Service Learning for Science: A Transformative Field Experience for Preservice Elementary Teachers

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Abstract

Preservice teachers are often faced with tension between theory about effective science education and practice. Service learning is one method for helping bridge the disconnect in meaningful ways that are mutually beneficial for both preservice teachers and community partners. With the recent adoption of the Next Generation Science Standards (NGSS) in most states, and the upcoming accountability testing for science, some elementary schools are beginning to shift toward more science instruction that supports students' developing understanding of science concepts, as well as the practices in which scientists engage. This transition time provides an excellent opportunity to purposefully partner universities with elementary schools in an effort to support science education (for preservice teachers, inservice teachers, and elementary school students). We have redesigned our science methods course to integrate service learning to provide our preservice teachers with authentic experiences for teaching the effective pedagogical strategies and theories learned in the course. This paper describes the service learning component of our science methods course, which includes a unique field experience. It also illustrates evidence of the positive impact this service learning approach has had on our preservice teachers and community partners, and lessons learned through the process.

Introduction

Preservice teachers (PSTs) are often faced with tension between theories about effective science education that we teach at the university and their student teaching experiences (Abell & Roth, 1992; Gunckel, 2013). One challenge is that science in the elementary grades is simply not being taught on a regular basis (Tilgner, 1990) and so many elementary PSTs have little to no opportunity to observe or practice teaching science during their student teaching[1] experience.

This might be due to heavy emphasis on mathematics and literacy at the elementary level, or that science is the subject area that elementary teachers feel the least prepared to teach (Banilower et al., 2013). In addition, when science is taught in the classroom where the PSTs are placed for student teaching, the pedagogical strategies that PSTs witness often do not match the strategies modeled in their science methods courses (Banilower et al., 2013; Bush & Cook, 2016).

Additional field experiences for PSTs that are incorporated into science methods courses allow them to have a more purposeful opportunity to observe and teach science activities aligned with research-based methods. Some studies have examined the effectiveness of collaborations between formal and informal educators (Gross and James, 2017), university partnerships with community organizations (Steinberg and Saxman, 2017) and the implementation of after school field experiences (Cartwright, 2016) in preparing science teachers. For our science methods courses, we typically schedule class meetings at the university for the majority of the term, then send students out to an elementary school site (where effective science teaching regularly occurs) for one or two class sessions to teach science lessons they've developed. We also have structured reflections afterwards so that PSTs could debrief what they taught. This is the approach that we have taken at our university because the majority of our PSTs' student teaching placements typically have not included regular, if any, science instruction. While this may be a common way to integrate field experience in elementary science methods courses, these supplemental field experiences are not only short-term, but they are also generally structured such that the PSTs don't get to know the students they're teaching or subsequently tailor their plans to meet the needs of the students.

In response to this problem, our goal was to restructure the existing field experience in our methods course so that our PSTs could spend the entire semester building relationships with the elementary students to whom they'd be teaching science lessons. We wanted our PSTs to have their elementary students in mind as they learned (in our methods class) how to effectively assess, plan, and teach science for a specific group of students representative of our diverse local community. We realized that service learning could be used as an innovative approach to contextualize a specific field experience in science that could benefit our PSTs, elementary students and their teachers. Introducing service learning into our science methods course was innovative because it served to improve and transform our PSTs field experience. Furthermore, we felt that service learning could help bridge the disconnect between the science education theory we wanted our PSTs to learn, while also providing them opportunities for authentic practice.

In this paper we describe the service learning component of our elementary science methods course, which includes a unique field experience in science for our PSTs. We also describe evidence of the positive impact this service learning approach has had on our PSTs and community partners, as well as lessons learned through the process.

Service Learning

Service learning (SL) is an instructional approach that centers around partnerships between university classrooms and community organizations. In this approach, students apply what they are learning in a course in the context of community service. What results is a mutually

beneficial partnership in which students learn to apply theory in a real-world context while also learning more about and helping their community. Furthermore, the community partners receive support in areas of need.

In the case of teacher education, SL usually takes the form of PSTs enrolled in a course during their preparation program engaging in service at schools within their community. In this situation, PSTs engage in a type of field experience that is targeted to the practice of skills and knowledge that they are gaining in the particular course incorporating the SL experience, while learning more about working with local student populations beyond the classroom in which they are placed for student teaching. In turn, local high-needs schools in which PSTs complete their service gain additional support. Research has suggested that SL can be a powerful strategy when incorporating field experiences in elementary teacher education programs, having enduring positive impressions on PSTs (Lederman, 1999) and benefiting their development of science teacher identity (Wilson, Bradbury, & McGlasson, 2015). Partner K-6 teachers also benefit; their students get to connect with university students and have more buy-in to the science content and connection to their own community (Bush & Cook, 2016).

PSTs often enter credential programs with stereotypical beliefs about students' abilities to learn, which can inhibit them from providing equitable learning opportunities (Sleeter, 2005). In addition, a large number of teachers in the United States leave their credential programs feeling unprepared to teach students from diverse backgrounds (Banilower et al., 2013). In a traditional student teaching experience, a PST is placed in one classroom with the guidance of an inservice teacher. If this classroom does not include regular science instruction nor have students from diverse backgrounds, PSTs may not gain the experience they need to differentiate for various types of learners. SL can act as one way to challenge PSTs' beliefs about diverse students (Cone, 2009) as well as themselves (Wilson et al., 2015). It can also assist in developing PSTs' reflective skills and in questioning their own biases and assumptions (Wade, 2000) by giving them a targeted experience to teach science to a diverse population, then explicitly reflect on the experience. Brown (2005) argues that SL assists PSTs by increasing their awareness of the diverse needs of the school community, which can inspire them to develop strategies to meet those needs.

Additionally, the recent adoption of the Next Generation Science Standards (NGSS; NGSS Lead States, 2013), means a need to implement science instruction in a way that is very different from how science has been taught in most elementary classrooms, for not only PSTs but inservice teachers as well (Banilower et al., 2013). As a result, there is a dire need for PSTs to practice applying NGSS in the context of real K-12 classrooms as part of their credential programs, not just in the theoretical context of the university classroom, as well as a need for inservice teachers to observe examples of NGSS-based instruction (NRC, 2012; 2015). By incorporating a SL field experience in our science methods course, we sought to not only give our PSTs a chance to practice authentic science instruction (which in our case

included communicating through letter writing with students; assessing their prior knowledge; planning and teaching a lesson) but also share examples of NGSS-based lessons with our partner inservice teachers.

Service Learning through our University's Community Engagement Center

Service learning (SL) is a widespread teaching approach at our university, where it is managed in collaboration with our Community Engagement Center in which university students engage with an organization in the local community to apply what they are learning in a course to a real-world context, while giving back to the community. Through a SL experience, students (1) bridge theory with practice, (2) help address issues in the local community, and (3) use their growing knowledge to respond to social problems.

SL is a teaching method that our university faculty use to help students deepen their understanding of course material in the context of issues that matter in the community. Students participate in on or off campus activities and experiences at a business, non-profit, or governmental setting (also known as community partners). They participate in these activities in order to respond to a social problem. In SL, students are asked to articulate how the service experience affirms, expands, integrates, or calls into question the academic content of the course. Students consider these issues through the process of structured reflections (described below). This form of experiential learning is mutually beneficial to the student and the community partner (August, Cook, Fabiano, Kivel, Macias, & Redada, 2017).

Other defining features of service learning (SL) from our university's Community Engagement Center:

- SL may be performed at a site either on or off campus.

- SL may involve direct service or be project-based:
    - Direct service learning is performed on site with students working either directly with clients or employees at an agency and this work should be beneficial to the community partner and educationally beneficial to the student. Examples of direct service work include:
        - Tutoring and mentoring students;
        - Writing Partners- letter exchange between university students and fifth-graders
        - Reading to third graders;
        - Volunteering hours at a food bank or a homeless shelter;
        - Facilitating health education programs; and
        - Developing and leading activities for people with disabilities.
    - Project-based service learning may involve more abbreviated contact with an organization and the bulk of the work students do focuses on developing a particular project that is beneficial to the community partner and of educational benefit to the student. Such projects have included:

        Designing or upgrading a website; conducting telephone surveys or on-line research; analyzing data and providing feedback to the partner; and, designing informational or promotional materials.

We use direct SL in our elementary science methods course to address several social needs which are mutually beneficial for our PSTs, elementary school students and their teachers: (1) providing elementary PSTs opportunities to authentically assess, plan, and teach science lessons tailored to elementary students with a high diversity of backgrounds and learning needs, (2) encouraging more time being spent on science instruction in elementary schools, and (3) engaging inservice teachers and their students in NGSS-aligned science instruction.

Elementary Science Methods: The Service Learning Component

To begin the process of developing a SL component in a methods course, a relationship must first be established with the partner schools and teachers. This relationship is usually facilitated by the university's Community Engagement Center (CEC). While we used the SL goals and Writing Partners Program from our university's CEC to develop the SL component of our science methods course, the process for identifying a community partner was adapted to meet the needs of our science course. As former elementary school teachers and professional development providers in our region, we have various connections with our local school teachers. Supervising our PSTs in their classrooms and engaging with inservice teachers on various professional development has provided us opportunities to build strong relationships with teachers from high needs schools in our area so we have been able to select our own fifth grade classes with whom to partner.

Over time, we've established mutually agreed upon goals for the SL that benefit all involved. For us as the elementary methods instructors, goals include providing opportunities for our PSTs to establish positive relationships with elementary students from diverse backgrounds, and to observe and practice teaching science activities in authentic settings. For the inservice teachers, goals include providing support to their fifth-graders in communicating information about conceptual understanding in science (via Writing Partners, which is described below), and to engage elementary students in working with university students in science, including a visit to our university campus. From this relationship, the goal is not only for our students to gain practice in teaching science to the fifth-graders, but for the fifth-graders to also see our students as college student role models and to begin to see themselves as future college students. Prior to each SL partnership, we meet with our community partners (inservice teachers) and discuss goals and protocol for the experience, including the various logistics involved in the Writing Partners letter exchange, scheduling the two face to face gatherings: (1) the PSTs visit and observation of the 5^{th} grade classroom and (2) the 5^{th} graders visit to the university campus.

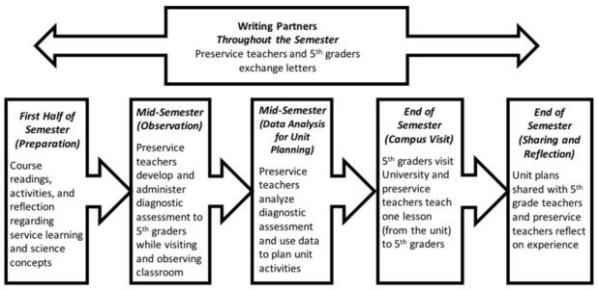
To formally articulate our goals for the SL component, we added two course objectives developed by our university's Community Engagement Center (CEC) to our science methods syllabus: (1) Develop appreciation for the diversity of communities that make up our region, and (2) Develop an understanding of the local social problems facing our community. We identified sustainable farming as the local social problem that PSTs and the elementary students would develop understanding about via science activities related to aquaponics, which is described in detail below. The resulting course description is:

> Knowledge of basic principles and strategies related to science education, incorporating an expanded treatment of science pedagogy, manipulatives, technological supports, accommodations, adaptive instructional techniques, and other strategies especially suited to the instruction of diverse student populations. This course will explore collaborative ways of teaching and learning science in a diverse school community. It will also include a service learning component, which serves as a pedagogical strategy for experiential learning that is mutually beneficial to the student and community partner. Methods and curriculum presented will work with all students, but are particularly designed for working with language minority and other diverse student populations, since these are the majority of students in California. The course will take an exploratory, constructivist approach to teaching and learning science, in keeping with the Next Generation Science Standards. The instructor and participating teachers will collaborate to create, deliver, and assess ways of teaching, and our students will work together to explore different ways of teaching science. All students will plan for and teach a science unit in a K-6 classroom, assess student learning, and reflect upon the effectiveness of their instruction and service learning.

Overview of the Service Learning Project

An overview of the SL project as it is incorporated into our 15 week semester-long methods course is outlined in Figure 1. Our science methods course meets once per week for three hours. SL is embedded into the course as a requirement, and includes several components that span across the entire semester. Each component of the process is described in greater detail below.

Figure 1 (Click on image to enlarge). Overview of service learning project.



Writing Partners. The first (and ongoing) part of the SL project for the PSTs is Writing Partners, where they are paired up with fifth-grade students to write and exchange five handwritten letters with them throughout the semester. The Writing Partners program is a form of direct service learning that is offered through our university's Community Engagement Center (CEC).

Goals of the Writing Partners program (from our university's CEC) include:

- building and/or strengthening literacy
- enhancing knowledge of writing through a letter exchange with a real audience
- connecting university students with K-12 students in the region
- using the letter exchange to help students articulate and reinforce their identities as 'college students'
- building relationships through literacy
- encouraging elementary school students to begin to prepare for college and see themselves as college eligible

Depending on the number of PSTs in the science methods course, and the number of fifth-graders in a class, we may partner with multiple inservice teachers and their classes such that our PSTs are paired with two to three students. While our PSTs individually write letters to only two or three 5th graders, they work in small groups (4-5 PSTs) to assess, design and teach their science lesson to a larger group of students, typically about a dozen. Initial letters include questions and comments to build positive relationships and for PSTs to learn more about the lives and experiences of the students in the high needs school. These questions start out more general and include examples such as: What are you learning about in science? What do you want to know more about? What do you like to do for fun? PSTs also include descriptions in their letters of what it is like to be a college student and why they went to college.

Subsequent letters attempt to glean information from the students about their conceptual understanding of science content related to an identified social problem (sustainable farming), since we're in an agricultural region that often experiences drought. In the science methods course, our PSTs specifically learn about the NGSS Disciplinary Core Ideas on Interdependent Relationships in Ecosystems and Human Impacts on Earth's Systems and Organization, and the Crosscutting Concept of Cause and Effect. They use this knowledge to collaboratively construct questions in their letters that allow the fifth-graders to describe their current understanding (or misunderstanding) about these concepts. As a class, we generate a list of potential questions they might ask their Writing Partners. Examples of specific questions include: Where do you think your food comes from? What do you think farmers do when there's not enough water available? What do you think sustainable farming is?

The collaboratively generated list of questions is then sent to the fifth-grade teachers to discuss in their classrooms. Inservice teachers agree to facilitate these discussions, which focus on understanding what the questions are asking as well as sharing ideas for how the students can respond to the questions. In this way, the fifth-graders are supported to meet the language demands of the letter exchange and get to engage in ongoing discussions about the science concepts and social problem of sustainable farming in their classrooms.

According to Miranda and Hermann (2016), using a fresh lens to change an existing practice is innovative. By leveraging the existing Writing Partners program on our campus, we were able to begin to look at the field experience within our methods course through a new lens and frame it in a new way. Because the course is so short, with a limited opportunity for our PSTs to spend time in classrooms outside of their student teaching placements, Writing Partners became a way for our students to develop relationships with 5^{th} graders from a distance, even before stepping foot in the classroom. While Writing Partners is a key thread throughout the SL experience we've designed, it is only one component of the experience. Additional components of the service learning project are described in the following sections and contributed to the transformation of our PSTs' experience in planning, instructing, assessing, and reflecting on student learning in science.

Preparation. In order to prepare our students for SL, we include a required reading on the first week of class titled "Strengthening Your Personal Development Through Community Engagement" (Arnaud, 2009). The article discusses positive outcomes of SL when faculty use it as a teaching method and make explicit connections between the course content and the SL experience. Effective learning occurs when a student can make clear connections between the content from university courses and apply it the real world (Arnaud, 2009). Thus, we find SL to be extremely applicable to our science methods course because we want to provide our PSTs with opportunities to not just learn about strategies for teaching science, but apply what they're learning with real students who represent the diversity of our community. Participating in the Writing Partners letter exchange also helps prepare PSTs by providing them opportunities to build relationships with fifth-graders so they can incorporate students' prior knowledge, experiences, and interests into the lessons they're planning.

Observation. Midway through the semester, after three letters have been exchanged, we go out to the public school with our PSTs to meet the fifth-grade Writing Partners students in person for the first time and to observe them engaging in science activities in their own classrooms. When we meet with the fifth-grade teachers to discuss goals and protocols prior to the SL experience, we mutually agree that the science content to be observed is related to interdependent relationships in ecosystems and human impact on Earth, particularly as it relates to sustainable farming, which has been the science focus of the letter exchange. A fifth-grade teacher partner may do a series of activities on decomposers while another chooses to do activities related to photosynthesis, emphasizing their roles in farming. During the activities, our PSTs observe using a protocol (see Figure 2) and participate with their fifth-grade Writing Partners to collect evidence on their conceptual understanding of the science content (in addition to effective pedagogy of the teachers). During the visit, our PSTs also spend time getting to know their student partners more, talking to them about their lives and interests outside of school.

At the end of the observation, our PSTs administer a diagnostic assessment that they've collaboratively designed in their small groups. We ask them to design the assessment based on an Agree/Disagree Formative Assessment for Classroom Teachers (Keeley, 2008). One example of a diagnostic assessment that a group developed was about worms:

> David and Caitlin were digging in the dirt in David's garden. David spots a worm and screams, "Ewwwwwww! There's a worm! Gross! I hate worms! They're so slimy and have NO PURPOSE! They don't help people in any way at all! I think we should get rid of all the worms!" Caitlin replied, "Get rid of them? No Way!!!! If we didn't have worms, the birds couldn't eat! That's the reason we need to keep worms around…for the birds!" Do you agree with David or Caitlin, or do you disagree with both of them? Explain your thinking.
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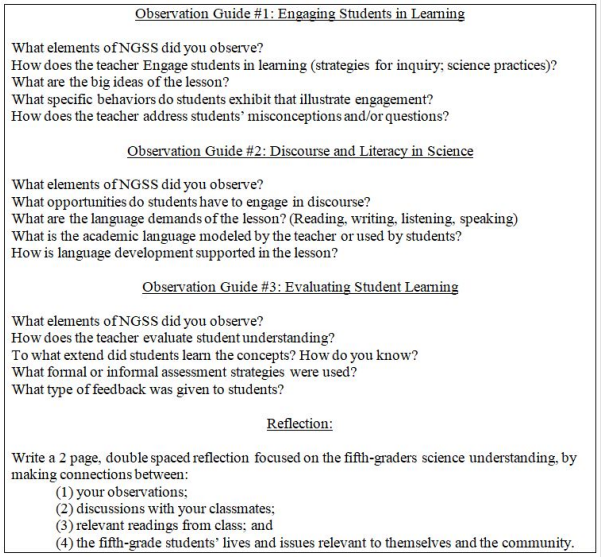
The agree/disagree assessment helps our PSTs determine prior knowledge the fifth-graders have about the purpose of worms in a garden, and how that relates to interdependent relationships in ecosystems (worms as decomposers or as food/energy for birds, or both). The PSTs also complete a structured observation/reflection on the pedagogy observed during the classroom visit. PSTs select one of the Observation Guides (see Figure 2 below) to focus on, take notes, then respond to reflection prompts about how the observed strategies may connect to theories learned in the science methods class, as well as how they may connect the concepts to the fifth-grade students' lives and issues relevant to themselves and the community. The following week in our methods class, PSTs get together in small groups (about 3), such that each of the three different Observation Guides is represented. In these groups, PSTs discuss their notes from the fifth-grade classes from their viewpoint, comparing their observations to those of their classmates. We then have a whole group

discussion about these observation and reflection prompts so that PSTs can debrief with each other about the different strategies observed related to engaging and evaluating students, and discourse/literacy.

Figure 2 (Click on image to enlarge). Observation guide and reflection prompts.



Observation Guide #1: Engaging Students in Learning

What elements of NGSS did you observe?
How does the teacher Engage students in learning (strategies for inquiry; science practices)?
What are the big ideas of the lesson?
What specific behaviors do students exhibit that illustrate engagement?
How does the teacher address students' misconceptions and/or questions?

Observation Guide #2: Discourse and Literacy in Science

What elements of NGSS did you observe?
What opportunities do students have to engage in discourse?
What are the language demands of the lesson? (Reading, writing, listening, speaking)
What is the academic language modeled by the teacher or used by students?
How is language development supported in the lesson?

Observation Guide #3: Evaluating Student Learning

What elements of NGSS did you observe?
How does the teacher evaluate student understanding?
To what extend did students learn the concepts? How do you know?
What formal or informal assessment strategies were used?
What type of feedback was given to students?

Reflection:

Write a 2 page, double spaced reflection focused on the fifth-graders science understanding, by making connections between:
(1) your observations;
(2) discussions with your classmates;
(3) relevant readings from class; and
(4) the fifth-grade students' lives and issues relevant to themselves and the community.

Data Analysis for Unit Planning. Following the mid-semester observation and collection of evidence at the public school, our PSTs continue the letter exchange with the fifth-graders while concurrently deepening their own understanding of aquaponics, which explicitly addresses interdependent relationships in ecosystems as it relates to sustainable farming. Aquaponics links aquaculture (cultivating fish) with hydroponics (cultivating plants without soil). It is the propagation of fish and plants together in a closed system. Fish waste (ammonia) is pumped with the water through a grow bed containing bacteria, which convert the ammonia to nitrate, and serves as food for the plants. Aquaponics is a sustainable method of farming because it significantly reduces the amount of water needed to grow plants, and is an excellent model for integrating science and engineering concepts into curriculum.

In our methods course, we introduce aquaponics to the PSTs by facilitating an activity from Project WET (Water Education for Teachers) called Life Box, where participants use their senses to make observations about materials in a box (soil and water). What they come to realize, after prompting them that there are 4 materials in the box needed for life, is that air and sunlight (the invisible stuff) is also needed. Then we show them an image of an aquaponics system and pose the questions, "Do all plants need soil to grow? What's in the soil that plants absorb for growth?" We review the nitrogen cycle and discuss the role of bacteria as decomposers in this system, and how these relate to interdependent relationships in ecosystems. We ask the PSTs to consider what prior knowledge students might need for understanding the concepts related to aquaponics, and spend some time collaborating on science activities that can support these concepts. In small groups, PSTs then use these ideas to design and tailor the activities for the lesson they'll teach to their

Writing Partners. The corresponding NGSS standard addressed in the methods course and aligned to aquaponics is *5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.* We chose aquaponics as a topic because our university is home to an aquaponics farm, maintained by our Environmental Science department. We are also in a region that has suffered severe drought, which negatively impacts our agriculture industry. Focusing on aquaponics as a means for sustainable farming is a relevant way for students (both our PSTs and the partner fifth-graders) to engage in the application of scientific concepts to designing solutions for real world problems that are meaningful to our community, a key component of SL.

During this phase of the semester, our PSTs use the diagnostic assessments gathered from their fifth-grade Writing Partner observation and analyze the results in their small groups, including evidence of patterns of students' prior knowledge and misunderstandings. They use the information they have learned about the fifth-grade students through the letter exchange and observation, along with the knowledge they have developed in the methods course to design their own NGSS-aligned units of study (3-5 lessons) around aquaponics. The length of the unit typically depends on the number of PSTs in the collaborative group; if there are four PSTs in a group, they'll each take the lead on writing one lesson, so the total number of lessons in the unit would be four. These units serve as a chance for our PSTs to apply what they've learned about the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts, to practice creating a unit with a storyline around a relevant phenomenon that integrates the three dimensions of NGSS together, while keeping the instructional needs and issues of social importance for a specific group of students in mind. As part of their unit plans, our PSTs fill in the Next Generation Alliance for Science Educators Toolkit (ASET) 3D Map (Sinapuelas, Lardy, Korb, Bae, & DiStefano, 2018) as a graphic organizer to demonstrate how their unit addresses and integrates the components of NGSS.

Campus Visit. The culminating component of the SL experience is the fifth-graders' visit to our university campus at the end of the semester. Our collaborative groups of PSTs select one lesson (out of the 3-5 in the unit they designed) to teach to their fifth-grade Writing Partners when they come to campus. Prior to the fifth-grade students' visit to campus, we spend two full class sessions on microteaching, where our PST groups practice teaching their lessons to their classmates and make improvements based on feedback from us and their peers. During the visit to campus, our PSTs also give the fifth-graders a tour of our aquaponics farm and integrate that experience into their lesson activities. In addition, the fifth-graders visit parts of the college campus such as the library, dorms, and athletics center and have the opportunity to observe and ask questions about life in college.

Sharing and Reflection. At the very end of the semester at the conclusion of the SL project, our PSTs complete the end of semester SL reflection during class, which includes the following questions:

- What concepts/principles/theories about teaching and learning did you experience through Writing Partners/Service Learning in this course?
- How can you use the knowledge and skills you gained from this experience to address social/environmental justice issues in your school community?
- How have you changed as a result of this experience? How will these changes affect you as a future teacher?

Upon completion of the SL project, the unit plans that our PSTs design are given to the partner inservice fifth-grade teachers so that they can use them to further develop their students' understanding of scientific concepts. Because the unit plans are a required assignment for the science methods course, they are easily compiled and shared with the teachers, who have indicated that they would use them to extend their students' learning once they returned to their classrooms after the visit. At this time, we ask the inservice fifth-grade teachers to reflect on the experience by answering the following questions:

- What, if any, impacts do you think this experience has had on you and your students?
- Do you have any suggestions to improve this experience for the future?

Inservice teachers' responses are voluntary and are used to improve the service learning component in subsequent semesters in an attempt to ensure the experience is mutually beneficial; inservice fifth-grade teachers are not monetarily compensated for their participation.

Lessons Learned

Perspectives representing the 27 PSTs in one semester's cohort and the two inservice teachers we partnered with that semester (see Table 1) suggest that participants benefited from the SL experience in ways that we wanted them to. In their written reflections, many PSTs referred to the importance of building relationships with students and using students' prior knowledge to engage them in authentic community issues related to science. We believe that these comments are directly related to our course objectives for the SL component: (1) Develop appreciation for the diversity of communities that make up our region, and (2) Develop an understanding of the local social problems facing our community. These general themes are based on preliminary analysis and we are in the process of systematically analyzing the SL reflections of PSTs across multiple semesters.

Table 1 (Click on image to enlarge)

Sample Quotes from Written Reflections on the Service Learning Experience

Preservice Teacher (PST) Perspectives	Inservice Teacher Perspectives
• Service Learning gave me experience creating relationships with my students. • Relationships are building blocks of social justice. • It is our responsibility to get our students involved in the social/ environmental issues in their own communities by creating awareness. • I experienced what it feels like to integrate community resources with learning objectives and content rich exploration. • I learned that we must acknowledge that all students have prior knowledge and experience and use that to engage them in science.	• It gave my students an opportunity to be exposed to other adult writing and to practice letter response format. In addition, the on-campus lesson provided a hands on science experience in which our students enjoyed. • Our students got a chance to learn from multiple teachers. They got exposed to a variety of science lessons from new NGSS.

While the unit plans that our PSTs have created are by no means perfect examples of NGSS-aligned curriculum, by creating them and practicing to teach a piece of those plans has given our PSTs a beginning experience toward implementation of NGSS. This is an experience that our PSTs have expressed as being valuable to them and has influenced the ways they think about teaching science to their own future students. In fact, when asked on the last day of class what experience was the most memorable for them out of the entire course in influencing how they teach about science, the first course activity/assignment that the PSTs brought up was the SL experience. In their last day of the semester discussions, PSTs described the experience as being not only powerful in giving them a chance to practice planning and teaching science, but also in really getting to know the fifth-graders as individuals through the letter exchange and visits.

Partner inservice fifth-grade teachers suggested that the SL experience exposed their students to NGSS-aligned lessons from various teachers, and that the process of writing letters to exchange with our PSTs was beneficial to students. The partnership between our PSTs and the fifth-grade students not only gave the fifth-graders opportunities to engage in learning concepts about sustainability, but also gave them a model for thinking about what college students are like and, for some, led them to talk about how they could see themselves as future college students. In fact, after the visit to campus, a fifth-grade student expressed to his teacher that he never knew that there was a college “right down the street.”

One thing worth noting is that when asked to write reflections about the SL experience, the inservice fifth-grade teachers discussed the impact the experience had on their students, but did not express how they, themselves, may have benefitted from the service learning. We were hopeful that the experience would reinforce the need for teaching more science in elementary school, give them more models for thinking about science teaching, and that the teachers would use the lesson plans that we’d shared with them to extend their students’ learning. Perhaps they did, but their written reflections indicated only what their students got from the experience. As a result, in our future service learning projects, we plan to be more explicit about the mutual benefits to all collaborators and work more closely with the inservice teachers to determine how they can benefit from the experience.

Conclusion

In this paper, we described an innovative service learning project that we have incorporated into our elementary science methods course to create mutually beneficial partnerships with schools in our community, as well as to give our PSTs a type of field experience that is meaningful for them as they learn to teach science. While our program had previously included a supplemental field experiences in the science methods course, it was short term and structured so that our PSTs didn't have opportunities to learn about the students they would be teaching science to. In order for our PSTs to get the experience we felt they needed, we restructured the field experience to integrate SL, which became the foundation of this field-based project, creating a mutually beneficial relationship between our PSTs and the fifth-grade classes in local high-needs elementary schools with whom they worked. Through the SL component (including Writing Partners), our college students and the fifth-graders learn that writing has the power to help them make connections across communities and within their community.

Our experience suggests that by incorporating SL into the methods course, our PSTs have benefitted by connecting theory learned in the course to practice with real students of diverse backgrounds, including practice planning and teaching with NGSS and designing science instruction with the learning needs and interests of specific students in mind. In addition, preliminary evidence suggests that the experience has also influenced some of our PSTs to think more deeply about integrating the community and social justice issues into their teaching.

Author Note

[1] In this paper we define "student teaching" as a traditional model for multiple subject credential candidates in which a preservice teacher is placed in the classroom of an experienced inservice elementary teacher as an apprentice, learning from the mentor teacher and gradually taking over responsibilities in the classroom.

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