitations of their analytical approach, and conclusions.

Sample learning objectives for Data Analysis Project:

1. **Critique of study design**
   - Evaluate study design, including recruitment practices, study procedures, and survey construction
   - Evaluate rationale for measures used to protect human participants (e.g., privacy, confidentiality)
2. **Hypothesis formation**
   - Identify constructs of interest, based on existing literature
   - Develop conceptual and operational hypotheses that can be tested in our dataset
3. **Data analysis**
   - Develop and apply strategies to organize and curate data, based on standard principles
   - Identify appropriate descriptive and inferential statistics for those variables
   - Perform and interpret statistical analyses on SPSS
   - Report the major results, using standard (APA) format
   - Present major results in a figure and/or table
4. **Interpretation**
   - Draw conclusions from the data
   - Evaluate the extent to which the data support a hypothesis
   - Speculate, within reason, about potential real-world implications

Figure 1. Sample learning objectives for the Data Analysis Project. Objectives could be modified based on students' development, course level, and nature of the SL dataset.

Teams submitted a draft of their report a few weeks before the end of the semester for formative feedback from the instructor, then revised and submitted their final team report during the last week of the semester. After the semester ended, analyses from their final reports were verified and included in informational handouts (see next below).

Two aspects of this project warrant additional reflection:

Jumping Into a Project "Mid-Stream."

One unique aspect of this SL project is that the students were not involved in study design and execution, but were working with secondary data. Students read the IRB proposals supporting the research project (see below) in preparation for in-class critiques of the study design, rationale, and execution. These conversations helped students think about potential confounds and variables in the dataset and the rationale for some of the procedural decisions that were made, based on the subject matter. For instance, students led a lively discussion about perceived benefits and drawbacks of alternative methods of data collection (e.g., focus groups, interviews), and how those approaches might impact recruitment, sample representativeness, and data analysis. To reduce students'

potential reticence to critique a study that their instructor helped to design, we discussed criticism as integral to the scientific process (e.g., Gillen, 2006), concrete examples from our study were provided, and the students then worked in small groups to facilitate idea-sharing.

Approaching Data Analysis and Statistics

The secondary dataset used in this SL experience was "messy" in anticipated ways. Prior to this course, many students seemed to have practiced basic statistics on relatively small, simple, and/or inauthentic datasets. A brief introduction to the attributes of "messy" authentic datasets were discussed, and we identified and evaluated strategies for working with "messy" data together in class (Gould et al., 2014; Kjelvik and Schultheis, 2019).

After students identified key features of their variables of interest (e.g., scale of measurement), a review of basic descriptive and inferential statistics was needed. The prerequisite course for "Drugs & Behavior" was a 200-level research methods course offered by the psychology department that could be used to fulfill major requirements in neuroscience and psychology. The course covered research methodology, basic statistics, and introductory work with SPSS. This experience seemed to provide adequate scaffolding for our work with this larger, more complex dataset (e.g., Kastens et al., 2015).

It was valuable for me to spend dedicated time with each team during their analyses. When this course was offered in person, I would circulate between teams as they worked. When this course was offered remotely (Fall 2020 and Spring 2021), I used a modified tutorial approach and scheduled dedicated times during our scheduled lab session to meet with each team. This arrangement came with a few additional benefits: it reduced the overall time that each team spent on Zoom (thereby reducing burnout), and it allowed teams who were not currently meeting with me to work in person (if desired) and in more flexible ways (i.e., to take breaks when needed, to transition to other lab projects/activities if stuck).

2a. Informational Handouts

In our early discussions, Ms. Melton requested informational handouts summarizing the major findings of the survey that could be distributed to local community stakeholders. Briefly, learning objectives for this project included presenting major findings accurately and concisely for a non-scientific audience and summarizing related scientific ideas to support and contextualize those findings.

In the first iterations of this course, student teams worked to create handouts directed at teachers/principals, parents/guardians, and local officials (e.g., city council members). I provided informal feedback on early drafts to each team; example feedback included (a) emphasizing the survey data, (b) formulating concise "take-home" messages about the data, and (c) considering the background and interests of their target audience. Students then presented a late draft to Ms. Melton for feedback. Example feedback from Ms. Melton included (a) more regional data for context, (b) simplifying figures for readability, and (c) more eye-catching, "fun" presentation formats. This project allowed students to practice communicating their results to non-scientific audiences. Students seemed to perceive this project as the most direct and tangible contribution to the ADC's mission.

Entire courses have been dedicated to science communication to various audiences. Due to time constraints and course priorities (see section 2b below), I ended up removing this project from our curricula and continued it as a series of independent study projects, often with students from the course (see "Leveraging student research power," below). Alternative suggestions include scaling down the Data Analysis Project and/or eliminating other large, non-required components of the course, to allow sufficient time for a project of this nature.

2b. Mock Grant Proposal

Currently, all 300-level laboratory courses in the Psychology Department and Neuroscience Program are designated as writing-intensive courses that meet major requirements. These courses focus on supporting reasoning, arguments, and creative thinking with scientific evidence, and typically involve writing a full scientific research manuscript based on laboratory work.

To meet these objectives, the PSYC350 students developed and wrote a mock grant proposal over the course of the semester. Mock grant proposals have been used in lower- and upper-division neuroscience courses (e.g., Itagaki, 2013; Köver, et al., 2014) to help students critique existing literature, identify gaps in knowledge, design a plausible study, and speculate about anticipated outcomes. Sample learning objectives include crafting a logical study with precise experimental details, and predicting results based on existing literature and proposed methodologies.

The mock grant proposal worked synergistically with the Data Analysis Project. Students practiced analyzing, interpreting and critiquing research articles (Gillen et al., 2006), which developed skills and provided specific content that could be used in both projects. In early iterations of this course, students were asked to craft a proposal for the GSCC on how data on substance use might be collected from the community, i.e., a revision, extension and/or follow-up to the study that had produced their secondary data. These proposals incorporated aspects of their Data Analysis project (e.g., as "pilot data"). Students connected their scientific thinking to SL goals by evaluating alternative data collection methods (e.g., focus groups, interviews), given participants' age range and the subject matter; considering the utility of survey questions that remained constant from year to year versus focusing on one particular topic/issue each year; and exploring the extent to which comparisons to national or statewide data were useful, given differences in macro- and local context-level factors that contribute to substance use. In future iterations of the course, some of these topics have been raised in class-wide and/or small-group discussions.

In subsequent iterations of this course, students were allowed to pursue their own interests, so long as the proposal related generally to the topic of adolescent substance use. This flexibility expanded the range of proposed topics and methodologies, enabled students to

build on their previous knowledge (most students are neuroscience or psychology majors, but a few have been biology, biochemistry, or chemistry majors) and resulted in vibrant discussions evaluating how certain questions in drug- and/or addiction-related research might be best addressed using different methodological approaches. Neuroscience majors were asked to include both behavioral and brain hypotheses in their proposal, and many proposed using animal models.

Throughout the semester, students brainstorm and troubleshoot various aspects of their proposal in scaffolded ways. Sections of the proposal underwent peer and/or instructor review and revision (e.g., Peterson et al., 2020) before the complete proposal was submitted at the end of the semester. Advantages to this project included increased student independence and logical fit with curricular writing requirements and scaffolding. Some students' topics were more closely related to the Data Analysis Project than others, which could be perceived as a disjunction between activities, but also resulted in valuable learning opportunities.

REFLECTION

Written reflections can help students identify valuable aspects of their SL experience (Welch, 1999; 2010). Students respond to instructor-developed prompts on various aspects of their SL experience throughout the semester. An example prompt might be:

> "Reflect on your data analysis work thus far. In what ways have you found yourself able to apply knowledge/thinking from your major/minor while working with these service-learning projects? In what ways have you found these activities to be difficult or challenging? What strategies or thinking have you utilized to help you follow through despite difficulties you may have encountered?"

Effort-based grading with a minimalist approach (e.g., strong, satisfactory, incomplete) was used for these reflections (Elbow, 1997; Schinsky and Tanner, 2014), to encourage honest, candid self-reflection and a willingness to take intellectual risks.

ASSESSMENT

I collected data on students' perceived learning related to this SL experience once, during its first iteration, which included all three engagement techniques described above. Of course, the SL experience has been refined since this assessment was performed, and many impacts could emerge well after the course ends. In these ways, the following data are limited but promising in describing the full impact of this SL experience. Assessment during subsequent semesters of PSYC350 was not conducted, due to the broad impacts of the COVID-19 pandemic.

Methods

Participants were undergraduate students, ages 19-21, enrolled in the first SL version of the 300-level "Drugs & Behavior" course (Spring 2019) at a small liberal arts university in Tennessee. The course prerequisite was completion of a 200-level research methods course. The course was comprised of juniors and seniors. Most (81%) students were psychology majors and 19% were neuroscience minors. No other inclusion/exclusion criteria were used. The IRB approved this study.

Study participants were recruited orally during the first lab session of the semester. A written announcement containing a link to the study materials on Qualtrics (www.qualtrics.com) was posted to the course Blackboard site after class. The Qualtrics link contained the informed consent form, which described the study's purpose as to better understand students' perceptions, attitudes, and learning related to their service-learning experience in the course. No deception was involved. Instructions informed students that they would be asked to complete brief (5-10min), anonymous surveys on Qualtrics at various points that semester about their SL experience. As these surveys provided opportunities to reflect on their SL experience, students were expected to complete each survey during our lab session, while I was out of the room.

Students were also informed of the pedagogical value of their data, and given the option to allow their anonymous responses to be shared publicly for research purposes by "opting in" or "opting out" at the end of each survey. If students "opted out," their anonymous data were seen by the instructor but would not be shared publicly. All students "opted in" to each survey.

No identifying information (e.g., name, gender, major) was collected, to enhance participant privacy. A text box at the end of each survey allowed participants to ask questions about the study while remaining anonymous; the instructor would post answers to the questions on Blackboard. Participants did not receive compensation.

Pre-Term Survey

The first survey was administered during the first week of the semester. Internally developed categorical questions (yes, no, not sure) were used to assess previous experience in SL courses, knowledge about this SL experience, and initial interest in this SL experience. Two Likert-type questions assessed students' agreement with statements about perceived complexity of understanding adolescent substance use and self-efficacy engaging with substance-related issues in the community. Three additional Likert-type questions adapted from existing SL questions (Gelmon et al., 2006) were used to assess expectations regarding the ability of SL experiences to make connections between the classroom and real world, better understand course materials, and benefit the community. The scale for all Likert-type questions ranged from 1 (strongly disagree) to 5 (strongly agree), with 3 being neutral. Two open-response questions collected qualitative data on students' definitions of SL and expectations about the SL experience.

Midterm and Final Surveys

Two existing SL surveys were administered during the midpoint of the semester and final week of the semester. The first survey (McClure Brenchley and Donohue 2017) consisted of 14 Likert-type questions across four domains:

academic learning, civic engagement, professional development, and service learning. The scale ranged from 1 (strongly disagree) to 5 (strongly agree), with 3 being neutral. Each question was changed to an active voice (e.g., "I am gaining knowledge, skills or awareness…") for the midterm survey.

The second survey (derived from Winterbottom and Mazzocco, 2015) consisted of 32 items. The items were rated on five-point scales in terms of level of agreement and importance, with the scales ranging from 1 (strongly disagree or strongly important) to 5 (strongly agree or strongly important), with 3 being neutral. Each question was changed to active voice (e.g., "I am developing a better understanding…") for the midterm survey. Composite scores on five standards were calculated (see Winterbottom and Mazzocco, 2015): students, content, instruction, learning environment, collaboration and communication, and professional growth and responsibility.

Finally, the pre-term survey (omitting the categorical questions) was used to identify change across the semester.

Results

Most of the class participated in preterm (87%, *n*=14), midterm (100%, *n*=16), and final (94%, *n*=15) surveys. Forty-three percent reported having taken a course with a SL component previously at the institution; one student was unsure whether they had or not. No student reported knowing that PSYC350 had a SL component prior to the first day of class. Over half (57%) of the students reported that the presence of a SL component increased their interest in the course; the remaining students reported being neutral/not sure.

All (100%) students agreed with the statement "Understanding adolescent substance use/abuse in the real world is complex" at the beginning and end of the semester" (pre-term: *M*=4.79, *SD*=0.43; final: *M*=4.73, *SD*=0.46). In contrast, the percentage of students agreeing with the statement, "There are limited ways that college students can help tackle substance use/abuse issues in a community" decreased from 50% at the beginning to 27% at the end of the semester (pre-term: *M*=3.36, *SD*=1.08; final: *M*=2.53, *SD*=1.25).

Students' self-reported responses about their SL experience suggest that it was positive and impactful. In the McClure Brenchley and Donohue (2017) survey, one-sample t-tests on the final survey data showed that nearly all scores differed significantly from the neutral score of 3.0 (df=14, p<0.05; Figures 2-3). The greatest differences emerged with response to academic learning (AL) and civic engagement (CE) questions (Figure 2).

There was one professional development (PD) question that was not associated with a statistically significant difference (Figure 3), but it was not an explicit objective of the course and thus little time was devoted to it.

Student also reported substantial agreement with statements across the five domains of the Winterbottom and Mazzoco (2015) survey at the end of the semester.

Composite scores on each domain differed significantly from the neutral score of 3.0 (df=14, p<0.01). The largest difference was in the Content domain [*t*(14)=13.08, p<0.01],

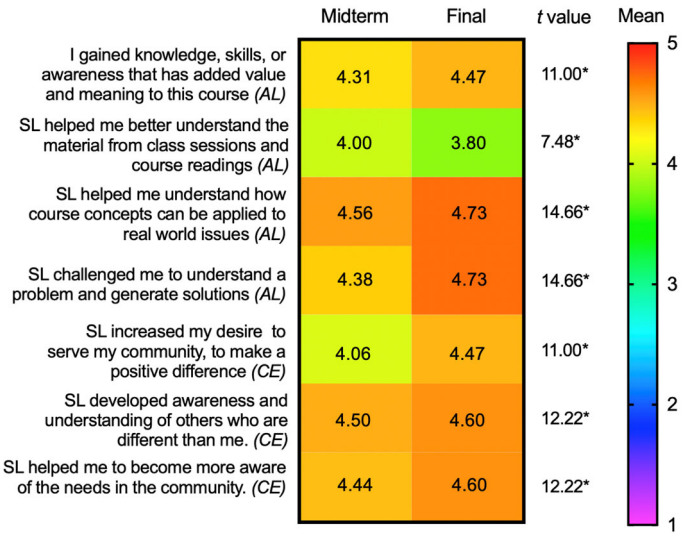

Figure 2. Data on academic learning (AL) and civic engagement (CE) outcomes associated with students' SL experience, collected on surveys at midterm and the end of the semester ("final"). Mean score on a five-point Likert-type scale (1 = strongly disagree, 5 = strongly agree) is listed in each box and represented on the color scale. One-sample t-test values on the final survey data are listed; * p<0.05.

which included questions such as, "To complement what I was learning in the classroom," and, "I understand the connection between the themes I have studied in the class and this experience." The next largest difference was in the Instruction domain [*t*(14)=11.85, p<0.01], which included questions such as, "I learned to apply principles from my course to new situations," and, "I refined my ability to articulate new ideas."

Students' responses to the open-ended question "Working with a community partner on issues related to adolescent substance use/abuse was…" on the final survey included:

> *"Challenging but rewarding and required thinking outside the box to apply what we learned to the [local] community."*
>
> *"A good way to further our understanding of the material we learn in the class room setting and apply it to the field."*
>
> *"Fulfilling! I think the idea that these deliverables might actually be read by someone makes working through the process diligently that much more sweet."*
>
> *"Very informative about the surrounding community and allowed me to get outside of the bubble [of our university] to see what is really going on in this area."*
>
> *"Informative and helped ground the project in reality. Meeting the community partner and knowing that they were sincerely hoping that our work would help them in their efforts made the project feel more important and meaningful."*

No negative comments emerged in this dataset. Some

students initially seemed concerned about the amount of work involved and the longer time frame of this project. The fact that most of this project was completed during lab sessions seemed to ameliorate students' concerns.

There were many limitations to this assessment. The relatively small sample size limits generalizability to some extent. Self-report measures can be inaccurate and subject to biases. The survey questions were not designed to intentionally assess learning objectives specific to this SL experience. Semester-based surveys also do not offer a sense of potential longer-term impacts that might develop or change after the course concludes. However, the benefits described here are consistent with broader literature on SL opportunities in higher education (Altman, 1996; Seifer, 1998; Ehrlich, 2000).

LOGISTICS AND RECOMMENDATIONS

ADCs As Community Partners

Early and consistent connection with Ms. Melton helped clarify their organizational goals and desired deliverables. For instance, we discussed community feedback on the informational summaries that the AD distributed, which helped us to refine the content and structure of this project in the future. Students requested more exposure to the community partner and local stakeholders (e.g., teachers), but access must be balanced with a respect for others' time and privacy. We are also interested in formalizing feedback from GSCC as well as our partners in the school district. Finally, we worked to design this SL experience to be relatively iterative and sustainable, so that our projects can develop and shift as needed in future semesters.

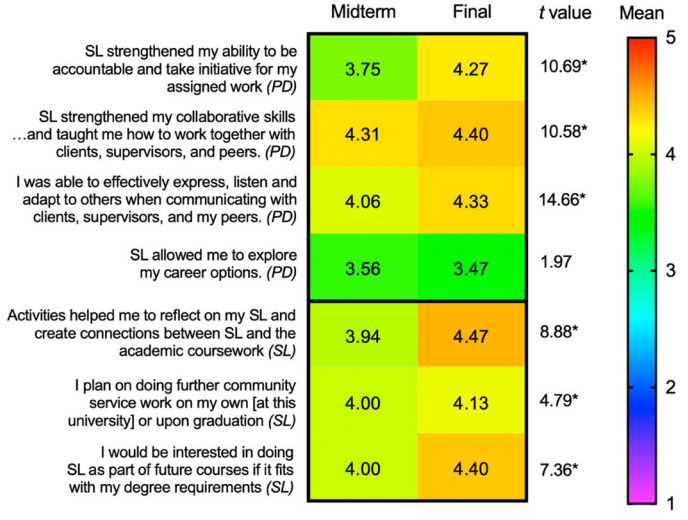

Figure 3. Data on professional development (PD) and service learning (SL) outcomes associated with students' SL experience, collected on surveys at midterm and the end of the semester ("final"). On the first SL question, "activities" was used to replace "Written assignments, discussions and/or exercises" for figure brevity. Mean score on a five-point Likert-type scale (1 = strongly disagree, 5 = strongly agree) is listed in each box and represented on the color scale. One-sample t-test values on the final survey data are listed; * $p<0.05$

Required IRB Approvals

Briefly, this course was supported by one IRB protocol with many amendments. The main protocol supported data collection in the local schools and underwent a full board review, due largely to the sensitive nature of the questions (perceptions/attitudes related to drugs and alcohol) and the participants, who were all minors (6-12th grade) and thus a vulnerable population. The availability of community resources (e.g., reliable internet, home computer access) influenced some decisions related to study design. For instance, we chose to send printed consent forms home with interested students to be signed and returned to their school. This potentially broadened the participant pool, but it was more labor-intensive than a digital form. The local community is also relatively small and rural, so particular attention was paid to participants' privacy.

Two amendments supporting PSYC350 were then submitted for expedited IRB review. The first amendment described how the survey data would be used in PSYC350, including privacy and confidentiality measures. This amendment was submitted a month prior to the start of the semester, to allow time to make any requested revisions by the first week of class and thus speed up students' ability to work with the survey data. The second amendment added the students as research personnel. During the first lab session, students were asked to upload their CITI Program certifications in responsible research ethics to Blackboard within a week. The prerequisite research methods course requires these certifications; all students found and uploaded them within a few days. The certificates were attached to the personnel amendment, which received prompt approval.

Finally, small amendments were submitted to add student researchers as personnel (see below).

Leveraging student research power.

Four students worked on various aspects of the survey research project supporting this SL experience. Two students helped source and review related literature, prepare survey materials for schools, confirm participant eligibility, and pre-process and code data. After PSYC350, two students helped to finalize the informational deliverables for GSCC. These students performed this work as part of an independent study and, in one case, a Summer Undergraduate Research Fellowship co-mentored by Ms. Melton.

Support and Resources

This SL experience could be conducted with limited funds, depending on the scope of data collection and participant compensation involved in collecting the dataset that students will use.

The GSCC study was funded, in part, by a research grant from the Mellon Collaborative for Southern Appalachian Studies. These funds covered survey costs (e.g., participant compensation).

Our institution's Office of Civic Engagement sponsors a Civic Engagement Fellows program for faculty. Fellows attend regular workshops, brainstorm and troubleshoot, and discuss strategies for cultivating and maintaining

relationships with our community partners. This program provided critical resources and support in developing this SL experience.

Finally, I was awarded internal funds from our Center for Teaching to engage PSYC350 students in focus groups and/or informational interviews with community members; the funds would be used for participant compensation. It was immediately clear that this proposed extension was too ambitious to prepare for and execute thoughtfully while maintaining our other course objectives. It presents, however, another potential approach to data collection that could be incorporated into a SL experience.

CONCLUSIONS

Incorporating this SL opportunity into our "Drugs & Behavior" course helped deepen students' understanding of the theoretical issues discussed in the classroom and underscore the complexities of studying substance use in the real world. It also enabled students to apply their critical thinking, research, and analytical skills to an authentic, "messy" dataset in a large, inquiry-driven project, which served a public health goal in the community. The experiences align with core competencies in undergraduate neuroscience but could also potentially translate to other STEM fields.

To discuss this SL experience and/or to obtain copies of relevant course materials, please contact kmcammac@sewanee.edu.

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