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Next Generation Science Standards and Place-Based Education: An Intrinsic Case Study of Teacher Experience

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Next Generation Science Standards and Place-Based Education: An Intrinsic Case Study of Teacher Experience

By

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B.S., Western Washington University, 2010

Plan B Project

Submitted in partial fulfillment of the requirements for the degree of Masters in Science in Natural Science/Mathematics in the Science and Mathematics Teaching Center at the University of Wyoming, 2015

Laramie, Wyoming

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Abstract

Research demonstrates that place-based education can help connect formal science standards to students’ lived experiences, both in and out of school, thus increasing the relevancy of what students are learning (Dentzau, 2014). However, there has been no research conducted to date that shows how place-based practices can be integrated into curriculum developed using the Next Generation Science Standards (NGSS). This intrinsic case study research aims to describe elementary school teachers’ experiences in integrating principles of place-based education within curricular units developed using the NGSS. A focus group and open-ended survey were used to gain a better understanding of teacher experience and provide insights into the compatibility of these two frameworks. Participants noted that integrating principles of place-based education was a natural fit with the NGSS and was essential in making these new standards relevant to their students’ lives. Additionally, benefits of integrating these two frameworks included (a) increased student ownership and engagement, and (b) an increase in their personal engagement as teachers. Rather than viewing these two frameworks as being in opposition, the experiences shared by the participants in this case study demonstrated that principles of place-based education can serve as a guide for developing new curriculum using the NGSS.
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Chapter 1

Introduction

Background & Rationale

Incorporating a variety of tenets of place-based education, such as experiential education, increased relevancy of material, bringing in community-based experts, and using local settings, have the potential to improve numerous education outcomes (Meichtry and Smith, 2007). Programs that successfully engage students have been found to create supportive and collaborative communities of learners and use learning activities relevant to students’ lives (Smith and Sobel, 2010). Understanding that the research shows that place-based education can lead to increased student achievement, is it possible for teachers to meet rigorous national standards in science while developing curriculum that is more engaging and relevant to their students’ lives?

A key idea behind creating the Next Generation Science Standards (NGSS) was “to develop clear, comprehensive, and challenging goals for student learning” (Bybee, 2013, p. 34). While the NGSS provide learning objectives, they do not dictate what specific content should be taught and how, thus leaving curriculum design up to local teachers and administrators. This research sought to document teacher experiences in integrating principles of place-based education within units developed using the NGSS. Research participants included kindergarten through fifth grade elementary school teachers in Sagebrush County and Paintbrush County School Districts in a rural western state.

To better understand teacher experience in implementing principles of place-based education in a science curricular unit, an intrinsic case study was conducted using multiple methods. Participants attended a two-hour workshop that was designed to provide a foundational
understanding of seven predetermined principles of place-based education. This workshop was embedded within a year-long sustained professional development progression as part of a Math Science Partnership Grant and was designed to meet recommendation outlined in Ready, Set, Science! (NRC, 2007) and Models and Approaches to STEM Professional Development (Wojnowski and Pea, 2013). Following the place-based workshop, teachers participated in a focus group discussion and completed an open-ended survey.

One of the antecedents of place-based education was John Dewey who wrote about the growing disconnect between the classroom and children’s lives outside of school in 1907. In School and Society, Dewey wrote that:

From the standpoint of the child, the great waste in the school comes from his inability to utilize the experiences he gets outside the school in any complete and free way within the school itself; while, on the other hand, he is unable to apply in daily life what he is learning at school. That is the isolation of the school—its isolation from life. (p. 89)

Science education standards-based reform has been a continual process since the late 1980’s and this isolation, as described by Dewey during the early 20th century, is still a relevant issue that must be addressed in schools across the United States (Smith and Sobel, 2010; Bybee, 2013).

As a result of the No Child Left Behind Act (2001), there has been a lack of focus on teaching practices and curriculum in general and the lack of science instruction from most elementary classrooms has been an unintended consequence of this legislative mandate (Bybee, 2013). A meta-analyses of research on student engagement in school found that around 40-60 percent of students in the United States are only minimally engaged in their education (Smith and Sobel, 2010). Students across the United States have been alienated by their educational
experiences and constant evaluation, which has resulted in increased withdrawal and dropout rates (Smith and Sobel, 2010).

The research demonstrates that place-based education can help connect formal science standards to students’ lived experiences, both in and out of school, thus increasing the relevancy of what students are learning (Dentzau, 2014). However, there has been no published research conducted to date that shows how place-based teaching practices can be implemented in curriculum developed using the NGSS.

The NGSS have created a clear and cohesive progression within and throughout kindergarten through 12 grade (K-12) classrooms and emphasize that curriculum and pedagogy must become a focus of teaching once again (Bybee, 2013). In order for “K-12 students to realize the benefits of place-based education, it is critical that classroom teachers be effectively trained in the use of place-based teaching strategies” (Meichtry and Smith, 2007, p. 2), which is why professional development focused on the principles and pedagogy of place-based education is so important. The claim that “standards-based education…diverts people from meaningful interactions with nearby places” seems to be prevalent in the place-based literature, but has not been reexamined with regards to the NGSS (Semken, 2007, p. 1043).

**Problem Statement**

While it seems logical to apply place-based principles in developing curriculum units using the NGSS in order to increase their relevancy to students, it is not well understood whether the underlying structure of each of these is conducive to their integration. The experiences of teachers integrating place-based principles within curriculum developed using the NGSS might offer valuable insights into the compatibility of these two frameworks.
Purpose & Research Questions

The primary objective of this intrinsic case study research was to describe elementary school teachers’ experiences in integrating principles of place-based education within curricular units developed using the NGSS. Best practices in professional development, as outlined in Ready, Set, Science! (NRC, 2007) and Models and Approaches to STEM Professional Development (Wojnowski and Pea, 2013) informed the development of the professional development workshop on place-based education. The intention of this workshop was to provide a foundational understanding of place-based principles that teachers could apply in their elementary school curriculum development, and further in their classrooms.

A focus group and open-ended questionnaire were used to gain a better understanding of teacher experience in integrating place-based principles with NGSS focused curriculum development. The results from each of these research methods were used to describe the teachers’ perceptions of the compatibility of principles of place-based education with the NGSS and will help answer the following research questions:

1. In what ways have teachers already integrated principles of place-based education in the units they have developed using the NGSS?

2. What is teacher experience of the compatibility of principles of place-based education and the NGSS?

3. What challenges and/or struggles do teachers experience in integrating principles of place-based education with the NGSS?

4. What opportunities and/or benefits do teachers identify in integrating principles of place-based education with the NGSS?
Chapter 2

Literature Review

The following assertion has guided literature review for this study; the compatibility of place-based education and national science standards are worth re-examining in light of the NGSS. This literature review is organized into four major sections: (1) science education reform, (2) place-based education, (3) professional development, (4) and intrinsic case-study methodology. Each of these sections contains multiple related subtopics that aim to provide theoretical and historical context for the subsequent sections of this paper.

Science Education Reform and the NGSS

History of Science Education Reform in the United States

Educational reform recommendations have strongly influenced curriculum and assessment development and science instruction in the United States over the past 60 years, thus it is essential to examine how these periods of reform have led to the development of A Framework for K-12 Science Education (NRC, 2012) and the NGSS (Achieve, 2013) (Braaten et. al., 2011). Science first became part of Kindergarten through 12th grade (K-12) school curriculum in the early 19th century and was based on the premise that science education would enable students to participate more effectively as citizens in a democratic society (DeBoer, 2000). John Dewey was also a firm supporter of science education and stated that, “whatever natural science may be for the specialist, for educational purposes it is knowledge of the conditions of human action” (Dewey, 1916, p. 228). Through this statement Dewey expresses the importance in teaching students to apply their scientific understandings as actively engaged citizens.
By the mid-1900s the challenge of balancing the relevance of science education with strong disciplinary content knowledge became apparent in the field of education (DeBoer, 2000). Within science education, the importance of academic rigor and content knowledge began to overshadow the previously recognized importance of making science curriculum relevant to students’ lives. Following WWII and the launch of Sputnik in 1957 came a renewed focus on the role of science and technology in education (DeBoer, 2000). This came as result of the growing fear that the United States’ status as a leader in scientific and technological enterprises was being challenged (Prather, 1993).

Science education reform efforts of the 1950s and 1960s were led mostly by scientists, in response to the Soviet Union’s space achievements and the aim of these efforts was to teach all K-12 students the skills, practices, and big ideas at the core of all of the disciplinary fields of science (Yager, 2000). For the first time, the theme of civic responsibility and an appeal that more focus on science could help ensure national security were topics being discussed at the national level, which incited debate over the objectives of science in education (DeBoer, 2000). During the 1960s an “emphasis on disciplinary knowledge, separated from its everyday applications and intended to meet a perceived national need, marked a significant shift in science education in the post-war years” (DeBoer, 2000, p. 588). Technology was largely dropped from curriculum at this time and although the inquiry approach to science education began gaining popularity, K-12 courses were still largely taught through direct instruction and heavy reliance on science textbooks (Yager, 2000).

The goals of K-12 science education were revisited again in the 1970s and science literacy was redefined as the ability of an individual to apply scientific concepts, skills, and values in their everyday interactions within society and the environment (DeBoer, 2000). This
renewed focus on the interface of science and society, as well as increasing the personal relevancy of science education, continued into the 1980s (DeBoer, 2000).

**A Nation At Risk: The Imperative for Educational Reform (1983).** Contemporary science education reforms are distinctly different from those that preceded them (Bybee, 1995). Compared to the reforms of the 1950s and 1960s, reform efforts in the 1980s and beyond have been initiated through state-level frameworks with new science curriculum being developed locally, allowing for higher levels of implementation (Bybee, 1995). Contemporary reform has also been bottom-up in sequence, in that elementary school reform precedes middle school and high school rather than the top-down sequences seen previously (Bybee, 1995).

While academics and practitioners in the field of education were debating whether curriculum should be organized around disciplinary content or social issues, the National Commission on Excellence in Education issued the report *A Nation at Risk: The Imperative for Educational Reform* in 1983 (DeBoer, 2000). *A Nation at Risk* came as a response to the perception that the United States was once again falling behind its global competitors in the fields of science and technology (Rutherford, 2005). This report called attention to poor national academic performance on math and science tests and stressed that without more rigorous curriculum and standards, the United States’ global economic position would be at stake (DeBoer, 2000). During the 1980s there was also a renewed focus on relating science to students’ everyday lives rather than preparing a limited few who would enter science and technology professions (Yager, 2000).

**Science for All Americans (1989) and Benchmarks for Science Literacy (1993).** In 1989 the framework *Science for All Americans* was released by the American Association for the Advancement of Science (AAAS) followed by the *Benchmarks for Scientific Literacy* in 1993.
Science for All Americans was developed as a response to the national call for standards-reform and sought to clarify the goals of science education. The developers of this report focused on the goal of educating for a more scientifically literate society (Bybee, 1995; DeBoer, 2000). This report encouraged instructors to cover less content in order to teach selected content at greater depth and the interdisciplinary nature of science, technology, and mathematics was also emphasized (Bybee, 1995). A focus on important conceptual themes, thinking skills, key concepts, and incorporating content that would enrich student’s lives were all stressed (Bybee, 1995; DeBoer, 2000). *Benchmarks for Science Literacy* was based on *Science for all Americans* and outlined goals and objectives to be used by science curriculum developers and instructors (Bybee, 1995).

**National Science Education Standards (1996).** In 1996 the *National Science Education Standards* were released by the National Research Council of the National Academy of Sciences. This document set national learning objectives and standards that would allow students to meet these objectives (DeBoer, 2000). Four new goals for science and technology education outlined that students must (a) apply scientific processes and principles in their decision making (b) effectively engage in public discourse and debate regarding issues related to science and technology (c) be engaged in the thrill of discovering the natural world and (d) apply their increased knowledge, skills, and understanding towards increasing their economic productivity (NRC, 1996). Meeting these goals determined whether or not students were considered scientifically literate. The importance placed on increasing the number of scientifically literate citizens was attributed to the need for students to effectively use scientific information encountered in everyday life, to prepare students for careers in science and technology, and to maintain the United States’ competitive edge in the global market (DeBoer, 2000).
**How People Learn (1999).** Beginning in the 1980s the National Science Foundation began funding projects that sought to better understand how humans learn (Yager, 2000). In 1999 *How People Learn: Brain, Mind, Experience, and School* and *How People Learn: Bridging Research and Practice* (NRC 1999a, 1999b) were published. Both of these reports provided a cognitive basis and insights into how students learn and had major implications for educators, curriculum developers, and others in the field of education (Yager, 2000).

**Taking Science to School (2007) and Ready, Set, Science! (2008).** *Taking Science to School* (NRC, 2007) laid the foundation for *Ready, Set, Science* (NRC, 2008), *A Framework for K-12 Science Education* (NRC, 2012), and *the NGSS* (Achieve, 2012) (Braaten et. al., 2011). Over a two year period, a comprehensive literature review was conducted in order to compile the latest findings in “cognitive science, developmental psychology, education research, the design of effective learning environments, the history and philosophy of science, and new interdisciplinary fields, such as neurobiology and sociocultural studies of the mind” (NRC, 2008, pg. xiv). After relevant literature were compiled, key findings were distilled, analyzed, and used to draw conclusions that would better inform current education practices (NRC, 2008).

*Taking Science to School* encourages the use of learning progressions to allow students to build on their conceptual knowledge and practices over time and emphasizes the importance of students developing skills in metacognition (Duschl et. al., 2008). These recommendations are rooted in the understanding that children are more competent than was once acknowledged, they can reason abstractly from a young age, and do not pass through set, well-defined developmental stages (Duschl et. al., 2008). Expanding on the four objectives outlined in *National Science Education Standards*, the authors of *Taking Science to School* developed “four strands of scientific proficiency for K-8 students”, which identify that students should be able to:
(a) know, use, and interpret scientific explanations of the natural world; (b) generate and evaluate scientific evidence and explanations; (c) understand the nature and development of scientific knowledge; and (d) participate productively in scientific practices and discourse. (NRC, 2007, p. 334)

One barrier to implementing the findings of Taking Science to School is that scientific concepts are often taught in isolation from the teaching of scientific processes, skills, and practices, resulting in a disconnect among students (Duschl et. al., 2008). Another barrier is that concept coverage is often emphasized over the depth of coverage and important core concepts are not revisited across grade levels (Duschl et. al., 2008). Much like the goals of educating a scientifically literate society described in the National Science Education Standards, one of the main issues that Taking Science to School aimed to address was the need to initiate and maintain interest of students in STEM disciplines (Duschl et. al., 2008; DeBoer, 2000).

Ready, Set, Science! (NRC, 2008) was published in order to make the findings of Taking Science to School more accessible to K-8 educators and the practitioners who support their work. This book provides specific examples and recommendations on how the findings from Taking Science to School have been implemented in classrooms across the United States.

A Framework for K-12 Science Education and the NGSS

A Framework for K-12 Science Education (2012). Similar to the reform documents that preceded it, the purpose of A Framework for K-12 Science Education (NRC, 2012), hereafter referred to as the “Framework”, was to help develop new science standards and guide professionals in education. The Framework also outlines an updated vision for what it means to be proficient in science and engineering. A new framework was needed because the previously used frameworks, the National Science Education Standards (NRC) and the Benchmarks for
Science Literacy (AAAS), were both outdated and did not reflect current research on how students learn (NRC, 2012). The committee responsible for writing the Framework sought to develop a conceptual framework by identifying the disciplinary core ideas, crosscutting concepts, and practices in science and engineering that would guide future standards development (NRC, 2012). This new three dimensional approach to teaching and learning science was developed in order to provide education practitioners with a practical means of developing the deep content knowledge and skills in their students that had been called for over decades of educational reform.

According to the National Research Council, many of the problems facing humanity in the future will “require social, political, and economic solutions that must be informed deeply by knowledge of the underlying science and engineering” (NRC 2012, pg. 7). For this reason, having a strong foundation in science and engineering is important for every individual, irrespective of whether they choose to pursue a career in the fields of science and engineering (NRC, 2012; Bybee, 1995).

The Framework describes what is needed in science, engineering, and technology education in the 21st century and how a progression should occur within and between grade levels (NRC, 2012). In order to address the need for greater coherence in K-12 science education, the Framework takes into account that learning is a developmental progression. It calls for focusing on specific core conceptual ideas in the life sciences, physical sciences, earth and space sciences, and engineering and technology that build on each other in complexity through the grade levels (NRC, 2012). What is meant by ‘inquiry-based science’ is also made explicit compared to in previous standards through the development of eight specific science and engineering practices (NGSS Appendix D, p. 5). Lastly, cross-cutting concepts are themes that
bridge the different disciplines of science and engineering. These concepts were included as one of the three dimensions of the NGSS in order to help scaffold students’ learning of new disciplinary core ideas and have been found especially useful in supporting students who are English Language Learners. It is emphasized that the Framework and new standards alone will not lead to improvements in K-12 education unless curriculum, assessment, instruction, and professional development also become aligned (NRC 2012).

The NGSS (2013). The Framework for K-12 Science Education and the NGSS, which were based upon the Framework, were informed by current research on how science and engineering are learned. Both of these documents emphasize the importance of developing coherent learning progressions from K-12 and the value of deep conceptual understandings over the memorization of discrete facts. Development of the NGSS was led by 26 lead partner states and the nonprofit organization Achieve (Stage et. al., 2013). Partner organizations included the National Research Council (NRC), the National Science Teachers Association (NSTA), and the American Association of the Advancement of Science (AAAS). Recognizing the historical context of standards-based reform, the basic idea behind creating the NGSS, was “to develop clear, comprehensive, and challenging goals for student learning” (Bybee, 2013, p. 34). Another major goal of the NGSS is to facilitate alignment of curriculum, instruction, assessments, and the professional development of teachers in science (Bybee, 2013).

The NGSS emphasizes that all three dimensions of learning, disciplinary core ideas, science and engineering practices, and cross-cutting concepts, described in the Framework should be taught and assessed together (NRC, 2012; Stage et. al., 2013). Each of the three dimensions of learning are found integrated into each performance expectation within the NGSS in order to ensure that students are exposed to the concepts and practices that have been shown to
provide the context for effective learning (NRC, 2012). Because the three dimensions of learning represent a new concept introduced by the Framework and NGSS, ensuring that teachers understand the rationale behind the structuring of these standards and their impacts on curriculum development and pedagogical practices is essential. Understandably, one of the most challenging aspects of implementing the NGSS in the classroom has been the integration of the three dimensions found within each performance expectation (Bybee, 2013). Although demanding, the fundamental goal of creating an integrated science curriculum “should be to increase students’ understanding of science concepts (both core and crosscutting), science and engineering practices, and their ability to apply those concepts and practices” (Bybee, 2013, p. 56).

The purpose of increasing students’ active engagement in the practices of science and engineering is twofold; first to motivate a greater diversity of students to continue to study and pursue STEM careers; and second to empower the next generation of citizens to understand the core ideas and processes of science and engineering (NRC, 2012). Research supports that diverse student groups show an increased interest in science and scientific reasoning with integrated curriculum and instruction (NGSS Appendix D, 2013). The NGSS have raised expectations for learning and demonstrate “significant shifts in terms of what students are expected to know and do” (Hakuta and Santos, 2013, p. 451). As a result of these shifts, the NGSS provide the potential for science education to become more intrinsically motivating for students of all ages and backgrounds (Stage et. al., 2013).

Moving forward, another challenge identified by Bybee (2013) is the need for curriculum development and descriptions of how curriculum, assessment, and instruction can be guided by the NGSS. The Sagebrush County School District and Paintbrush County School District
teachers who participated in this study are in this critical stage of curriculum and assessment development and implementation. As part of the Math Science Partnership (MSP) program these teachers have been participating in sustained professional development workshops in which they explore the three dimensions of the Framework and work in grade level cohorts to develop new science curriculum units using the NGSS.

**Connections to Common Core State Standards.** According to Stage, Asturias, Cheuk, Daro, and Hampton (2013) the NGSS has the potential to be more successful than previous standards in improving science education due in large part to their alignment and synergism with the Common Core State Standards. Hakuta and Santos (2013) also believe that the NGSS and the Common Core “represent a significant change in standards-based reform in education” (Hakuta and Santos, 2013, p. 451). The NGSS were designed to align with the Common Core and follow a clear and logical progression within grades and across grade levels (Bybee, 2013; NRC, 2012). Similar to the NGSS, the Common Core were also developed on the premise that covering fewer topics in greater depth yields better results in terms of student achievement and understanding (Stage et. al., 2013; Hakuta and Santos, 2013). The performance expectations of the NGSS were cross-referenced with the Common Core, encouraging interdisciplinary teaching and assessment (Stage et. al., 2013).

By drawing on much of the same research regarding how students learn, the NGSS and Common Core emphasize many of the same learning outcomes, which should aid in their integration in curriculum design. Both the Common Core and NGSS articulate the importance of developing students’ skills in reasoning and problem-solving (Stage et. al., 2013). The Common Core are focused on developing skills and abilities for learners to become civically engaged, which is a goal mirrored in the NGSS (Stage et. al., 2013). As of April 2013 the Common Core
had been widely accepted, with 45 states having adopted them, and it is hoped that the NGSS will be widely adopted as well as a result of the intentionality of their alignment (Stage et. al., 2013; Hakuta and Santos, 2013).

**Place-Based Education**

**John Dewey and Experiential Education**

John Dewey was a foundational figure in progressivist education philosophy and place-based education (Jayanandhan, 2009). While progressivism and place-based education are not always recognized as being intimately linked, Dewey’s work laid the foundation for both. While John Dewey “does not directly mention place, we have seen that his educational philosophy is richly intertwined with the dimensions of place and the concerns of place-based education” (Jayanandhan, 2009, p. 108). Place-based education specifically addresses Dewey’s concern that 19th century schools failed to provide relevant context for learners, resulting in a disconnect between their lived experiences inside and outside of the classroom (Smith, 2002). The power of personal experience in relation to place is expressed in Dewey’s Democracy and Education (1916) and Experience and Education (1932). In addition to the importance of students’ personal experiences, Dewey claims that shared experiences also have the ability to shape knowledge and identity formation of the individual.

Core tenets of Dewey’s educational philosophy included the inclusion of the environment, experience, and democracy in education. Dewey defines democracy as “a mode of associated living, of conjoint communicated experience” and urges that learning to be an actively engaged citizen benefits both the individual and society (Dewey, 1916, p. 87). Holding constructivist views, Dewey posited that learning is not passive; learners must be actively engaged in something that is personally relevant and interesting to them. Place-based educators
have expanded upon this philosophical foundation and argue that one role of education is to prepare and encourage learners to lead socially and ecologically sound lives (Jayanandhan, 2009).

**Early Place-Based Education—1990s and Early 2000s**

Building upon the work of Dewey, Theobald and Curtiss (2000) describe the compatibility of place-based educational theory and constructivist theory. Theobald and Curtiss claim that, “learning that is isolated from authentic circumstances fails to capture the student’s most powerful and fundamental motivations” (p. 3). Jayanandhan (2009) identified two branches of place-based education that have emerged over time: (a) rural pedagogy of place, which strongly emphasizes local community and environment and (b) urban pedagogy of place, which builds on a rural pedagogy of place by focusing on the struggles and resistance tied to the experiences of urban youth. Neither of these branches is mutually exclusive and David Greenwood (formerly Gruenewald) calls for a “critical pedagogy of place” that connects both rural and urban pedagogies (Jayanandhan, 2009; Gruenewald, 2003a). Greenwood added to the tenets of place-based education by arguing that education must draw attention to issues of absence, in addition to fostering connection to place (Jayanandhan, 2009). Within this context, issues of absence refer to issues such as social struggle and inequality.

With regards to a definition of place, ecocritic and writer Lawrence Buell (2005) explains that “the concepts of place…gestures in at least three directions at once: toward environmental materiality, toward social perception or construction, and toward individual affect or bond” (p.63). This definition demonstrates the physical, socially constructed, and individually constructed dimensions of place (Jayanandhan, 2009). Theobald and Curtiss state that the goals of place-based or community-based education should be to “provide experiences in problem
solving and critical thinking and should foster positive attitudes toward the people with whom they share the community” (Theobald and Curtiss, 2000, p. 5). David Sobel expanded upon this definition by describing place-based education as “the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum” (Sobel, 2004, p. 6-7).

Sobel (1997) discussed the developmental importance of connecting elementary aged students with their local natural and social environments before delving into environmental issues that can result in disempowerment. When students have been introduced to global environmental issues such as deforestation and habitat loss before developing strong connections to their local human and environmental communities that can become disengaged and disillusioned with the impact they can have in light of these very big issues. Greenwood reinforced this sentiment asserting that fostering connections to place early in life will lead to ecological literacy and active citizenship later in life. He also draws parallels between Sobel’s developmental claims and the writing of Aldo Leopold in his well-known essay “The Land Ethic” (1949), where he writes:

It is inconceivable to me that an ethical relationship to land can exist without love, respect, and admiration for the land, and a high regard for its value…The most serious obstacle impeding the evolution of a land ethic is the fact that our educational and economic system is headed away from, rather than toward, an intense consciousness of land. (p. 223)

This passage demonstrates that developing connection to and value for place is not new and has been perceived as at odds with other educational values, such as economic competitiveness, for more than half a century.
As described by Smith (2002), place-based learning is an approach to pedagogy and curriculum that “offers students engaging learning experiences that also contribute directly to their school and community” (p. 30). Similarly, Greenwood claims that “the study of places can help increase student engagement and understanding through multidisciplinary, experiential, and intergenerational learning that is not only relevant but potentially contributes to the well-being of community life” (Gruenewald, 2003a, p. 7).

The development of place-based curriculum is dependent on the creativity of individual teachers and students and thus it cannot be prescriptive or packaged (Smith, 2002). General characteristics of place-based education include: students as producers of knowledge rather than consumers, direct experience and real-world problem solving, teachers take on the role of co-learner and guide, and students’ questions help drive the curriculum (Smith, 2002). While place-based education “lacks a specific theoretical tradition”:

> It’s practices and purposes can be connected to experiential learning, contextual learning, problem-based learning, constructivism, outdoor education, indigenous education, environmental and ecological education, bioregional education, democratic education, multicultural education, community-based education, critical pedagogy itself, as well as other approaches that are concerned with context and the value of learning from and nurturing specific places, communities, or regions. (Gruenewald, 2003a, p. 3)

In *The Best of Both Worlds: A Critical Pedagogy of Place*, Greenwood (2003) calls for the convergence of critical pedagogy and place-based education in order to challenge both educators and students to critically examine the places they inhabit, whether urban or rural. Greenwood draws on the social reconstructivist work of Paolo Freire who explained that
“knowledge emerges only through invention and re-invention, through the restless, impatient continuing, hopeful inquiry human beings pursue in the world, with the world, and with each other” (Freire 1970, p. 1). In these ways, a critical pedagogy of place incorporates the theoretical underpinnings of both Deweyian progressivism and Freirean social reconstructionism.

**Place-Based Education Today**

Many of the intended goals and outcomes described in the 1990s and early 2000s have been rearticulated and expanded upon in more recent literature. According to Smith (2007), one of the benefits sought through this educational approach continues to be to improve student engagement and performance. Some of the other underlying goals of place-based education include attaining social justice and ecological sustainability, and increasing the permeability between school classrooms and the human and non-human communities in which they are situated (Smith, 2007). If the goals of attaining social justice and ecological sustainability are to be realized, then:

People both now and in the future must possess the willingness to attend to the local, the confidence to believe that their efforts can make a difference, and the skills required to take effective action. Place-based education offers a way to make this happen. (Smith, 2007, p. 192)

Smith provides overviews of schools and teachers that have successfully enacted place-based education and how they were able to accomplish this given the constraints of conventional public schools. Qualities of classrooms that have adopted place-based education include inquiry and problem-solving focused on local issues, as well as a collaborative community where teachers are learning and discovering alongside their students. Smith points out that “collaborating with outside-of-school experts may be one of the most important aspects of
effective place-based educational efforts” (Smith, 2007, p. 204). Meichtry and Smith (2007) also reinforced the ideas of incorporating a variety of tenets of place-based education, such as experiential education, increased relevancy of material, bringing in community-based experts, and using local settings, and how they have the potential to improve numerous educational outcomes.

Jayanandhan (2009) points out that one challenge facing place-based educators is the reality that we live in an extremely mobile and global society. One important issue that must be addressed in place-based education is that few learners in today’s society remain rooted in one place. Neither urban nor rural place-based pedagogies explicitly address how educators can teach their students the metacognitive skills to connect to new places throughout their lives. In supporting students’ abilities to learn “how to learn how to be in a place”, educators could help “make place-based learning portable” for students who live in an increasingly mobile and globalized world (pp. 109-110).

**Professional Development**

**Professional Learning Communities**

Developing professional learning communities is a professional development approach that has become increasingly popular in the past two decades in the United States, although the principles upon which this approach is established are not new to the field of education (Hamos et. al., 2009; Lomos et. al., 2011). With many 20th century classroom teachers working in isolation, the professional learning community approach emerged as a means of creating a more supportive and collaborative community among educators (Hamos et. al., 2009). Professional learning communities draw on many different theoretical perspectives including the perspective of schools as system-oriented organizations (Lomos et. al., 2011). This is based on the idea that
teacher’s experiences and metacognitive reflection on their teaching practices stimulates learning, which can lead to a change in community-based behavior when shared among colleagues (Lomos et. al., 2011). Other interrelated concepts include: learning communities, professional communities, and teacher networks (Lomos et. al. 2011).

The origin of the term ‘learning community’ dates back to Peter Senge’s book *The Fifth Discipline* published in 1990 (Hamos et. al., 2009; Jones et al., 2013). This original definition was specific to the field of business and referred to ‘learning organizations’ as those where creative ways of thinking and collective aspirations were encouraged. Education practitioners and researchers adopted the term ‘learning organization’ and adapted the definition by replacing ‘organizations’ with schools and communities of educators (Hamos et., al., 2009). Professional learning communities can account for a number of practices including: collaboration between administrators and teachers, involving the local community in the classroom experience, and creating a greater sense of community within the classroom environment (Hamos et., al., 2009). While there is no universal definition for professional learning communities recognized in education, for the purposes of this study a professional learning community will be defined as collaboration between teachers and district administrators within and between school districts (Lomos et., 2001; Hamos et., 2009; Jones et al., 2013).

Using a professional learning community model can have many positive impacts on educators and their students. One of the primary benefits of professional learning communities is improving teaching practices that can in turn increase student achievement (Jones et. al., 2013). A meta-analysis of studies that used the same general definition of professional learning communities focused on the impacts of professional learning communities on student achievement conducted in 2011 found small, but significant results indicating that professional
learning communities can increase student achievement (Lomos et al., 2011). The use of professional learning communities as a professional development approach has also been shown to increase collaboration and create a supportive professional environment for educators (Hamos et al., 2009).

Hamos et al., (2009) found that professional learning communities can reduce teacher isolation, especially among teachers new to the profession. Additionally, when this approach is used to increase collaboration among teachers and between teachers and their administrators, teachers are better able to meet the specific needs their students (Jones e. al., 2013).

Implementation of professional learning communities is an effective professional development approach because they hold the potential to improve teaching practices, increase student achievement, increase collaboration between teachers, address the specific professional development needs of teachers, and be sustained over time.

**The Math Science Partnership Program.** The Math Science Partnership (MSP) program is a state-level grant administered by the Wyoming Department of Education under the No Child Left Behind. The goal of these MSPs is to increase student achievement of all K-12 students in mathematics and science by increasing teacher content knowledge and skills within STEM areas. The Sagebrush County and Paintbrush County School District’s MSP program focuses on continuing STEM professional development for K-12 teachers, in which they were collaboratively working on developing all new science curriculum for both districts. Professional learning communities are a commonly used professional development strategy and have been utilized by the professional development model for the Sagebrush County and Paintbrush County School District over the past two years (Hamos et. al., 2009). This approach helped guide the development of the workshop on the principles of place-based education used in this case-study.
Backwards Design

As described by McTighe and Wiggins (2004), the backwards design process is intended to enable educators to develop and deepen their students’ understanding of major conceptual ideas. Focusing on the intended learning outcomes and writing curriculum and assessments to meet these is not a new concept in education, however, educators do not often practice it. McTighe and Wiggins found that many educators begin the curriculum design process with activities related to a particular topic without first articulating the targeted goals, skills, understandings, and performance tasks for their students.

In Translating the NGSS for Classroom Instruction, Bybee (2013) explains that the performance expectations in the NGSS are meant to be a starting point for the backwards design process, which can lead to increased levels of student learning. In this MSP, teachers used this backwards design process, and the tools and resources provided in Understanding by Design: Professional Development Workbook (2004) in developing their new STEM units using the NGSS.

The Conceptual Change Model

The Conceptual Change Model was a strategy that was first defined clearly during the early 1980s (Davis, 2001). In 1981 Nussbaum and Novick developed a three-step approach to address student’s misconceptions in the classroom. These steps included making misconceptions explicit to students, promoting dissatisfaction in those misconceptions, followed by the introduction of a new framework that fits around a new conception (Zhou, 2012). Around the same time, a group of Cornell scientists (Posner, Strike, Hewson, and Gertzog) added to the theory of conceptual change and coined the phrase “conceptual change model” based on the theories of Piaget and Kuhn (Davis, 2001). Much like Nussbaum and Novick, Posner published
a model in 1982 to address student misconceptions through fostering accommodation of student thinking (Suping, 2003). Expanding on the three-step approach of Nussbaum and Novick and incorporating elements of the model developed by Posner et al., Joseph Stepans and colleagues introduced a six-stage model focused on teaching for conceptual change in 1999. This model included the following steps:

1. Commit to an outcome
2. Expose beliefs
3. Confront beliefs
4. Accommodate the concept
5. Extend the concept
6. Go beyond (Stepans, Saigo, and Ebert 1999, p. 141)

In 2003, the term intentional conceptual change was coined by Sinatra and Pintrich to emphasize the need to engage cognitive, metacognitive, and motivational processes to shape conceptions (Zhou, 2012).

Within the Conceptual Change Model, knowledge is constructed by the individual in a scheme of accommodation and assimilation (Watson and Konicek, 1990). According to this view, the Conceptual Change Model can be seen as an extension of a constructivist learning theory (Hewson, 1992). Conceptual change is a method of learning; learning is tied to social processes, and therefore, sensitivity to socio-cultural context must also be taken into consideration (Hewson, 1992). The Conceptual Change Model is not only about students acquiring new facts, but rather about providing tools for students to shape their conceptions to solve problems, explain phenomena, and form opinions about the real world (Davis, 2001).
Ebert and Crippen (2010) found that the Conceptual Change Model can be used to help improve professional development for science educators (Ebert and Crippen, 2010). Understanding that a teacher’s background and beliefs about teaching can prevent them from adopting new pedagogical practices, it is important for teachers to be given opportunities to confront their own conceptions about teaching in their professional development experiences (Ebert and Crippen, 2010). For this reason the professional development workshop on place-based education used as part of this study was structured based on the Conceptual Change Model. Participating teachers were given the opportunity to discuss and evaluate their conceptions of place-based education before identifying and integrating these principles into the curriculum they were developing using the NGSS.

**Effective Approaches in STEM and Place-Based Education Professional Development**

Professional development is a fundamental component to the profession of teaching and even early supporters of science curriculum in public schools agreed that, “teachers would need a deep command of subject matter and pedagogical content knowledge to teach science effectively” (Pea and Wojnowski, 2014, p. 9). According to the NRC (2008) it is imperative that teachers have a strong foundational knowledge in science and knowledge of science pedagogy. As more research on the effectiveness of professional development emerged over time, professional development transitioned from being focused solely on teachers, to being focused on students and their learning outcomes (Pea and Wojnowski, 2014). Today the driving forces in STEM professional development are increasing students’ scientific literacy and inspiring them to consider pursuing careers in STEM (Pea and Wojnowski, 2014).

There are many similarities in the effective strategies in professional development outlined in the literature for both STEM and place-based education. In a study that aimed to
determine the impact of an environmental, place-based professional development program on participant’s level of confidence in implementing the material cover in a classroom setting, Meichtry and Smith (2007) outlined components of successful professional development workshops. These components include (a) modeling effective teaching strategies to be implemented in K-12 classrooms and (b) having sustained professional development and teacher support over time (Meichtry and Smith, 2007). Similarly, in Ready, Set, Science! Michaels et al. (2008) described how STEM professional development opportunities should be (a) sustained in the long-term and provide ongoing support, (b) demonstrate clear and concise linkages to content and teaching practices, and (c) emphasize purpose and rigor through thoughtful design.

While long-term, sustained support for teachers is emphasized in both STEM and place-based education professional development, literature on STEM professional development focuses more on shaping students’ career preferences. One of the goals in STEM professional development seems to be to support teachers and provide the training necessary for them to be able to empower a greater diversity of students to be civically engaged citizens and to pursue STEM careers (Pea and Wojnowski, 2014). Pea and Wojnowski describe why teaching STEM is an important national issue; science and engineering indicators show that an increase in the number of students choosing STEM careers is necessary to “maintain America’s competitive edge in the world marketplace, improve economic stability, and secure national defense” (p. 5).

Unlike the literature on STEM professional development, the emphasis within place-based professional development is on developing students’ capacity to think critically, problem-solve, and apply their knowledge to issues within their local communities. While this difference may seem slight, one of the ultimate goals of STEM professional development is shaped by issues of
national security and economic stability, which are all but absent in place-based education professional development.

Pea and Wojnowski (2014) suggest that many different models and approaches to professional development can be successful as long as they appropriately fit local school districts. Meichtry and Smith (2007) also emphasize the importance of effective professional development in the application of place-based teaching strategies if students are to benefit from place-based education.

It is important that teachers be viewed as investigators and actively engaged as learners in professional development settings (Michaels et. al., 2008; Pea and Wojnowski, 2014). In addition, after professional development opportunities, it is essential that teachers be given the chance to apply what they have learned, make revisions and adjust their curriculum, and share their experiences with others (Michaels et. al., 2008; Pea and Wojnowski, 2014). Teachers must be given opportunities to reflect on their learning and modify their teaching practices accordingly (Pea and Wojnowski, 2014).

All of these effective professional development practices were taken into account in designing and implementing the professional development workshop on place-based education used as part of this study. For this reason, teachers were given time to work in their grade-level cohorts on their curriculum development following the place-based education workshop. Although this workshop was a single event as part of this study, it was embedded within a long-term MSP project, allowing for the sustained support of teachers as they have continued to apply principles of place-based education into their curriculum development.
Case Study Research

Descriptive and Intrinsic Case Study Methodology

An intrinsic case study methodology was chosen because the goal of this study was exploratory in nature and is focused on the experience of teachers who represent a singular case. Multiple descriptive and intrinsic case studies were used to inform the methodology used in this research study. Bustamante and Moeller (2013) used an intrinsic case study approach to gain insights into the experiences of teachers participating in online professional development through interviews, course documents, and audio-visual materials from the online course. Similarly, this intrinsic case study sought to gain an experiential understanding of particular phenomena; in this case the phenomenon being studied is teacher experience integrating principles of place-based education within curricular units developed using the NGSS.

Through an exploratory study, Jennings et al. (2005) used a combination of methods, including surveys and interviews, to gain a better understanding of the impact of standards reform and place-based education on teaching practices. This study aimed to better understand policy reform from the perspectives of policy makers and practitioners and place this understanding within a historical context in Vermont. One issue that arose in conducting surveys of teacher experience was in the immense number of terms for different educational practices that teachers used, such as service learning and community-based education. The diverse use of terminology made finding common threads difficult from teacher responses (Jennings et. al., 2005). To help avoid this issue, explicit definitions of terminology were used as part of the professional development workshop and survey used in this research study.

Another descriptive case study of teacher experience conducted by Black (2004) used classroom observations, interviews of teachers and students, and a questionnaire. Each of these three forms of data were compared and contrasted by researchers, who used an analytic inductive
approach to pull out themes from each of the four study participants. These emergent patterns and themes were used to examine three major research questions. Similarly, Bustamante and Moeller (2013) used exploratory questions, such as “How are technology, pedagogy, and content integrated into the course?” (p. 88) to help guide the research and gain insight into the experiences of research participants. In accordance with both of these qualitative case studies, four major research questions were outlined and used to examine themes that emerged from the focus group and survey data as part of this research study. Member checking, which is having participants check analysis to ensure their experiences are not misrepresented, was used to verify the focus group transcript was accurate. Comparative coding, which involved having an outside researcher code a section of data to verify coding reliability, was also used in both of these studies to corroborate codes, patterns, and themes in data analysis. The survey/questionnaire and interview methodologies in each of these descriptive or intrinsic case studies was used to help inform the methodology and data analysis used in this intrinsic case study (Jennings et. al. 2005; Black, 2004).
Chapter 3

Methods

Population

Participants included twelve teachers employed in Sagebrush County School District and Paintbrush County School District who attended Math Science Partnership (MSP) professional development seminars starting in June 2014. As participants in the MSP program, each teacher takes part in several professional development workshops throughout the school year and summer and works in a grade level cohort to develop new science curriculum using the Framework. Because each teacher either volunteered to participate in this program or was recommended by their principal, it is possible that the participants in this study have a greater interest and commitment to teaching science and learning about the NGSS compared to their colleagues.

All of the participants were certified elementary school teachers who had been teaching from two to over thirty years. Five of the twelve participants had also earned their master’s degrees in education related fields at the time of this study. Participants had lived in their respective geographic areas from two to over thirty years. Each participant identified multiple connections they had with their local communities and the local environments where they lived. Some of the community connections included: local businesses/business owners, energy development, association with local government agencies, coaching, volunteering, and involvement with recreational sports teams. Some of the local environmental connections included: spending time outdoors, visiting public lands, and outdoor recreational activities (hiking, fishing, camping, boating, hunting, and cross country skiing).
Setting

Located in a rural western state, both Sagebrush and Paintbrush Counties (pseudonyms used in accordance with IRB protocol) have experienced economic booms in recent years due to energy development. Local economies are largely driven by energy development, however both also have national tourism destinations. The communities in both Sagebrush and Paintbrush Counties can be characterized as rural and predominantly white, with growing Hispanic/Latino populations.

The professional development workshop on place-based education and focus group interview took place at the Pronghorn Learning Center on December 8th, 2014. The Pronghorn Learning Center is the central administration offices and professional development venue for Sagebrush County School District.

Data Collection

Because the aim of this study was exploratory and focused on the experience of the research participants, it is most accurately described as an intrinsic case study (Bustamante & Moeller, 2013). The intrinsic case study methodology was chosen in order to identify emergent patterns and themes in teacher’s experiences integrating place-based principles within units being developed using the NGSS (Black, 2004).

Participants attended a two-hour professional development workshop on place-based education to provide a foundational understanding of seven predetermined principles of place-based education. These principles included: (a) fostering love of one’s place (b) focusing on local issues (c) learning takes place in school yard, local community/environment (d) learning is personally relevant to students (e) engaging students in investigation, inquiry, and problem-solving (f) learning is interdisciplinary. An outline for the workshop and materials are included in Appendix C.
In order to gain better insight into teacher’s experience, data were collected from an anonymous online survey and a focus group session. The survey contained mixed open-ended qualitative questions and quantitative questions. These mixed methods were chosen to strengthen and validate the research findings (Burke and Christensen, 2014; Huberman and Miles, 1994; Braun & Clarke, 2013). The focus group was conducted following completion of the online survey and an audio file was recorded for later transcription. The focus group lasted 35 minutes and the open-ended survey took most participants between 10-30 minutes to complete.

This study used concurrent time orientation and an identical sample relationship (Burke & Christensen, 2014). Data from the anonymous survey and focus group were collected on the same day and all participants who participated in the focus group also completed the survey. Pseudonyms were given to each participant during the focus group transcription and multiple data sources were used to verify findings (Moeller, 2013). The audio file from the focus group was transcribed verbatim and analytical notes were recorded.

Data Analysis

Thematic analysis was chosen as the most appropriate means of data analysis because this research involves a single case and seeks to describe teacher experience in an inductively oriented design (Miles & Huberman, 1994; Braun & Clarke, 2013). Using thematic analysis, themes were identified in a bottom-up, emergent way and used to explore and describe the phenomenon being studied (Braun & Clarke, 2013).

Following transcription and familiarization, which involved making note of items related to the research questions, complete coding was used to code all data relevant to the research questions from both the focus group transcription and the survey responses (Braun & Clarke, 2013). Complete coding entailed creating codes across the entire data set for items related to the
research questions. Themes that emerged during the coding process were described and recorded. Upon completion of coding, all themes were reviewed and used to develop a thematic map. Each theme was then further defined and each name of each theme and code was also refined (Bruan & Clarke, 2013).

Limitations

Limitations of this study included having a small sample size, a single trial, unknown survey reliability and validity, and limited code verification and triangulation. This research study sought to explore the experiences of teachers already working with the NGSS as part of the MSP, which limited the sample size. Teachers participating in this ongoing professional development program tended to be self-selecting and high achieving teachers with inherent interest in improving science curriculum in their districts and thus their experiences are not necessarily representative of other elementary school teachers in their districts.

The survey developed for this research study was loosely based on surveys found in other educational research papers, however there was no analysis of the reliability or validity of survey questions. Code verification of transcript coding was used to validate and strengthen the findings of this research study, however this was limited in scope. Another researcher was asked to code selected sections of the focus group transcript and survey responses for the purpose of verifying how developed codes were assigned, however a complete comparison of coding was not carried out due to time restrictions. Data from the focus group, qualitative portion of the survey, and quantitative portion of the survey were used for triangulation, however the quantitative portion of the survey was somewhat limiting and only included six questions. This limited the amount of triangulation that could be completed.
Chapter 4
Results
Introduction

This chapter discusses the findings of this research. The themes and categories that emerged from the qualitative focus group and survey data will be presented according to the four research question. During data analysis, themes and categories that emerged during the coding process were reviewed and used to develop five different thematic maps. These visual maps each include one overarching theme, along with several supporting categories that will be more closely examined as they address each of the research questions. It should be noted that each of the participants in the focus group were given pseudonyms, however the survey responses were anonymous and excerpts from the survey will be presented according to survey question number. Findings from the qualitative portion of the survey were graphed and will also be presented as support for the qualitative findings under each research question. The four research questions that will be addressed in this section include:

1. In what ways have teachers already integrated principles of place-based education in the units they have developed using the NGSS?
2. What is teacher experience of the compatibility of principles of place-based education and the NGSS?
3. What challenges and/or struggles do teachers experience in integrating principles of place-based education with the NGSS?
4. What opportunities and/or benefits do teachers identify in integrating principles of place-based education with the NGSS?
Findings for Research Question One

Research question one stated: In what ways have teachers already integrated principles of place-based education in the units they have developed using the NGSS? During the professional development workshop seven principles of place-based education were explicitly referenced. These included:

1. Fostering a love of one’s place
2. Focusing on local issues
3. Supporting learning with partnerships
4. Taking place in school yard, local community/environment
5. Learning is personally relevant to students
6. Engaging students in investigation, inquiry, and problem-solving
7. Learning is interdisciplinary

Research question one overlapped entirely with research questions two and four and as a result a thematic map was not created for this research question. In both the focus group and survey, participants described specific examples of how they were already integrating principles of place-based education with the NGSS. The majority of participants agreed with the following survey statement: before the workshop on place-based education, I feel that I had already integrated multiple principles of place-based education in the unit I have been developing using the NGSS (see Figure 1). Although they may not have identified these examples as aligning with specific ‘place-based principles’ before the professional development workshop, after creating a shared definition they were able to retrospectively look through the curriculum they had developed using the NGSS and identify examples.
Figure 1. Pre-Existing Integration. Participants’ response to the following survey question: Before the workshop on place-based education, I feel that I had already integrated multiple principles of place-based education in the unit I have been developing using the NGSS.

Participants referenced examples from their curricular units that related to each of these seven principles throughout both the focus group and survey. In the survey, one participant provided the following example of how their unit focused on local issues (Principle #3) saying, “our unit will show [our students] how erosion is relevant to our community and surrounding area. Showing this connection will help them connect to their local place” (survey question #9).

Another participant described how investigation and problem-solving (Principle #6) were incorporated within an interdisciplinary unit: "The energy and motion unit is a physical science unit that involves engineering and technology practices in regards to investigating and developing solutions for energy conservation” (survey question #14). These findings show how participants had already been integrating principles of place-based education with the NGSS.
Findings for Research Question Two

Research question two stated: What is teacher experience of the compatibility of principles of place-based education and the NGSS? The qualitative and quantitative research findings related to this research question will be presented in Figure 2 and Figure 3 below and will then be further described and supported. The theme that emerged aligning with this research question was ‘the compatibility of NGSS and place-based principles’ and corresponding categories under this them included: (a) general compatibility, (b) community support and involvement, (c) interdisciplinary curriculum, (d) making standards locally relevant, (e) responsibility as teaches, and (f) investigation, inquiry, and problem-solving (see Figure 3).

Overall, participants viewed principles of place-based education as being compatible with the NGSS. This finding was supported by qualitative responses in the focus group and survey, as well as in the quantitative survey question shown in Figure 2.

Figure 2. Compatibility of Frameworks. Participants’ response to the following survey question: In my experience the principles of place-based education are compatible with the NGSS.
Figure 3. Compatibility Thematic Map. The categories that emerged from the focus group and survey data related to the theme of compatibility of the NGSS and place-based principles. The box on the left represents the theme and the boxes on the right represent categories that emerged from this theme.

**General compatibility.** Several participants expressed the view that the NGSS are strengthened by the integration of the principles of place-based education and that these two frameworks are generally compatible. In describing some of the local opposition to the NGSS, one participant stated:

...they get hung up on that ‘this is kind of a nationalized curriculum, this doesn’t apply to us where we’re at or in [our state]’ but I think when you tie [place-based principles] into it ... we can take these standards and make them applicable to our kids. (Michael)

Many of the participants agreed that the NGSS are broad enough to fit well with the principles of place-based education and that integration of these two frameworks would allow them to teach 21st century skills. Betty mentioned both of these ideas when she explained that the teaching
approaches introduced by place-based education fit with the 21st century skills emphasized in the framework and NGSS. Examples of 21st century skills referred to by participants included several of the science and engineering practices, such as asking questions and defining problems and engaging in argument from evidence. While ideas surrounding the general compatibility of these two frameworks also emerged from the survey, they were less common than in the focus group. One participant stated “[place-based education] is a natural fit with NGSS” (survey question #16).

Community support and involvement. Several participants spoke of the support and community involvement with the science units they had developed using the NGSS. Many of the teachers in Paintbrush have spouses working for a government agency and they described their experience of having professional allies within this organization. Similarly, in the survey one participant noted how curriculum developed using the NGSS was made relevant to students through community support: “Throughout each unit we are bringing in local [government agency] experts to speak and interact with the students so that they are able to see how our own community is effected (sic)” (survey question #16).

Many of the participants seemed to value bringing in local experts in order to relate curriculum to issues affecting the local communities. While participants most commonly referenced bringing in experts from the community, several also discussed getting students outside of the classroom and into the field or surrounding community. Such experiences included having students visit a local natural resource area and bringing in community experts to speak about natural resource development. Several participants also credited community support and involvement with increased engagement and investment on the part of their students. During the focus group, Nancy stated: “it’s cool for [the students] to see how someone can take that
information and expand upon it and make it into a job, you know, that’s their career is doing science”.

**Interdisciplinary curriculum.** Many of the participants seemed to experience compatibility of these two frameworks in that both encouraged them to teach interdisciplinary curriculum. In speaking about writing new science curriculum using the NGSS, Michael stated "it forces us into looking at other standards and our other curriculum. It forces teachers to look at how can we intertwine all this stuff".

Michael went on to explain that developing interdisciplinary curriculum also allows for more efficient use of time, "you can’t do it all if that’s how you do it… if our amount of time with kids is not going to change, then the how we do things has to change". Similarly, in the survey one participant described how designing interdisciplinary curriculum allows teachers to use their time more efficiently by having tying science into the reading block of the daily schedule.

Participants also agreed that interdisciplinary curriculum encouraged students to make connections across content areas, increased relevancy of curriculum, increased student engagement, and made learning more fun. During the focus group Amy stated, "I’ve been more interested too in thinking about [how] we’re interweaving reading and writing and math and technology and science and [in the process] we’re just making it more fun”.

In both the focus group and survey participants discussed specific examples of how they have been able to integrate engineering and technology into the units they had developed using the NGSS. In describing one of the NGSS physical science units, one participant wrote about an energy and motion unit that involves engineering and technology practices by having students investigate and develop solutions to energy conservation issues. Participants also described how
they were able to make their units interdisciplinary mostly through integrating language arts and social studies standards in with their science curriculum.

**Making standards locally relevant.** Participants discussed numerous ways that they were able to make the NGSS locally relevant. These included making curriculum personally relevant to their students, incorporating local issues, using local examples, learning outside the classroom, using authentic forms of assessment, helping their students make connections, and comparing local, national, and global issues. Several participants mentioned that incorporating principles of place-based education into the units they were developing using the NGSS helped their students make connections between the content they were learning in school and their everyday lives. Lisa described that, "when [her students] have the schema and they can connect it to their world” it increases their engagement and leads to deeper learning. In the survey another participant described how relating the NGSS to local issues helps students connect to their local communities:

> Our students are young and do not have a lot of life experience to see the relevancy of erosion, particularly slow erosion. Our unit will show them how erosion is relevant to our community and surrounding area. Showing this connection will help them connect to their local place (survey question #9).

Many of the participants also mentioned how they were able to develop authentic forms of assessment by incorporating principles of place-based education into the units they were creating using the NGSS. Rebecca explained that they based the pre/post assessments in their Earth Science unit on local examples in order to make the content more relevant to their students. In the survey, other participants described how they used authentic assessment to make the NGSS locally relevant by basing their end of unit performance tasks on local issues and by
posing engineering problems to students to determine how well they were able to apply what they had learned to issues that could arise in their local community.

Responsibility as teachers. Multiple participants expressed ideas regarding teacher ownership and responsibility to make the NGSS locally relevant for their students in the focus group, however this theme did not show up in the survey data. Nancy describes her perspective that the NGSS can be made locally relevant, however it takes ownership on the part of teachers to make this happen: "I think that’s our job as teachers and it’s a little bit of that ownership instead of ‘oh these standards don’t apply to me’, like you said, ‘well bring them in and make them work for where you live’". Anna also expressed concerns that they did not teach much science in early elementary even though much of what is taught could be connected to science.

Investigation, inquiry, and problem-solving. Many participants described examples of the investigations, projects, and hands-on activities that relate the NGSS to principles of place-based education. In the survey one participant explained how an investigation would help meet the NGSS and create a hands-on learning experience for their students. Similarly, another participant wrote about how hands-on investigations allowed their students to make connections to overarching questions and become active problem-solvers. In the focus group, Rebecca expressed analogous views regarding how compatible the NGSS are with principles of place-based education in terms of providing hands-on experiences.

Findings for Research Question Three

Research question three stated: What challenges and/or struggles do teachers experience in integrating principles of place-based education with the NGSS?

The qualitative and quantitative research findings related to this research question will be presented in Figures 4, 5 and 6 below and will then be further described and supported. The first theme that emerged aligning with this research question was ‘challenges and constraints
integrating the two frameworks’ and corresponding categories under this them included: (a) faculty buy-in, (b) time constraints, (c) creating developmentally appropriate curriculum, (d) fitting standards with place, and (e) financial constraints (see Figure 6). The second theme that emerged aligning with this research question was ‘challenges and constraints specific to the NGSS’ and corresponding categories under this them included: (a) stakeholder support, (b) NGSS compared to Common Core State Standards, and (c) NGSS are complex and/or confusing (see Figure 7).

In the survey, participants did not express any challenges and constraints, however many did come out in the focus group. The quantitative survey responses show that most teachers did not find integrating these two frameworks to be challenging and do not believe external constraints limit integration (See Figure 4 and Figure 5). Although participants did not find integrating these two frameworks to be particularly challenging, they were mixed in their experience of external constraints that might limit this integration (see Figure 6). Some of the challenges and constraints experienced by participants were specific to the NGSS while others were related to integrating the two frameworks (place-based principles and NGSS). As a result of this dichotomy, two themes were developed to differentiate between these two sets of experiences.
Figure 4. Challenges to Integration. Participants’ response to the following survey question: In my experience it is challenging to integrate principles of place-based education with the NGSS.

Figure 5. External Constraints. Participants’ response to the following survey question: I feel that there are external constraints that might limit the integration of principles of place-based education with the NGSS.
Figure 6. Challenges and Constraints with Integration Thematic Map. The categories that emerged from the focus group and survey data related to the theme of challenges and constraints to integrating the two frameworks. The box on the left represents the theme and the boxes on the right represent categories that emerged from this theme.

**Faculty buy-in.** One of the challenges several teachers discussed during the focus group was that of faculty buy-in among their colleagues who were not participating in the MSP professional development workshops. This seemed to be a bigger issue for teachers in Sagebrush County School District due to the larger size of their district, but was also mentioned by some of the Paintbrush County School District teachers. David, who worked in Paintbrush County School District, explained that many teachers he worked with are resistant to change, especially when they are being asked to change the way they teach multiple subject areas at once or are uncertain about how long changes will last in their district. He stated: "People are always a constraint as well…even when you have admin (sic) that have ‘bought in’ there’s always those who don’t and won’t buy in no matter how much they’re told". In other words, even though an earlier constraint, that of administrative support, has been obtained, it did not necessarily translate into colleague buy-in due to historical issues in the district.
Betty also emphasized how time constrains teachers’ willingness to adopt new curriculum and teaching strategies. She explained how curriculum must be both “guaranteed and viable” meaning that all students have equal opportunity to learn the same curriculum and it is practical in terms of time for teachers to implement. Betty stated that lack of availability of time is ultimately what hinders many teachers from adopting new curriculum, such as the new NGSS units. She explained further that the teachers in Paintbrush County School District were currently writing new curriculum in multiple subject areas adding to this time stress.

In addition to time, Rebecca described how teachers who are not involved with developing the new curriculum are unwilling to buy-in due to a lack of understanding or familiarity with the NGSS. While teachers who have participated in the MSP professional development workshops have gained an understanding of the learning progressions implicit in the NGSS, their colleagues have not had this same training and therefore do not value the NGSS in the same ways. Because the NGSS are relatively new and not well understood by all district administrators, Rebecca also described how her school district has not communicated a clear vision for the future implementation of their NGSS curricular units. She expressed that a lack of vision across their school district has contributed to this lack of understanding and buy-in on the part of many teachers.

**Time Constraints.** While the issue of time constraint also emerged within the category of faculty buy-in, it also appeared to fit as its own stand-alone category. During the focus group Betty explained that in her school district:

We have a lot of irons in the fire right now we’re not only rewriting science curriculum but also re-writing English/language arts and math and so I think that
that just puts a lot on the plate of everyone that it does become a bit of a hindrance. (Betty)

Multiple participants describe how a competition over time in their districts is a constraint to developing their new curricular units using the NGSS and integrating principles of place-based education within them.

**Creating developmentally appropriate curriculum.** Several participants voiced that a lack of familiarity with place-based principles and how to create developmentally appropriate curriculum using these principles was a challenge for them. While referring to the place based principle ‘engaging students in investigation, inquiry, and problem-solving’, Michael explained how he was unsure what investigation and inquiry should look like in a 2nd grade classroom as compared to a 6th grade classroom.

**Fitting standards with place.** Within both the focus group and survey, participants described challenges and constraints with fitting the NGSS with their local settings. Many participants provided specific instances in which it was difficult for them to come up with local examples that fit with content covered in the NGSS. Some of the teachers were developing a unit that covered erosion and discussed how many of their students had limited background knowledge of what flooding and other forms of erosion looked like. Rebecca expressed: "we don’t always see all of it in [our state]". Other participants explained that it was challenging for them to find ways to make certain units, such as chemistry, personally relevant to their students.

**Financial constraints.** The challenge posed by financial constraints was voiced by participants in Paintbrush County School District during the focus group, but was not expressed by participants in Sagebrush County School District. Lisa and Betty described how their district had already invested money in Foss Kits® that did not necessarily align with what they would be
teaching at their grade level with the NGSS. Lisa explained that "it becomes being able to change to these standards and do activities that meet the next gen standards (sic) and they’ve spent all the money on the Foss Kits @.

Figure 7. Challenges Specific to the NGSS Thematic Map. The categories that emerged from the focus group and survey data related to the theme of challenges and constraints experienced specific to the NGSS. The box on the left represents the theme and the boxes on the right represent categories that emerged from this theme.

The focus group data revealed that participants experienced several challenges and constraints that were specific to the NGSS rather than integrating place-based principles with the NGSS (see Figure 7). Although this theme and these categories emerged, they do not relate to research question three directly. These findings will still be presented, but will not discussed in great detail.

Stakeholder Support. During the focus group, participants described state and district level constraints that inhibit them from implementing the NGSS in some way. Uncertainty of stakeholder support at the district and state level has led to a lot of uncertainty on the behalf of teachers. Michael explains that, "as a district we haven’t formally adopted them you know so I
don’t know if I’d call it a hindrance, but there’s always that question". Several participants expressed that they had already invested time and energy into developing new curricular units using the NGSS, but were unsure about the future of these new standards in their districts.

**The NGSS compared to Common Core State Standards (CCSS).** Another theme that emerged from the focus group data that was specific to challenges and constraints experienced by teachers was a comparison of the NGSS with the CCSS. Participants voiced concerns about lack of public understanding of these new standards, a general opposition to nationalized curriculum, and again an uncertainty of the future of these standards. David described the uncertainty of the future of both the NGSS and CCSS in his district in stating,

> When you don’t have buy in from the state on common core yet you’ve worked on it for three years and we’ve all been down that road where we’ve worked on things and you know literally in the next year it’s gone.

**The NGSS are complex and/or confusing.** One of the final challenges experienced by participants was the complex nature of the NGSS themselves. Participants described how understanding and interpreting the NGSS was a challenge for them. They explained that the NGSS have taken more time for them to understand compared to previously used standards, teachers are not familiar with the new content they are being asked to teach, the NGSS are not user friendly, and they need to learn how to bundle standards more effectively. Michael describes this sense of confusion, "How are we gonna (sic) incorporate the engineering practices and the cross cutting concepts, but it takes more time and it’s a challenge to read”.

**Findings for Research Question Four**

Research question four stated: What opportunities and/or benefits do teachers identify in integrating principles of place-based education with the NGSS?
The qualitative and quantitative research findings related to this research question will be presented in Figures 8, 9, 10, and 11 below and will then be further described and supported. The first theme that emerged aligning with this research question was ‘benefits for students’ and corresponding categories under this theme included: (a) fosters student citizenship, (b) increased academic achievement, (c) promotes community building, and (d) increased buy-in and engagement (see Figure 10). The second theme that emerged aligning with this research question was ‘benefits for teachers’ and corresponding categories under this theme included: (a) more efficient use of time, and (b) teacher ownership (see Figure 11).

Participants experienced a wide range of opportunities and benefits in integrating these two frameworks. The findings that participants feel confident in their ability to incorporate principles of place-based education with the NGSS and plan to continue integrating these two frameworks in the future helps support these findings (see Figures 8 and 9). Similar to research question three, two themes emerged from this research question according to benefits that were more specific to students and benefits that were more specific to teachers. Figures 10 and 11 show the two themes with corresponding categories that emerged from the focus group and survey data.
Figure 8. Confidence in Integrating Frameworks. Participants’ response to the following survey question: I feel confident in my ability to incorporate place-based education principles into the curriculum units I have developed using the NGSS.

Figure 9. Future Framework Integration. Participants’ response to the following survey question: I plan to integrate principles of place-based education into the next units I design using the NGSS.
**Figure 10.** Benefits for Students - Thematic Map. The categories that emerged from the focus group and survey data related to the theme of benefits for students. The box on the left represents the theme and the boxes on the right represent categories that emerged from this theme.

**Fosters student citizenship.** In both the focus group and survey, participants described how integrating principles of place-based education within units developed using the NGSS fostered student citizenship. In the survey, one of the participants wrote, "The connection between community and the student helps to foster citizenship preparing them to be active, responsible citizens" (survey question #8). This shows how integrating place-based principles 3 and 4: ‘supporting learning with partnership and having learning take place in the school yard, local community/environment’ into NGSS curricular units allowed participants to foster student citizenship. David also described how he believes that active citizenship is a life skill that will benefit his students’ immediate communities and any communities they are members of in the future. He went on to explain that the skills they are teaching their students by integrating principles of place-based education with the NGSS are things he would want his daughter and son to be able to use as well.
**Increased academic achievement.** Participants described how they believed that integrating these two frameworks increased student transfer and application between subject areas and across grade levels. Using place-based education principles was also seen as a way to make the NGSS more personally relevant to students. In the survey one participant explained that, "Place-based education practices allow for students to have more ownership in their learning which can allow for more collaboration and increased academic achievement" (survey question #8). Another participant stated, "Integrating place-based education with the NGSS is the perfect opportunity to make learning relevant for students" (survey question #16).

**Promotes community building.** The idea that integrating these two frameworks promotes community building emerged from the focus group data, but was not found explicitly in the survey data. However, David described how place-based principles allow his students to develop a love of place, which in turn helps them develop into active, contributing community members.

**Increased buy-in and engagement.** In both the focus group and survey participants described how they perceived that integrating place-based principles with the NGSS increased student buy-in and engagement. They noted increased student collaboration, motivation, and ownership in their learning. One participant also valued the student-centered nature of place-based education, while teachers become co-investigators or facilitators. Another participant explained how integrating these two frameworks "will be more motivating and engaging for students as they will have a more vested interested in material because it will be more meaningful to them" (survey question #8).
More efficient use of time. Participants described how developing interdisciplinary curriculum using the NGSS and place-based principles allowed them to use their classroom time more efficiently. Michael explained that they had limited time with their students and as a result they needed to change the way they teach in order to maximize their limited time.

Teacher ownership. Teacher ownership was the only category that emerged from both the survey and focus group to support the theme of benefits to teachers. Participants expressed how integrating these two frameworks in developing new curriculum and teaching encouraged them to be creative, allowed for increased flexibility in teaching curriculum, and provided freedom for them to meet their student’s individual needs. Several participants expressed the belief that they understood their students best and as result it was important for them to have ownership in developing curriculum that would be relevant and appropriate for their students. Michael expressed this idea saying, "thankfully that we’re allowed to do this work and make some of the decisions because a lot of times when you know teachers aren’t involved in that process you end up with something that’s not the best for kids".

Similarly Rebecca valued having the freedom to stretch herself and her students rather than following a rigidly set curriculum. Several participants also expressed how having the
opportunity to be creative in designing new curriculum using place-based principles and the NGSS increased their engagement as teachers.

Summary of Research Results

The quantitative data collected from the survey, in addition to the qualitative data collected from both the survey and focus group helped address each of the four research questions proposed by this research study. The overarching question posed by this research was: What is teacher experience in integrating principles of place-based education into units developed using the NGSS? and these data provided insight into this question. Data from both the survey and focus group supported the finding that teachers feel that they have already been integrating principles of place-based education within units they have developed using the NGSS. These data also supported that they experience principles of place-based education and the NGSS as being highly compatible. Participants also expressed that overall, they are confident in their ability to integrate these two frameworks and that they plan to continue integrating them in the future. Lastly, the data regarding challenges and constraints in integrating these two frameworks yielded mixed findings because data from the focus group was not supported by data from the survey.
Chapter 5
Discussion

In analyzing the data from both the survey and focus group, many interesting findings emerged regarding the four research questions. In comparing these findings, research questions #1, 2, and 4 seemed to be complementary in the findings they revealed, while question #3 was asynchronous. For this reason, the findings from question #3 will be addressed first followed by the findings questions #1, 2, and 4 collectively. The four research questions proposed at the beginning of this research study are:

1. In what ways have teachers already integrated principles of place-based education in the units they have developed using the NGSS?
2. What is teacher experience of the compatibility of principles of place-based education and the NGSS?
3. What challenges and/or struggles do teachers experience in integrating principles of place-based education with the NGSS?
4. What opportunities and/or benefits do teachers identify in integrating principles of place-based education with the NGSS?

Question 3 - Challenges and/or Struggles Experienced

In reviewing the challenges and/or struggles experienced by participants in this study the most striking finding was that none of the major constraints described by the teachers were directly related to integrating principles of place-based education with the NGSS. Rather, teachers expressed how extraneous constraints jeopardized the long-term viability of the curriculum they had developed using the NGSS. These external constraints included: (a) colleague buy-in, (b) communication of vision across each school district, and (c) uncertainty of
the future of the NGSS due to lack of stakeholder support. Each of these major concerns will be discussed in greater detail below.

**Colleague buy-in & communication of vision.** While participants did not find integrating principles of place-based education with the NGSS to be particularly challenging, many did describe other external constraints such as buy-in by their colleagues who were not part of the curriculum development process. Because only a small portion of the elementary school teachers in Sagebrush County School District are participants in the MSP, the majority of teachers in this district have not received any professional development regarding the NGSS. They are also not actively engaged in the process of developing new science curriculum using the NGSS. This issue of colleague buy-in is also compounded by the participant’s perceived lack of vision across either of their school districts for the future of the NGSS and the science curriculum they have developed. It is possible that teachers are reluctant to change their curriculum and teaching practices due to both their lack of background knowledge of the NGSS and other historical issues in their school districts. While these constraints do not address research question #3 directly because they are not specific to issues regarding the integration of place-based principles with the NGSS, they would be worth exploring further in future research.

**Stakeholder Support.** The teachers who participated in this study expressed a high level of uncertainty with regards to the future of the NGSS in their state and local school districts. Participants worried and expressed concern that all the time and energy they had invested into new curriculum development could be lost without stakeholder support at the state and district levels. The National Science Teachers Association has emphasized that “the responsibility for implementation [of the NGSS] cannot and should not be vested solely in teachers and other
school-based personnel”, but rather must be a shared responsibility among district and state level stakeholders (NSTA, 2013, p.3).

Participants also expressed the concern that parents and other community members held misconceptions regarding the difference between national science standards and a nationalized science curriculum. One of the greatest concerns with national standards is that they will lead to a “one-size-fits all curriculum”, however this fear is unfounded (Theobald and Curtiss, 2000, p. 4). Standards and curriculum cannot be used synonymously and national standards do not portend national curriculum. While national standards can be used to develop locally relevant curriculum, one does not guarantee nor preclude the other. Theobald and Curtiss argue that historically, place-based education and constructivist curriculum and pedagogy have been at odds with state and national standards. However, they also concede that “standards do not have to be an impediment to constructivist learning approaches within a community-based curriculum”, but rather students taught in this way will exceed set standards (Theobald and Curtiss, 2000, p. 5). An organized effort to increase public understanding of the NGSS and dispel common misconceptions regarding the role of these standards may help increase stakeholder support.

An additional challenge noted by many of the teachers was the complex and/or confusing nature of the NGSS themselves. Understanding how to integrate the three dimensions of the NGSS within new curricular units and pedagogical practices has been challenging for the teachers who took part in this study, even with the continued support from professional development workshops. Future research might evaluate the need for professional development opportunities and characteristics of programs that have successfully trained teachers and administrators in implementing the NGSS.
Questions 1, 2, & 4 - Compatibility, Opportunities, and Benefits Experienced

Data from both the survey and focus group supported the findings that teachers had already been integrating principles of PBE with the NGSS. This explains why most participants also experienced these two frameworks as being highly compatible and even described how integrating the principles of place-based education have strengthened their NGSS curriculum. Most participants also described how they are confident in their ability to integrate principles of place-based education into the units they have developed using the NGSS and plan to continue doing so in the future. In reviewing the findings from research questions #1, 2, and 4 three characteristics of compatibility emerged from the teacher’s experiences. These included: (a) the NGSS encourage teaching interdisciplinary curriculum, which is a principle of place-based education, (b) both the NGSS and place-based education emphasize the need for authentic forms of assessment, and (c) Both the NGSS and principles of place-based education allowed for creativity in curriculum development. Each of these characteristics of compatibility and their implications for the development of curriculum integrating these two frameworks is discussed in greater detail below.

Interdisciplinary curriculum. The teachers who participated in this study emphasized that the NGSS encouraged them to develop and teach more interdisciplinary curriculum compared to previously used standards. This is a promising finding because the NGSS were designed to support interdisciplinary teaching by encouraging connections across science disciplines and other subject areas. A core tenet of place-based education, ‘making learning interdisciplinary’ was seen by participants as a way of using their time more efficiently, increasing relevancy of content, and increasing student engagement. Interdisciplinary teaching
also enhances science learning, particularly for students traditionally underserved in public education (NGSS Appendix D, 2013). One participant pointed out that, “by integrating place-based education with all standards and teaching cross-curricular units students are actively engaged in the learning process” (Survey Question #16) and another participant expressed how “integrating place-based education with the NGSS is the perfect opportunity to make learning relevant for students” (survey question #16).

**Authentic assessment.** The second characteristic of compatibility that emerged from the research findings was that both the NGSS and place-based education emphasize the need for authentic forms of assessment. According to Greenwood, “contemporary school reform takes little notice of place”, and diverts attention from meaningful and engaging educational approaches (Gruenewald, 2003b, p. 620). Critics of standards based reform have argued that accountability via high-stakes assessments leads instructors to adopt teaching strategies such as direct instruction and abandonment of place-based pedagogy such as inquiry and experiential, student-driven learning (Jennings et al., 2005). While issues related to high-stakes assessment are often linked to standards based reform in the literature, there are few examples showing the compatibility of standards and authentic assessment. In this study, several participants described how they were able to develop authentic assessments that would be relevant to their students’ lives using the NGSS. Within integrated instructional units advocated for by the NGSS, it is expected that diagnostic and formative assessments are embedded throughout curriculum to provide feedback on instruction and student understanding (Bybee, 2013). The findings from this research show that teachers felt encouraged to develop authentic forms of assessment through integrating principles of place-based education with the NGSS.
Creativity in curriculum development. Participants also described experiencing an increased sense of ownership in having the opportunity to develop their own curriculum and an increased engagement and flexibility to meet the individual needs of their students. It seemed that the process of developing new science curriculum, which integrated principles of place-based education with the NGSS, lead to this sense of ownership and increased engagement on the part of the teachers. In addition to having freedom in the design process, teachers experienced flexibility to meet the unique needs of their students when implementing these curricular units. This would be a potential area for future research seeing as few teachers have the opportunity and freedom to develop their own curriculum.

Conflict vs. compatibility reexamined. The arguments that standards result in decontextualized curriculum and that time spent meeting extensive standards takes away from locally relevant learning opportunities are commonplace in place-based education literature (Jennings et. al., 2005). In their argument against standards, Theobald and Curtiss (2000) claim that standards based education results in low student engagement, inauthentic assessment practices, and a failure to recognize students as unique individuals with varying preparedness for educational achievement. They contend that the intellectual content lacks meaningful context and the developmental, experiential, socioeconomic, and cultural differences between students, schools, and communities are not taken into account or addressed in standards.

Differing views or focuses within place-based education can determine how compatible this framework is with the NGSS, however “the conflict between standards and place-based curriculum may be more rhetorical than real” (Jennings et. al., 2005, p.63). There is little research supporting the claims that national science standards either hinder or support place-based education. Several of the participants in this study noted that integrating principles of
place-based education was a natural fit with the NGSS and was even essential in making these new standards relevant to their students’ lives. While descriptive case studies have shown an increase in student engagement and achievement with the implementation of place-based curriculum and pedagogy, none have explicitly examined the relationship between place-based education and national science standards. This gap in the literature is especially apparent with regards to the newly released NGSS. While this research study has provided insight into teacher experience of the compatibility of the NGSS and principles of place-based education, future research is needed to provide further insight in this area.

**Future Research.** While this research has met the primary objective of describing elementary school teachers’ experiences in integrating principles of place-based education within curricular units developed using the NGSS, there are many additional questions that have emerged from this study. The experiences of teachers integrating place-based principles within curriculum developed using the NGSS has offered valuable insights into the compatibility of these two frameworks, however future studies might expand this research by including a larger sample size and teachers with a greater variety of backgrounds. Because the research participants teach in rural settings it could be valuable to document the experience of teachers working in urban settings and/or different geographical locations across the United States.

The challenge of addressing colleague buy-in and achieving district wide dissemination is also a pertinent area of further research. Much of the teachers’ sense of ownership seemed to be tied to the process of developing their own curriculum, which would also be worth examining more closely. For example, will colleagues who do not have ownership over these newly created NGSS units experience the same compatibility with the principles of place-based education as the teachers in this study did? It would also be interesting to compare the experiences of teachers
who are teaching using lessons based on the NGSS, but whom have not developed their own curriculum.

**Conclusion**

Many place-based education advocates have expressed concern that standards-based reform hinders students from connecting to, understanding, and helping to sustain their local communities (Jennings et al., 2005). However, local and national values do not have to be seen as at odds with one another as they are not mutually exclusive (Nespor, 2008). Through studying the compatibility of standards-based reform and place-based education, Jennings et al. (2005) found that standards can provide support and justification for existing place-based curriculum. The findings from this study have shown that the NGSS and principles of place-based education can be highly compatible. Teachers were both confident in their ability to integrate these two frameworks and planned to continue integrating them as they continue developing new science curriculum. Having the freedom to design creative curriculum has also increased teacher ownership and engagement, which is worth examining further in the future. Rather than viewing these two frameworks as being in opposition, the experiences shared by the participants in this case study have shown that principles of place-based education can serve as a guide for developing new curriculum using the NGSS.
References


Appendix A

Teacher Focus Group—Interview Guide

1. In what ways have you already integrated principles of place-based education in the units they have developed using the NGSS?
   a. Which specific principles were already integrated in your curriculum and where?

2. In your opinion how compatible are principles of place-based education and the NGSS?
   a. Would your experience integrating principles of place-based education be different using [your stats] science standards and/or other science standards you have experience with?
   b. Can you think of any changes that would allow you to more easily integrate principles of place-based education with the NGSS?

3. What challenges and/or struggles have you experienced in integrating principles of place-based education with the NGSS?
   a. Were there any principles of place-based education that were more difficult to integrate? Why do you think this is?
   b. Are there any external constraints that might limit the integration of place-based principles in your units (e.g. time, resources, understanding, and support)?

4. What opportunities and/or benefits do you associate with integrating principles of place-based education with the NGSS?
   a. Would you consider integrating principles of place-based education into your next units? Why or why not?
   b. Are there any benefits to either you or your students that you associate with integrating principles of place-based education into your curriculum units?
Appendix B
Survey of Teacher Experience

Please answer the following questions as honestly as possible. Your responses will help me to better understand your experience in integrating principles of place-based education within the unit you have been developing using the Next Generation Science Standards (NGSS). Your responses are completely CONFIDENTIAL.

I. Experience Integrating Place-Based Principles with the NGSS

Please read through the statements below rate them on a scale of 1-5 where:

“5” represents “strongly agree”

“4” represents “agree moderately”

“3” represents “neither agree nor disagree”

“2” represents “disagree moderately”

“1” represents “strongly disagree”

1. Before the workshop on place-based education, I feel that I had already integrated multiple principles of place-based education in the unit I have been developing using the NGSS.
2. In my experience the principles of place-based education are compatible with the NGSS.
3. In my experience it is challenging to integrate principles of place-based education with the NGSS.
4. I feel there might be external constraints that might limit the integration of principles of place-based education with the NGSS.
5. I plan to integrate principles of place-based education into the next units I design using the NGSS.
6. I feel confident in my ability to incorporate place-based education principles into the curriculum units I have developed using the NGSS.
II. Definition and Values of Place-Based Education

In this next section you will be asked general questions regarding place-based education.

For this section ‘values’ will be defined as: something (as a principle or quality) intrinsically desirable. Some examples of common educational values include: respect, responsibility, safety, creativity, collaboration, and academic achievement.

7. Please define place-based education in your own words.

8. What educational values (if any) do you associate with place-based education practices?

III. Integration of specific Place-Based Principles with the NGSS

In this next section you will be asked a series of questions about how place-based principles have been integrated into the science unit you are developing using the NGSS. Please provide detailed responses to the questions below and provide specific examples where relevant.

Some examples of principles of place-based education include:

- Fostering love of one’s place
- Focus on local issues
- Takes place in school yard, local community/environment
- Personally relevant to students
- Engaging students in investigation, inquiry and problem solving
- Interdisciplinary

9. In what ways might the science unit you are creating help your students connect to their local place?

10. Which components of the science unit you are creating are focused on local issues?
11. Which components of the science unit you are creating will take place in the schoolyard, local community, and/or environment?

12. Describe how the science unit you are creating is personally relevant to your students?

13. In what ways will the science unit you are creating engage students in investigation, inquiry, and problem solving?

14. In what ways is the science unit you are creating interdisciplinary across science disciplines (i.e. physical sciences, life sciences, earth and space sciences, engineering and technology)?

15. In what ways is science unit you are creating interdisciplinary across content areas (i.e. English and Language Arts, Math, Social Studies, Art, etc.)?

16. Is there anything else you would like to add regarding your experience integrating principles of place-based education with the NGSS?

**IV. Teaching Background**

In this next section you will be asked a series of questions about your personal teaching background.

17. How many years have you been teaching (total and in all types of schools)?
   _______ (Write a number)

18. What subject area(s) are you certified to teach? (Please list them below)

19. What other types of credentials do you have? Please include any teacher training that you may have received or other certifications that are relevant to your present teaching situation. (Please list them below).

20. How long have you lived in this geographic area (Sagebrush County or Paintbrush County)?

21. What connections do you have to local community where you live?
22. What connections do you have to the local environment where you live?

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE
Appendix C

Sample Teacher Consent Form

You are invited to participate in a research study looking into compatibility of principles of place-based education and the Next Generation Science Standards. This is a research project that I, Sarah Hackworth, will complete to satisfy partial requirements for a Master’s Degree in Natural Science from the University of Wyoming. As the Responsible Project Investigator (RPI) I will be studying the experience of integrating place-based principles with curricular units that have been developed using the Next Generation Science Standards. I hope that you will participate in this study. Your participation will provide information that could help inform other elementary school teachers and school administrators interested in place-based education and the Next Generation Science Standards.

Participation in this study entails completion of a questionnaire, participation in a focus group discussion, and attending a professional development seminar on Place-Based Education. The professional development seminar will take place during the December 2014 UW STEM Math Science Partnership Professional Development workshop at the Pronghorn Learning Center. A focus group will take place following the workshop and a questionnaire will be submitted using Google Forms online. All data collected will be entirely anonymous and analyzed to describe teacher experience in integrating principles of place-based education with curriculum units developed using the Next Generation Science Standards.

You will be asked to devote 20-30 minutes to participating in the focus group and another 20-30 minutes in completing the questionnaire. Subjects will also be asked to participate in a 2-3 hour Professional Development workshop on Place-Based Education. The total amount of time you will be asked to be involved in this study will be between 3-4 hours.

There are minimal risks to participants involved in this research study. Potential minimal risks may include feeling some level of embarrassment or self-consciousness in questionnaire and/or focus group responses, as well as the potential risk that information obtained through the questionnaire or focus group could adversely affect participants if disclosed outside the research setting. The potential risk of disclosure of the information outside of the research would be related to possible embarrassment and will not impact the reputation or employability of the participants. To minimize these potential risks participants will be identifiable only to the RPI and Supervising Faculty Member. No identifying features will be associated with the final written report. Surveys will be anonymous and conducted electronically to reduce personal identifiers and the privacy of participants. The audio recording from the focus group will be transcribed with pseudonyms for each participant and personal identifiers will be removed and therefore, the risk in this study is minimal, not more than ordinarily encountered in daily life.

You may choose to withdraw from the study at any point in time by indicating that they would like to opt out of the study for any reason. Participants may withdraw during the professional development workshop on place-based education, during the focus group discussion, or while completing the individual survey. They will be able to opt out by indicating their preference to the RPI or any other workshop provider (e.g. the Faculty Supervisor, who will be present during the workshop).

Indirect benefits include having opportunities to reflect on your teaching practices and share your experiences in implementing place-based practices and/or principles in your new Next Generation Science Standards (NGSS) curriculum units. This research may provide a case study and resource to other elementary school teachers and school administrators interested in place-based education and the NGSS.

Both the audio file of the focus group and the electronically submitted questionnaires will be stored on a password-protected computer and only the RPI and the Supervising Faculty Member will have access to the raw data. Google Forms can be set up such that the data is returned to the RPI without any identifying information. If you wish to have copies of the subsequent reports on the research project, you will be able to submit this desire through the use of a second Google Form that is not connected to the
survey. The data collected through the questionnaire will be entirely anonymous and thus your responses will no be able to linked back to you. This will help protect your privacy and confidentiality. The data will not be used for any research purposes other than those stated above. The data will be stored up to 3 years and then be destroyed.
Freedom of consent:

My participation is voluntary and my refusal to participate will not involve penalty or loss of benefits to which I am otherwise entitled, and I may discontinue participation at any time without penalty or loss of benefits to which I am otherwise entitled. To terminate participation in the study, I will indicate my preference to the Responsible Project Investigator or any other workshop provider (e.g. the Faculty Supervisor, who will be present during the workshop).

If you have any questions about the research or participation in the research please contact:

<table>
<thead>
<tr>
<th>Sarah Hackworth</th>
<th>Ana Houseal</th>
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If you have questions about your rights as a research subject, please contact the University of Wyoming IRB Administrator at 307-766-5320.

Consent to participate:

____________________________________________
Printed name of participant

____________________________________________          ______________________
Participant signature          Date
Appendix D

Outline of Place-Based Education Workshop

Objectives—During this workshop teachers will:

- Come up with a shared understanding and working definition for Place-Based Education
- Explore misconceptions and reconceptions of place- and community-based education according to Smith and Sobel 2010.
- Understand six of the key principles of place-based education and come up with examples for each.
- Identify where six principles of place-based education are already included in the units they are developing.
- Identify opportunities to incorporate more of the place-based principles in the units they are developing.

Guiding Question: What is place-based education and how can core principles of place-based education inform curriculum development?

Workshop Outline:

<table>
<thead>
<tr>
<th>Amount of Time</th>
<th>Topic/Activity</th>
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<tbody>
<tr>
<td>30 minutes</td>
<td>Individual definitions of place-based education</td>
</tr>
<tr>
<td>10 minutes</td>
<td>Group definition of place-based education</td>
</tr>
<tr>
<td>20 minutes</td>
<td>Misconceptions and reconceptualizations of place-based education</td>
</tr>
<tr>
<td>40 minutes</td>
<td>Six core principles of place-based education</td>
</tr>
<tr>
<td>50 minutes</td>
<td>Identify and incorporate principles of place-based education in units</td>
</tr>
<tr>
<td>10 minutes</td>
<td>Revisit individual definitions</td>
</tr>
</tbody>
</table>

More Detailed Plan:

1. Engage: Individually come up with your own definition for place-based education
2. Group discussion/brainstorm of a definition for place-based education—writing ideas on white board
3. Share common definitions for place-based education by leaders in the field
4. Explore: What are some misconceptions of place-based education and reconceptualizations according to Sobel and Smith 2010? Have teachers work in small groups focusing on one of these examples. Everyone will have a chance to present their misconception/reconceptions out to the rest of the group. Did they share any of these misconceptions?
5. **Explain:** Have teachers work in small groups, each focusing on a different place-based principle. Each group will create a poster for their principle that explains what it is and provide an example of the application of their principle, which they will present out to the whole group. Posters will be reference tools for teachers as they begin working on their own units.

6. **Elaborate:** Have teachers identify core principles of place-based education in their own units and look for opportunities to incorporate more. Teachers will be given the option to work individually or in groups of two or three.

7. **Evaluate:** Have teachers revisit their personal definitions from the beginning of the session and individually work on a “I used to think…But now I know… and my evidence is…” statement from this workshop on place-based education.

**Materials:** Poster paper and markers, handouts with Smith and Sobel’s misconceptions and reconceptions of place, 6 core principles of place-based education and definitions of place-based education from the literature and other resources for teachers, sheets of paper for “I used to think…” activity.
Appendix E

Place-Based Education Workshop Handout

What is Place-Based Education and Why is it Important?

- Definitions of Place-Based Education include:
  - Gregory Smith’s definition of place-based education:
    “An approach to curriculum development and school-community relations that draws upon local cultural, environmental, economic, and political concerns” (Smith 2007, p. 189).
  - The Rural Trust, which is one of the earliest proponents of place-based education in the United States, developed the following definition:
    “Place-based education is learning that is rooted in what is local—the unique history, environment, culture, economy, literature, and art of a particular place. The community provides the context for learning, student work focuses on community needs and interests, and community members serve as resources and partners in every aspect of teaching and learning. This local focus has the power to engage students academically, pairing real-world relevance with intellectual rigor, while promoting genuine citizenship and preparing people to respect and live well in any community they choose.” (Rural School and Community Trust, 2005)
  - David Sobel’s definition of place-based education:
    “Place-based education is the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum. Emphasizing hands-on, real-world learning experiences, this approach to education increases academic achievement, helps students develop strong ties to their community, enhances students’ appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens.” (Sobel, 2004, p. 7).

- Goals and Benefits of Place-Based Education:
  - The main goals of place-based education include increasing:
    1. Student achievement
    2. Community social and economic vitality
    3. Ecological integrity (from promiseofplace.org).
  - Benefits of place-based education include: increased student engagement in school, increased academic achievement, development of ties between students and their communities, increased student appreciation for their community and the natural world, increased involvement of community members in local schools, increased capacity for problem-solving and critical thinking in students, and development of commitment for serving as contributing citizens (Center for Place-Based Education 2014).
Relevant Case Study: Smith describes the Environmental Middle School, in Portland, Oregon, which integrates environmentally based activities with service learning projects for the human community with more traditional classroom activities. Students enrolled in this program consistently outperform their peers although their teachers do not emphasize test preparation (Smith 2002). This case study shows how place-based education can increase student engagement and achievement by reducing the disconnect between student’s experiences in and outside of school.

7 Core Principles of Place-Based Education:
1. Develop love of one’s place in students
2. Focus learning on local issues
3. Support learning with partnerships
4. Plan activities that will take place in school yard, local community/environment
5. Make learning personally relevant to your students
6. Engage students in investigation, inquiry, and problem solving
7. Teach Interdisciplinary—Both within and across content areas

Teaching Techniques & Practices Associated with Place-Based Education:
- Cultural journalism (e.g. Foxfire), experiential learning, expeditionary learning, constructivism, problem-based learning, outdoor education, contextual education, service learning, multicultural education, civic education, community based education, critical pedagogy, and project-based learning (Smith 2007; Gruenewald 2003).

Resources and References
Books
- Last child in the woods
- Place- and Community-Based Education in Schools
- Childhood and Nature: Design Principles for Educators

Articles


**Online resources**
- Promise of Place: [http://www.promiseofplace.org/what_is_pbe](http://www.promiseofplace.org/what_is_pbe)
- The Center for Place-Based Education: [http://www.antiochne.edu/anei/cpbe/](http://www.antiochne.edu/anei/cpbe/)
- Casper Mountain Science School: [http://caspercollege.edu/cmss/](http://caspercollege.edu/cmss/)

**Misconceptions and Reconceptualizations of Place-Based Education (Smith and Sobel, 2010)**

**Misconception 1:** Place- and community-based education sounds appealing, but it’s not for us. Our school has to focus on keeping our test scores improving so we can meet Annual Yearly Progress.

**Reconceptualization 1:** Place- and community-based education helps motivate students to learn and can contribute to increase test scores on standardized tests.

Second, place- and community-based education is a mindset, a paradigm shift, a way of thinking broadly about the school’s integral relationship to the community and the local environment. It’s not a new curriculum unit. It’s not like the DARE program, the new FOSS science curriculum mandated by the district, or Everyday Math. Instead, it’s a new approach to all of these curricular areas. Let’s take DARE for instance. The fact that the local police officer is coming into the classroom, connecting the police department and the school, is illustrative of once aspect of place-and community-based education—breaking down the walls between the school and the community. From a place- and community-based education perspective, we’d also have the park superintendent and the town recycling coordinator and the neighborhood redevelopment director in the classroom, as well. And, instead of just having the DARE police officer in the school, the fifth graders might take a field trip down to the police station, and maybe even go to court to see a trial of an adolescent DWI offender.

**Misconception 2:** Place- and community-based education is another add-on that teachers have to shoehorn into their curriculum.

**Reconceptualization 2:** Place-and community-based education is a new way of thinking about the school’s role in society. It requires a more holistic mindset about school reform than No Child Left Behind.

Third, place-and community-based education owes much to environmental education as well as to critical pedagogy, problem-based learning, service learning, constructivism, and many other education innovations of the last half-century. Place-and community-based education is certainly about local places and the environment, but it’s also about history, the arts, cultural
diversity, social justice, and more. It’s about literacy emerging from reading neighborhood street signs; it’s about drumming being central to the music curriculum in a school with a majority of African-American students; it’s about learning to sail as part of the science curriculum.

**Misconception 3:** An educational approach that focuses on place is environmental education in sheep’s clothing.

**Reconceptualization 3:** Place- and community-based education involves using all of the environments in which students live—natural, social, cultural—as starting points to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum.

Fourth, it is true that much good place- and community-based education has happened in rural communities. The Rural School and Community Trust has initiated projects from Maine to Alaska, and from North Dakota to Louisiana that have resulted in community revitalization and school improvement. But cities are places, too. And some of the most exciting examples of place- and community-based education are flourishing in inner-city schools. Most interesting is to see the coming together of critical pedagogy, with its emphasis on social justice, and place- and community-based education, with its emphasis on learning the neighborhood. This results in curriculum initiatives that focus on access to green space as a social justice issue, homelessness, the bathrooms in substandard school buildings, learning the history of community revitalization, and including local African-American, Asian, Cape Verdean, and Hispanic artists in the art curriculum.

**Misconception 4:** Place and community-based education is for rural schools in small communities with lots of wide-open spaces out the back door.

**Reconceptualization 4:** Place- and community-based education is alive and well in urban and rural, Northern and Southern, liberal and conservative communities and schools.

Finally, place- and community-based education requires a different approach to planning and teaching than an education centered on textbooks, lectures, and classroom demonstrations. It doesn’t necessarily take more time. In effective place- and community-based educational settings, teachers and students become co-investigators of issues and concerns, with students taking increasing responsibility for their own learning. Teachers no longer must prepare all of the content that students are to master. They instead assemble materials, human resources, and inside and outside-of-classroom experiences that serve as the foundation for student learning. When this happens and the work students are asked to complete is vital and meaningful, young people take control of their own education. Teachers no uncommonly experience professional revitalization and an increase in energy. Teaching in this way does not become a source of exhaustion but a source of vocational meaning.

**Misconception 5:** Place- and community-based education takes much more time and energy, both of which are in short supply for most teachers.

**Reconceptualization 5:** Place- and community-based education relies upon learning experiences that require teachers to use their time in new an often invigorating ways.

We are discovering that in schools where teachers, students, and community members have embarked on the process of integrating the local into educational activities, teaching and learning become dynamic for both young people and adults. What had been abstract and
seemingly irrelevant becomes as immediate as the dangerous railroad crossing on the way to school or stories about the heroism and activism of children’s neighbors and ancestors. More students find reasons to become involved in school, and their achievement begins to demonstrate the attention and commitment they bring to their studies. Many teachers rediscover the possibilities and ideals that drew them into education as a vocation and become energized and passionate about their work with the young. And community members realize that schools can be more than they ever imagined and that students are capable of making extraordinary contributions to their common life.

7 Core Place-Based Education Principles:
1. Love of one’s place.
2. Focused on local issues.
4. Takes place in school yard, local community/environment.
5. Personally relevant.
7. Interdisciplinary.

Place Principles
- **Learning is grounded in and supports the development of a love for one’s place.**
  - Students will become experts for their school and they will teach others about their school. Through studying the plants and animals around their schools, they will learn to appreciate the uniqueness of their place, as well as developing an appreciation for their sister school and Casper Mountain.
  - Students will develop a love for our school and helping to keep it clean.
- **Learning is focused on local issues.**
  - Students will become stewards of their school and will practice Leave No Trace principles to care for their school.
  - Students will visit the local landfill and see the results of throwing trash out instead of recycling.
- **Learning is supported by strong and varied partnerships with local organizations, agencies, businesses and government.**
  - (A local master gardener) has already come in and taught composting, so we have a vermicomposter going in the room. Next month the Keep Casper Beautiful representative will start recycling.
  - We connected with the UW Science Posse on bears and adapting.
- **Learning takes place on-site, in the schoolyard, and in the local community/environment.**
  - We spent a lot of time on the playground, in the park by our school, Casper Mountain, Platte River, and walking to various places around our school.
  - Students will do activities in the schoolyard, possibly other areas in the county and at nearby Saratoga Wetland/Lake are to support their understanding of science and the local community/environment.
- **Learning is personally relevant to the learner.**
  - Students will do group activities and then discuss the implications for the community environment and themselves as part of the community.
- Recycling is something that students can do at home as well as at school.
- **Learning engages students in investigation, inquiry and problem-solving.**
  - Students will conduct an experiment to reduce, reuse and recycle waste in the school.
  - This inquiry is appropriate for second graders and will likely lead to other questions
  - Students will be learning how to make observations, collect and record data and share their results with others.
- **Learning is interdisciplinary.**
  - The activity will require research and therefore language arts standards will be addressed. In addition, learning about the community is a social studies standard.
  - It is science, civic responsibility, map making, math (graphing and data gathering) technology, reading, writing and some social studies as well.