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Place-Based Education: An Impetus for Teacher Efficacy

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PLACE-BASED EDUCATION: AN IMPETUS FOR TEACHER EFFICACY

by

Tamara Chase Coleman

A dissertation submitted to the Graduate College
in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
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PLACE-BASED EDUCATION: AN IMPETUS FOR TEACHER EFFICACY

Tamara Chase Coleman, Ph.D.
Western Michigan University, 2014

This research investigated professional development in place-based (PB) methodology on the efficacy of science teachers. While teachers are expected to use best practices they do not always implement them due to a lack of efficacy in implementation. A professional development program (PD) was designed to increase confidence among teachers planning to incorporate PB methods. Place-based education (PBE) is recognized as a best-practice among professional educators. PBE includes the selection, design and engagement with science using the geographic place as the content. The literature reports that student learning and teacher efficacy will improve when teachers are prepared effectively in PB practices. This dissertation research examined the effects of PD in PB methodology and its influence on the efficacy of seven science teachers who participated in this research. An exploratory, qualitative research approach was used to study the characteristics of change among teachers. Qualitative information was collected about the teachers’ confidence with PBE methodology and practices through interviews, in reflective journals and through observations of them working with students in PB settings. Changes in teacher efficacy were accompanied by their becoming more intentional with PBE, networking with experts and expressing a commitment to connect content with the community. The consistency of changes in efficacy among the seven...
teachers in the study was mixed. Three of the teachers became more confident in their approach to teaching using PB methods and reported the gain in confidence was influenced by the PBE professional development. Three teachers reported that the PD had little effect on their efficacy as teachers to implement PBE. These teachers cited complications from more critical issues in their careers such as time to prepare PBE lessons and meaningful participation in the PD. Those difficulties proved to be hindrances in developing efficacy in implementing PBE. Themes emerging from this research are: PBE is accepted by teachers as a positive methodology to improve efficacy; PBE was recognized as connecting students with and engaging them in learning about their local community and environment; longevity in teaching does not equate with efficacy, and the level of efficacy improves when teachers meaningfully engage in PBE.
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I am grateful to the teachers across the US. During my 25 years of experience in education I have crossed paths with some of the most giving, dedicated individuals I have ever met. The individuals who were kind enough to allow me into their classrooms and spend their time talking with me on their lunches and planning hours, in the evenings and in the summer were warm, giving and selfless. They hold high standards for their students and in many ways are the parents some of their students do not have at home. They give of their time, energy and hearts. They supplement their classrooms with resources from home, purchased with their own money, and they write grants when that money runs out. When the education arena is yelling and screaming about too many kids in the classroom, not enough time, or not enough money, they keep their heads down, their chins up and their eyes on the prize—student engagement—with science, their communities and the individuals who care about them. There are many teachers across
the US who exemplify efficacy and often they are not the squeaky wheels, so go on, unheard and underappreciated. I thank you all.

I wish to thank my wonderful family which includes friends who are like family. To my beloved husband, Mike, I am grateful for your love, the financial sacrifices and unending support of my often irrational endeavors. I look forward to your health and a crazy and exciting life with you apart from this consuming process! To my amazing, talented, wise, and patient daughter, Maddison; while it was exciting to have attended school with you, I am glad it is over! I am particularly impressed by your patience with me- so much of your life was spent waiting for me or forgiving me for many tired days and not enough money. Thank you very much for the joy and beauty you bring to our family.

I would not have started this without the inspiration from my father and my grandmother but I would not have finished it without the care and support of my brother. This is dedicated to you and the memory of you, Robert. Cheers, family! Let’s start having some fun!

With gratitude,

Tamara Chase Coleman
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CHAPTER I
INTRODUCTION

This study examined learning about science; in particular, the science of nature and the environment, and teacher efficacy, or confidence in teaching science. In doing so, it attends to professional development for elementary and secondary teachers being prepared in place-based (PB) teaching about the environment.

One method of teaching about nature and engaging the student in his or her environment is place-based education (PBE). It has been shown to enhance students’ cognitive abilities, and their affective, and social learning (Gruenewald, 2003; Dyment, 2005; Knapp, 2005). Most importantly, it has been shown to provide greater motivation and attitude change in teachers than conventional teaching methods and is, therefore, an appropriate focus for this study in teacher efficacy. Place-based education was the methodology informing the teachers in this study. Hereafter, study of nature will be called science and place-based methods are the approach used in the teacher education program with the intention of addressing issues in science.

The Problem

There are numerous issues that are chronically being addressed in science education, largely due to the dynamic nature of the content, classroom practices, and theories of learning. Several of those issues involve a minimal, at best, relationship with the content and practices of science, especially related to the natural environment and
low scores on science education assessments (NGSS Lead States, 2013; UNESCO, 2013; Louv, 2005; Nabhan and Trimble, 1994). Additionally, teachers often fail to incorporate lessons in and about the environment with which students interact on a regular basis, yet many teachers believe they are successfully incorporating those topics in their lessons (Loughran, Mulhall, and Barry, 2012). The problem addressed in this study is: despite teacher education in best practices, research shows that teachers, in general, may not have the confidence to utilize them in their teaching. This issue is one of low teacher efficacy, which results in students’ continued lack of engagement with the environment. This research was intended to examine the role of professional development in place-based education on teacher efficacy.

Research studies and philosophical treatises have focused on the relationship between knowledge about nature and experience in nature during the past five decades (Carson, 1962; Nabhan & Trimble, 1994; Louv, 2005). In 2013, the Next Generation Science Standards addressed the improvement of authentic science learning and student experiences by incorporating more doing of authentic science (NGSS, Lead States, 2013). Place-based education methods present authentic and appropriate practices that encourage engagement with science. They suggest:

Scientific practices are the behaviors that scientists engage in as they investigate and build models and theories about the natural world. The National Research Council (NRC) uses the term practices instead of a term like “skills” to emphasize that engaging in scientific inquiry requires coordination of both knowledge and skills simultaneously. Use of the term practices helps avoid the interpretation of skill as rote mastery of an activity or procedure. Part of the NRC’s intent is to better explain and extend what is
meant by ‘inquiry’ in science and the range of cognitive, social, and physical practices that it requires (para.2).

Science educators are seeking to improve science learning and science teaching through professional development. Professional development often has as its goal an improvement in pedagogical content, or improving the teacher’s confidence to use teaching methodologies that engage students in meaningful ways with the content of science. The rationale is that professional development provides a means to prepare teachers to meet rigorous expectations set for students (NGSS, Lead States, 2013; Louv, 2005; Nabhan and Trimble, 1994; VanAalderen-Smeets, Walma, VanderMolen and Asma, 2012; Jones and Carter, 2007).

The Handbook of Research on Science Education also discusses issues in efficacy and devotes much attention to this subject (Abell & Lederman, 2007). The last six chapters of the book culminate in the issues that remain after decades of teacher professional development in science education. Why are elementary teachers not teaching science? Why are teachers not incorporating the best practices they have been trained to use? Why do teachers believe they are implementing best practices, yet observations do not confirm their implementation? (Abell & Lederman, 2007; VanAalderen-Smeets, Walma, VanderMolen and Asma, 2012; Jones & Carter, 2007). TIMSS (2011) study draws attention to the important relationship between student achievement and teacher efficacy. The current study investigates that relationship.

Statement of Purpose

The major purpose of this dissertation is to explore and learn from the relationship between teacher efficacy and professional development in place-based learning. It is
believed that professional development may be designed and delivered to teachers so that it addresses the value in teaching science (the beliefs) and classroom practices (the practices), and boosts teacher confidence. The result will be an increase in the efficacy of teachers who teach science.

As the basis for this research, literature about place-based education, teacher professional development, and teacher efficacy was explored. Recent studies by Chang (2010) and Farah (2011) examined teacher beliefs and efficacy. More specifically, Chang (2010) determined a relationship between professional preparation and an increase in efficacy in beginning math teachers. Farah (2011) noted a positive relationship between efficacy and student learning as it applied to the teaching of technology, and a study by Munoz (2008) correlated teacher efficacy with student achievement. Individual change and constraints to change within the larger social contexts of school were examined. While these researchers discuss teacher efficacy in terms of subject matter, they do not associate efficacy with a proven classroom methodology such as PBE. It is this association that provides the link between beliefs and implementation. Thus, the questions of teacher efficacy remain.

**Research Questions.** Three research questions were investigated in the current study. They are:

1. What evidence is there that place-based professional development affects teachers in terms of efficacy, namely their beliefs and practices?
2. What factors affect teachers’ self-efficacy?
3. How do teachers account for changes in their efficacy?
The general hypothesis was that the best characteristics of place-based teacher education build confidence. The application of place-based education results in self-realized positive changes in science teaching through changes in efficacy.

**Defining the Terms**

**Place-based Education (PBE).** PBE may be defined as “quality experiences in local settings” and is an emergent educational field in the 21st century (Knapp, 2005, p. 277). However, reviews of the literature suggest that PBE has persisted for decades and probably started with Dewey (1938) and Carson (1962), and in later years was revived by Dillard (1974). It incorporates the local community, and the learner’s environment is the geographical place. This place provides the context for learning. It is largely student-centered and is enhanced by skills provided by community members. PBE is thematic and frequently includes learning in social science and language arts. PBE may refer to a methodology, practices, or place-based learning (PBL) and has been substantiated by current research as a positive method of teaching (Gruenewald, 2003; Dyment, 2005; Knapp, 2005). While PBE provides benefits for students and teachers in terms of attitude and motivation, the focus of this study was the use of PBE to enhance teacher efficacy through teacher professional development.

After an analysis of place-based literature, Smith (2002) determined patterns in place-based education. Common patterns are:

- cultural studies including oral and written histories
- nature investigation, including water testing and observation of a habitat
- real-world problem-solving, including implementation of these changes
interaction with local business and community members, including internships and career exploration

immersion into community functions such as town and council meetings

Place-based learning, therefore, encompasses both curricular content and instructional methodologies. Place-based methods typically result in (Smith, 2002; Woodhouse & Knapp, 2000):

- multidisciplinary and thematic content
- students designing learning, based on curiosities
- teachers facilitating learning experiences by networking within the community
- curriculum based on local phenomena
- problem solving about self, others, and ecological economic, historical, and cultural elements of the geographical place
- authentic data collection and analysis

In addition, PBE has been successful in Advanced Placement (AP) and other high stakes classes as it encourages alignment with national and state standards (Saracino, 2010) such as the Next Generation Science Standards (NGSS Lead States, 2013). The curriculum and pedagogy of place-based learning converge in a response to feeling “alienated from nature and human nature” and in authenticating content to the learner and his or her community (Woodhouse & Knapp, 2000, cited by Knapp, 2005). In this research, the term “place-based” will include elements of history and historical characters who worked the land, the present community of people, the environmental issues they work to remedy, and the learners.
**Indicators.** Indicators for this study inform the observer that progress is being made toward the intended goal of implementation of place-based methods and an increased teacher efficacy. For example, the place-based elements listed above (such as teachers facilitating learning experiences by networking within the community and curriculum based on local phenomena) are indicators of a place-based lesson. They provide evidence that progress is being made toward the goal for the lesson. “Indicators represent the valued attributes and characteristics of something” (Jenness, 2001). The following elements are indicators used in the observation stage of this research:

- Thematic
- Student interest
- Set in place
- Active, problem solving
- Teacher-student interaction
- Student-student interaction
- Student community interaction
- Authentic engagement in the place
- Content, standards aligned Environmentally focused

**Teacher Efficacy.** Teaching practices are behaviors enacted by teachers in their classroom and are dependent upon teacher efficacy, which consist of teacher beliefs, confidence and attitude about teaching. Tschannen-Moran and Woolfolk-Hoy (2012) define teacher efficacy as thoughts, values, and feelings about science. These authors extend the belief that a desire to learn about science and a feeling of understanding of
science are embedded within teacher efficacy. To clarify, self-efficacy as it has been defined by Bandura (2000), includes feelings and thoughts about science, confidence in teaching science, and how individuals practice as science professionals. Prior research on the self-efficacy of teachers has addressed the desire to learn about science, teaching science, and understanding science. Each has been shown to be embedded within teacher efficacy. As it lends itself to this study on teaching, efficacy attends to the beliefs of teachers and how those beliefs relate to behaviors, specifically through the implementation of place-based lessons. Research has suggested self-efficacy is related to teachers’ abilities to overcome hurdles in their teaching, such as stress, time, struggling or defiant students and other systematic issues that occur when working in a school setting.

This study addresses issues in science, in particular, a lack of teacher efficacy by using indicators to observe the implementation of professional development in place-based methods.

Potential benefits of this research include the design of greater opportunities for the teacher-as-learner within professional development (Loughran, 2007) and the implementation of best practice skills. The research will enable science researchers and educators to focus their energy on positive changes in the learning of skills appropriate for students. The changes may include easier adjustments to a changing, global environment, a closer relationship with nature, higher levels of performance and greater engagement in science, and skills that make students competitive in the global economy (NGSS Lead States, 2013; UNESCO, 2013; Louv, 2005; Nabhan and Trimble, 1994).
Chapter 2 addresses the research literature on the topics of professional
development, place-based education, and teacher efficacy in greater breadth and depth.
The results of prior research studies will be discussed critically to determine the research-
based status of the topics of professional development, PBE, and teacher efficacy.
CHAPTER II

THE THEORETICAL BASIS FOR THE RESEARCH AND LITERATURE REVIEW

This research was intended to examine the role of professional development (PD) in place-based education on teacher efficacy. A description of the theoretical foundation and a review of the literature on teacher efficacy and professional development in place-based learning is the principal objective of this chapter. A challenge, experienced by the present research, was to identify and analyze the teacher voice in science education research. Loughran (2007) noted that research in science education is conducted largely with the voice of researcher, not the classroom teacher of science. As reported in a study of elementary teachers’ content knowledge (Schibeci and Hickey, 2000), science education researchers typically observe classrooms and teachers, but many researchers have never been a teacher in a classroom themselves, rather the researchers are often university faculty members. Research that draws on the voice of the teacher is believed to reveal beliefs and self-efficacy. Research on place-based learning, in the judgment of this researcher, provides evidence about professional development and self-efficacy through the teacher lens.

This chapter presents an overview of the literature and theoretical framework that guided this research. Together, the theoretical framework, the literature, and the findings in this study will further inform the science education field regarding issues prevalent in science teaching and will contribute to theoretical discussions regarding teacher efficacy.
and the methodology best suited to its investigation. This review is intended to formulate a rationale for the study of teacher efficacy as a result of place-based learning professional development.

**The Theoretical Framework**

The theoretical framework for the current study was derived from research on efficacy (Van Aalderen-Smeets, et al., 2012; Osborn, Simon and Collins, 2003; Jones and Carter, 2007; Bandura, 2000). Place-based methodology was used as the filter through which teacher efficacy was observed. The early theoretical justifications for educational methodologies that are the predecessors of place-based learning were put in place within educational research beginning in the mid-20th century and have continued as a professional practice into the 21st century (Dewey, 1938; Carson, 1962; Knapp, 2005).

A seminal theory of teacher efficacy by Bandura (2000) contended that a person’s behavior could be based on the belief that such behaviors result in particular outcomes (outcome expectancy). Those outcomes also guide belief in a person’s ability to enact such behaviors (self-efficacy). Regarding behaviors such as the implementation of place-based methods, teachers believe they can and are enacting best practices. However, a discrepancy between the theoretical, expected components and the observations of classroom practices suggested this was not occurring (Mintzes, 1989; Jones & Carter, 2007).

**Belief and Practice Mismatch.** The theoretical basis for this study is illustrated in Figure 1, based in part on Jones and Carter’s work with teacher beliefs and attitudes (2007, p. 1074). This model provides a framework for the review of the literature. It is theorized that beliefs, attitudes, knowledge, skills, and motivations directly link to
instructional practices. Jones and Carter (2007) suggest that belief systems are linear (Figure 1). However, they describe the boundary between science teaching efficacy and implementation as a “belief and practice mismatch” (2007, p. 1082). In order to more closely align the beliefs of teachers to the implementation of those beliefs, rather the practices, it is necessary to address the efficacy of the teacher, which is comprised of attitudes, knowledge, and motivation. Professional development for teachers is couched in instruction, implementation, knowledge, skills and motivation, all of which are components of the theoretical model. Changes in attitudes, knowledge, and motivation are expected to affect perceptions of self-efficacy. The perceptions and environmental feedback held by the individual are referred to as filters in other contexts (Bandura, 2000), as well as in the model, and filter the implementation of methods such as place-based methods.

Efficacy, beliefs, and environmental constraints within contexts affect attitudes toward and motivation to implement instruction. Constraints exist and may hinder the implementation of the instructional practices, which are place-based practices in this research. The model is the guide for this research to determine the role of professional development in place-based learning on teacher efficacy. Specifically, this review examines literature on teacher belief systems, which include attitudes, implementation, knowledge, and motivation. It examines perceived filters of those beliefs, how instructional practices are impacted by such filters and environmental responses to those belief systems. It then reviews professional development opportunities for teachers in order to explore how professional development can best eliminate the “belief and practice mismatch” (Jones & Carter, 2007, p. 1082). According to the theoretical framework and
the literature on efficacy, if a teacher with high efficacy believes in a specific methodology, such as place-based learning, then the teacher will be more likely to implement such practices despite environmental and contextual constraints.

*Figure 1.* Efficacy as it guides instructional practices. Taken from Jones, M. G., & Carter, G. (2007, p. 1074).
**Teacher Efficacy: The Beliefs.** Teacher self-efficacy is based on Bandura’s (1986) social cognitive theory, which depicts individuals as their own agents of change. People are products of their environment, but are also producers of it. They design their own responses and actions, such as actions in a classroom. As it relates to self-efficacy, individuals have beliefs about their efficacy that then translate into personal change. Efficacy can be referred to as one’s confidence in the *ability to overcome*.

Efficacy relates social cognitive theory to constructivism and is seen in “how people feel, think, motivate themselves and behave” (Bandura, 1994, p. 2). General teaching efficacy provides confidence that students can be taught regardless of their background. Personal teaching efficacy is the individual’s belief in their ability to perform the tasks necessary to bring about positive change in their students. As it pertains to this study, Bandura theorizes that individuals have thoughts that influence their motivation and decision to behave, or not to behave in certain ways (Bandura, 2000).

Individuals are motivated by various factors. The motivation may be something internal or it may be something external. Individuals with high self-efficacy are more certain of their personal abilities to handle challenging situations and this certainty acts as the motivator to keep them from giving up. On the other hand, those who have low efficacy do not have this certainty, tend to give up more easily, and feel stress about the situation (Bandura, 1994). These individuals do not feel the ability *to overcome* hurdles and stressors. Efficacy is used in this research to include contextual applications related to professional development and place-based learning.

**Indicators of Efficacy: The Implementation.** Characteristics of teachers who improve learning by exhibiting efficacy have been determined by two important studies.
They include a study by Farah (2011) on teacher’s technology self-efficacy and a study by Munoz (2008) on Latino student success.

Farah employed a qualitative case study in which a survey was used with the intention of understanding teachers’ current level of technology self-efficacy. A group of nine teachers with varying levels of technology self-efficacy was interviewed and attended one of three focus groups to gain a better understanding of factors influencing their current level of self-efficacy. A document analysis of local school professional development plans was also conducted. Results revealed personal, behavioral, and environmental factors that influence teachers’ self-efficacy and that more can be done to increase technology efficacy, which may in turn increase student achievement.

Farah (2011) used the following traits to depict efficacious teachers, and these terms are adapted from her interviews (2011, p. 46):

- Personal characteristics such as stress or scares
- Mastery traits such as learn or experiment
- Behavioral words such as risk-taker or innovative
- Environmental characteristics such as support, time or opportunities

Munoz’s research (2008) used a mixed-methods study investigating the relationship of student success in math and science and teacher efficacy in an urban-fringe high school. Achievement was assessed using the variables of gender and socioeconomic status. Teacher’s efficacy scores were pre-assessed and then correlated with the students’ math and science pre- and post-test scores. Results indicated positive student achievement in nearly all student populations. The impact of teacher and personal efficacy on student achievement revealed a causal relationship and emphasized the
importance of mentoring and growth within and among the faculty at this school. Munoz found personal traits indicative of efficacious teachers. These indicators are:

- Preparing: intentional and thoughtful lesson plans; specific procedures
- Engaging/guiding: puts forth effort to reach, takes responsibility for learning
- Fostering achievement: emphasizes content connections; student-designed lessons
- Ability/confidence: facilitates growth toward desired outcomes
- Daily effort: consistent, daily focus on growth

As the current study ultimately intends to improve student achievement in the sciences, another important finding by Munoz is the relationship of “how efficacy contributes to achievement” (p. 83). Munoz determined that the following traits are indicators of efficacy for teachers who improve their students’ achievement:

- Motivating: encourages, convinces students they can achieve goals
- Guiding: uses different tools and methods to reach all students, regardless of learning style
- Believing: daily demonstrates that it is the teacher’s responsibility to provide students with the best educational experience so they can accomplish their goals
- Caring/Pride: cares enough to always have a great lesson plan in place and pride in students' abilities

Farah (2011) and Munoz (2008) provide indicators beneficial for this dissertation. According to the theoretical framework, observations of the teachers enable the researcher to look for such traits as indicators of the efficacy in implementation of the PB methodology.
**Place-based Education: The Instructional Practice.** Researchers regularly strive to identify the factors that contribute to a teacher’s efficacy. These factors can be targeted in teacher professional development to enhance beliefs that translate into best practice behaviors.

Scribner and Cole (1973) investigated issues associated with learning science in formal settings. They concluded that “in school, science lays common sense to rest” (p. 556). However, place-based learning has been shown to enhance students cognitively, affectively, and socially and provide for quality learning experiences. Researchers illustrate that in conventional schools, learning is absent the normal context of students’ daily lives away from school (Gruenewald, 2003; Dewey, 1938; Knapp, 2005). Place-based learning sets the learning context and the physical context to complement one another. To clarify this point Falk and Dierking (1997) state:

Learning is the process of applying knowledge and experience to new experiences; the effort is normally played out within a physical context and is mediated in the actions of other individuals. In addition, learning always involves some element of emotion and feeling (p. 216).

The relationship between teacher efficacy and professional development on place-based learning is examined here. Place-based education incorporates instructional theories and methodologies promoting particular approaches that build teacher confidence in science education.

**Issues in Science Learning and Teaching**

The Trends in International Mathematics and Science Study (TIMSS, 2011) reports provide data on the mathematics and science achievement of U.S. students
relative to students in other countries. TIMSS data have been collected every 4 years from 4th and 8th graders since 1995. TIMSS were administered to students at grade 12 in 1995 and 2008. In the most recent TIMSS (2011), more than 20,000 students in 1,000 schools in the United States and 60 other countries participated at grades 4 and 8. Approximately 500,000 other students around the world took this assessment in the spring of 2011.

What makes this report significant to this dissertation is its emphasis on teacher efficacy. Data about teacher participation in professional development was self-reported by teachers in response to the query about preparedness to teach science topics, and confidence in teaching science (TIMSS, 2011, p. 308) relative to answering student questions, ability to provide challenging tasks and explaining science experiments. Additionally, information regarding the teachers’ ability to engage student interests and relate lessons to students’ daily lives was collected.

According to TIMSS, confidence in teaching science, a key component of teacher efficacy and student achievement was a factor in which 4th grade teachers in the United States were slightly below the international average. Regarding their feeling prepared to teach science, teachers in the United States (60%) were also below the international average (62%). On the other hand, 8th grade teachers in the United States rated themselves higher (84%) than the international average (73%) on confidence to teach science. Of note, the TIMSS survey reported higher student science achievement for teachers who had job satisfaction compared to those teachers who were “somewhat” or “less than satisfied” (TIMSS, 2011, p. 323).
The 2011 TIMSS study indicates that, in general, teachers in the United States are less confident, participate in fewer professional development opportunities, and do not feel well prepared to teach science relative to the international average. Teachers in the United States also reported being less satisfied with their jobs. Alternatively, TIMSS surveyed teachers’ ability to relate lessons to students’ daily lives. The international and the United States averages for responses were nearly the same, 64% to 63%, indicating an application to everyday lives. The measures of central tendency from the TIMSS survey are interesting from the standpoint that there is an international interest in teacher efficacy being self-reported despite some slight variation in the average values reported, such as with the 8th grade teachers.

The TIMSS study serves as a barometer by which to examine student success as it is related to teacher efficacy and the role of professional development. Place-based learning and methodology allow teachers to relate lessons to the daily lives of students and foster more positive attitudes and authentic learning (Gruenewald, 2003; Falk & Dierking, 1997; Dyment, 2005). This research suggests a study such as the current study which is about teachers trained in quality PBE and teacher efficacy.

**Place-based Education as Best Practices for Teacher Efficacy.** PBE has been reviewed as a method for enhancing experience with the environment, as it adheres to the constructivist approach and provides learning in classroom settings both within schools and out-of-doors. This section summarizes the values of place-based education for teacher efficacy and is an appropriate method for teacher development and implementation. The professional development for this study focused on place-based
methods and included teachers who expressed an interest in PBE methodologies as best practices.

Current science education relies largely on constructivism, which emphasizes the importance of connecting learning to prior knowledge and experience, and depends on authentic problem-solving in real situations (Gruenewald, 2003). In constructivist theory, students create meaning via their interaction with the world around them. In this way, it is situated learning; interacting with the environment, both natural and cultural (Brown, Collins & Duguid, 1989). Through such interactions, and the development of meaning that occurs, students create explanations about the world in which they live. If the new information agrees with the learner's current experience and information, the meaning the learner makes is maintained. However, if it does not agree, the students’ understanding and meaning are in conflict. At this point, the student can reject the new information or revise one’s understanding of it. In short, learners need abundant sensory experiences with their external world and opportunities to verify information from new experiences.

For decades, research has illuminated (Dewey, 1938) the great disconnect between what happens during a student’s in-class time and what happens in real life. The learning in classrooms lacks authenticity much of the time, and for this reason, it is difficult for students to apply their learning. Place-based education emphasizes authentic learning, which has been referred to as meaning-making-with information, assimilation of content from an integrated curriculum and practical problem solving. To this day, elements of Dewey's philosophy (1938) of encouraging authentic, experiential learning continue to thrive in place-based, pedagogical practices (Gruenewald, 2003; Knapp, 2005) which overcome the disconnect between children's experiences outside of school.
and in-school learning. Place-based practices are evident when educators design the
curriculum around learners' interests and abilities and use local phenomena as a context
for learning. They are revealed when teachers engage learners in service to the
communities in which they live (Gruenewald, 2003; Knapp, 2005).

Nature as the place and context for learning has been shown to enhance people’s
psychological well-being, self-image, and self-satisfaction, cultural identity, and
community pride, in addition to environmental health and commitments to the
environment (Nabhan and Trimble, 1994). However, according to Louv (2005), there is
a dearth of experience in the natural world, leading to multiple emotional and cognitive
issues such as poor performance on science assessments, physical illness and obesity, and
cognitive issues. There is growing evidence of the need to teach science in ways that
develop and integrate the types of learning expressed by Dewey (1938) in a society
described by Louv (2005). Researchers have hypothesized about and collected evidence
regarding the link between the setting in which an experience takes place and the quality
of the experience itself (Morag & Tal, 2012). Several have speculated regarding the
effects of PBE on individual’s and groups’ engagement in community building and other
relationships beyond learning (Woodhouse and Knapp, 2000; Morag and Tal, 2012) in
addition to positive impacts on teachers’ attitudes and efficacy (Dyment, 2005; Morag
and Tal, 2012).

The studies synthesized here are important components of this literature.
However, two studies are elaborated as they represent the themes of the review and
provide a notable perspective to the themes, methodology and analysis. The studies are
Dyment’s (2005) study of barriers to teaching about the use of schools’ green spaces and
Morag and Tal’s (2012) study of assessing learning outcomes in school field trips and impacts on teachers.

In Dyment’s (2005) study, research was conducted to (1) determine how green school grounds are being used for learning; (2) identify barriers to acceptance of the practices that exist and (3) determine if the barriers found are different from Rickinson and co-investigators’ 2004 study on barriers to out-of-doors learning. Dyment intended to determine if and what barriers existed when green school grounds were used for learning as opposed to a location away from the school. She elaborated the benefits for students in learning in the out-of-doors and concurred with the benefits cited by Rickinson.

What makes this study noteworthy is that the research determined positive cognitive, affective, interpersonal/social, and physical/behavioral impacts for students and teachers in addition to fewer barriers when using the place in the form of green school grounds. This included improved student-teacher relationships, more satisfaction for teachers, increased ability for students to think creatively and to use higher order thinking, and better performance on standardized tests. The researcher posits an “untapped potential” (p. 40) through teaching with green school grounds as the place and alludes to various benefits for the community. Dyment’s study observed differences from the prior study of out-of-doors learning entailing field trips (Rickinson, 2003, as cited by Dyment, 2005) and made suggestions for teaching in community and green settings. In short, the suggestions entailed being in the environment by utilizing green school grounds in a place-based educational program.
In her research, liability and resources were not barriers while teacher efficacy, larger class sizes and a movement to “back to the basics” (p. 39) were identified as barriers. Weather issues and a lack of principal support also appeared as issues when green space and associated curriculum were being used as an integral part of the school day. Of note for the current study, participants suggested that teachers were not confident teaching out-of-doors, especially if they never learned in an outdoor setting.

Dyment illustrated the internal barriers to teaching best practices, which rely more on deeper beliefs held by the teachers, rather than simply managing bussing, curriculum and weather issues. Rather, the teachers perceive a responsibility that appears to be quite specific and very narrow. In quoting Dyment (2005, p. 39):

“Teachers are limited by conventional assumptions about education—their own need to master the subject area, and to have all answers in advance fearing it will take away from the most important teachings that will be tested.”

Most importantly, data from Dyment’s study provided an impetus to further investigate teacher efficacy via place-based methodologies. It presented a fresh perspective in the “belief and practice mismatch” (Jones & Carter, 2007, p. 1082). As it pertains to this dissertation, and according to Dyment’s research, if teachers can maximize the personal benefits and minimize the barriers (curriculum, confidence) when applying an approach such as PBE, the personal benefits could provide an impetus for them to change their teaching approaches and align their practices with these beliefs. In sum, she suggests “external training will do little for those whose internal values and perceptions do not include outdoor learning. Either way, “legitimizing green school grounds will improve upon all issues” (Dyment, p. 41).
A more recent study conducted by Morag and Tal (2012) observed twenty-two eight-hour field trips attended by 4th-6th graders. This study is important due to its focus on all components of field trips and the benefits the trips pose for both students and teachers. Their research on Field trips in Natural Environments (FiNE) is a means to evaluate learning in a variety of informal nature settings. Importantly, as Morag and Tal suggest, much research on designed environments exists (such as the layout of schools and classrooms), while research on natural environments does not exist. Their research further defines and assesses best practices throughout the process of designing and conducting out-of-classroom, place-based learning.

The authors investigated the characteristics, instruction and learning outcomes of the field trips they observed. They listed the benefits of field trips to include cognitive, affective, social, physical and behavioral components and point to a general lack of research on situated cognition and constructivism in tandem with pedagogy in such settings. They found an increase in teacher benefits such as physical activity for the teacher/observer and facilitated active learning and an opportunity to collaborate with expert facilitators. Outcomes had just two components identified, whereas planning, pedagogy, and activity had additional components (Table 1), which included the researchers’ observation of students’ physical activity.

The instrument provided a framework that enabled teachers and researchers to observe and record all elements of the field trip (Table 1). More specifically, an example 6th grade field trip (referred to as 6 Mis by the authors) is illustrated below in Figure 2. The numbers refer to the components of the related Table 1. Scores are color-coded and
refer to quality or successful field trip elements. Dark color refers to low level, light grey refers to high level and no color refers to medium level presence/success. The example field trip (6 Mis) provided success in collaborative planning (outer ring) and the outcome of feelings, attitudes and beliefs (inner ring). However, a limitation of the FiNE research that is apparent when doing a critical analysis was the inability to provide a clear link between activities during the field trip and the overall outcomes among students.

Table 1

**FiNE Framework Components for Assessing Field Trips (Morag and Tal, 2012, p. 755)**

<table>
<thead>
<tr>
<th>Planning</th>
<th>Pedagogy</th>
<th>Activity</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom preparation</td>
<td>Clarifying the goals</td>
<td>Physical activity–observer</td>
<td>Feelings, attitudes &amp; beliefs</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Using the environment</td>
<td>Active learning–students</td>
<td>Knowledge &amp; understanding</td>
</tr>
<tr>
<td>Connection to curriculum</td>
<td>Connection to everyday life</td>
<td>Physical activity–students</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social interactions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facilitator’s performance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data collected mainly by observation and from teachers/facilitators

Data collected from students
Figure 2. FiNE model of field trip (6 Mis). The numbers refer to the components of the model in Table 1. Scores are color-coded. Dark color refers to low level, light color refers to high level and no color refers to medium level (Morag and Tal, 2012, p. 769).

Indeed, field trips allow for multiple benefits, including learning of science content, and experience in a variety of out-of-school settings. These settings can be aligned to the curriculum and when facilitated properly, they can provide active, real-world authenticity lacking in most conventional classroom settings.

Morag and Tal (2012) suggest a movement away from traditional approaches to an authentic learner-centered approach; one that can be imparted via PBE and provides benefits to both students and teachers. For these reasons, science education is an opportune part of the curriculum in which to research teacher development relative to place-based education as a best practice for implementation.

**Place-based Lesson Indicators.** The literature on benefits of place-based education for teachers builds on student benefits and suggests more research exploring teacher efficacy and implementation.

DeWitt and Storksdiek (2008) in their review, Key Findings from the Past and Implications for the Future, state that field trips such as those in place-based lessons are
not suited to teach complex concepts better than in the classroom, but are meant solely for discovery and exploration. However, Dewitt and Storksdiek also point out that while cognitive and affective learning has been shown to occur as a result of out-of-school learning overall, it is not a substitute for in-class learning, per unit of time. Of note, however, the authors state “under certain favorable circumstances” out-of-school learning may “lead to better learning outcomes” (Dewitt & Storksdiek, 2008, p. 187).

These favorable circumstances include the following components and are similar to those that exemplify PBE as discussed previously in this dissertation. This list includes indicators of place-based lessons, which were observed during the field data collection component of the present research. Each of the following criteria was evaluated regarding its significance to the observation protocol and was implemented when germane to the questions guiding the present research (Appendix F):

- pre visit orientation of the setting
- prior knowledge
- moderately structured with room for exploration
- supplemental pre and post-visit activities
- high engagement
- link with local or state curriculum
- some structured activity linking the curriculum to the visit
- repeat visits
- student control
- social interaction
• teachers who were enthusiastic and engaged

• students collect and analyze authentic and first hand data (DeWitt & Storksdiek, 2008, p. 190)

This research is of great value to a study on place-based learning in that these “favorable circumstances” encourage the greatest cognitive and affective benefit, and may actually “lead to better learning outcomes” (DeWitt & Storksdiek, 2008, p. 187) than conventional learning processes. These circumstances directly align with PBE and indicate the value of the method in teaching and learning for conventional classroom teachers and their students. However, DeWitt and Storksdiek (2008) stated, “Even when teachers seem aware of ‘best’ field trip practices, their own field trip implementation might still deviate from a best practice script” (p. 187).

**Indicators of a Successful Place-based Professional Development.** Flaherty’s (2007) study added to the literature of place-based learning by examining post-college age persons as it pertains to teacher education. The focus of the research was place-based learning among adults who were participating in a statewide Regional Learning Opportunities (RLO) program associated with the West Virginia Prevention Resource Center (WVPRC). The RLO program assisted a county planning process with assessment, capacity-building, planning, implementation, and evaluation. Flaherty’s (2007) research examined how participants (including staff members and directors) perceived and experienced the process, and identified and examined the significance of positive and negative factors in the experience.
The research focused on the RLOs in the Commonwealth of Virginia. A primary research objective was to identify factors that enhanced the place-based learning for the participants. The data were collected at the statewide, regional, and individual county levels. This data consisted of interviews with the planners, facilitators, and the program participants, in addition to observations of monthly RLO meetings for ten months. In addition to field data collection, there was a review of planning documents, curriculum materials, reference materials, and monthly reports and triangulation of multiple people and events through participation, observations, and interviews. Participants in the study had the opportunity to review and to clarify emergent themes at the monthly meetings.

Data analysis resulted in both positive and negative participant perceptions. Approximately half of the participants described the RLOs as very helpful and half described them as unhelpful and confusing. Important for design of a successful professional development, the factors that enabled learning were either process or content-related. Networking, confidence, a positive attitude and a focus on the local community emerged as positive factors while negative process-related issues also emerged, such as lack of fluidity of planning and then implementation, confusion about teaching versus facilitation, different skill levels among participants, and inadequate resources like staffing and time.

Flaherty’s research is significant for investigations of PBE because it requires a critical examination of the pedagogy of place and importance of place in situated contexts within planned social transformation (Flaherty, 2007). In addition, it is “concerned with the contextual, geographical conditions that shape people and the actions people take to shape these conditions” (Gruenewald, 2003, p. 4). In terms used by PBE researchers
(Gruenewald, 2003; Knapp, 2005), the goal of critical pedagogy of place (Gruenewald, 2003, p. 3) is to develop a relationship with the familiar (the learner’s community), seek new information about the place, and eventually form some type of action to care for it. Noteworthy in Flaherty’s (2007) study is PBE’s impact on adults as learners in professional development and its relationship to teacher development. It brings to the forefront the questions about effective teacher education and the means to achieve positive impacts on attitude and efficacy.

Similarly, Vanalderen-Smeets, et al. (2012) and Osborne et al. (2003) note that when teachers gain greater confidence and self-efficacy and a more positive attitude through continuing education efforts, they subsequently teach science in a better manner and are able to improve the attitudes of their students in this area. Internal factors associated with science teaching (a teacher’s ability to teach science with a lack of stress associated with doing so, and confidence in the field) are different from external factors (such as administrative support for science supplies or directives to teach specific standards) yet directly reflect the teacher’s desire and ability to engage his or her students with science.

Van Alderen-Smeets, et al. (2012) point out that students lose interest in the pursuit of science careers early in school and therefore one should pay attention to improving students’ interest early. This problem has been remedied in some cases by adding more science time. Rather, these authors state the need for improved professional development for science teachers, with a focus on teacher attitudes toward science, which may stem from their own positive or negative experiences in science. Results of such negative science attitudes include lower self-efficacy resulting in less teaching about
science and in general, a lack of confidence in science illustrated by less engagement of students with science experiences. Van Aalderen-Smeets, et al., (2012) summarize in their review of teacher attitudes and teaching of science:

…in the context of primary teachers and science it should be noted that increases in knowledge do not always lead to improvements in the amount and quality of teaching these topics. Only when teachers believe that science [topics] are relevant and important, when they have positive feelings toward these subjects, and when they perceive themselves to be capable of teaching them without being dependent on too many context factors will teachers change and improve in their teaching of these topics. (p. 179)

What stands out from the models for teacher, program, and student success is the degree of long-term mentoring that takes place from facilitators of professional development to the teachers. Long term mentoring allows for modeling of proper teaching techniques and the development of a relationship between the facilitators and the teachers. Studies on teachers as learners indicate that while teachers may learn to teach certain ways, they inevitably rely on old ways of teaching and perhaps the methods their own teachers used. Additionally, studies indicate that while teachers reported they had implemented processes and procedures of quality, their teaching actually indicated they did not do so (Loughran, 2007 from Handbook of Research on Science Teaching). While this brings to light the relationship between teacher professional development and attitude, it does not address how teacher education impacts subsequent implementation. This poses the question: what makes for successful teacher education and thereafter,
implementation of learned methods and resources? This research suggests a study on teacher efficacy and professional development in place-based learning.

**Exemplary Teacher Professional Development.** Penuel, Fishman, Yamaguchi and Gallagher (2007) conducted a study on a professional development program with the explicit intent of determining indicators of effective teacher education. Effectiveness of the program was defined in terms of implementation of the skills and curriculum comprising the PD. Their intent was to examine the design and conduct of professional development programs as they result in both teacher practice and student learning.

After analysis of results from 28 professional development situations, they compiled a list of traits present in the most effective professional development opportunities; those that specifically resulted in the implementation of the program. To test these results, and the corresponding list of traits, they sampled 454 teachers participating in a GLOBE workshop to determine their level of implementation of the GLOBE program and teacher perception of the professional development experience.

Their research revealed the following indicators of professional development experience that prompted implementation:

- Teacher study groups rather than large workshops
- Collective participation of teachers from the same school
- Being mentored or coached, even engaging in an internship
- Curriculum-linked or site-based professional development geared toward teacher-specific curriculum (aligned with teacher goals)
- Duration of time long enough to allow practice of new skills
The authors’ results apply to the current study in that the place-based professional development was designed to align with the above traits, and was attended by all participants in the current study. These indicators were also used in the observation of place-based methods for this dissertation study.

In addition, the focus of Fallik, Eylon, and Rosenfeld’s (2008) study is directed toward education of teachers, and, they confirm, teachers do not always teach according to what was learned in professional development. The article discussed not why, but rather how to remedy the problem. Their research looks at a continuous professional development model (CPD) in two phases. The intent of their study was to evaluate the effectiveness of the project-based learning (PBL) model in Science and Technology (PBLSAT) on novice teachers who attended a preliminary education component, and also expert teachers who attended both components of the workshop. The PBL model is similar to the PBE model in that it is constructivist in nature. It too, is rooted in Dewey’s experiential, student-focused and active learning model and was designed by Dewey’s student, Kilpatrick, in 1918.

Their research questions, examined in two stages are:

Stage 1:

1. How do novice teachers evaluate their own knowledge before and then after the workshop?

2. What are novice teachers’ perceptions of benefits and then difficulties for selves, school and students?

Stage 2:
How do expert PBLSAT teachers evaluate the value of the two support frameworks?

Their workshop model consisted of the following: (a) collaboration between teachers in the program and staff, (b) support for teacher as learner, teacher as teacher, and teacher as innovator, (c) a central connection with curriculum and authentic topics, (d) integration of these central topics with PBLSAT and standardized achievement test skills and (e) support for the teachers while they develop their projects and enact them in their own classrooms.

The researchers worked with 600 Israeli teachers between 1992 to 2004, focusing on teacher-as-learner by conducting PBLSAT workshops intended to educate the teachers. The first workshop component treated the teachers as the teachers should interact with their students; teaching them experientially, using open-ended, yet structured projects. In this way, the teacher became the learner. The curriculum was determined by the Israeli science standards. As the multi-year study progressed, the workshop time frame began with 56 hours of workshops in the first year and developed into 21-28 hours of workshops.

The second workshop component focused on teacher as teacher. Facilitators worked with teachers to plan, organize and act as mentors of PBLSAT. A specific and interesting element of this workshop was that of dealing with specific issues at each teacher’s school (such as time, resources and administrative issues). These workshops took approximately 21-28 hours as well.

Specifically, the study included 58 novice middle school teachers who completed a pre and post questionnaire consisting of open-ended and closed-ended questions.
it was not clearly described, there were nine specific skills tested on the pre and post-test. According to Fallik et al., these skills are question asking, choosing a driving question, formulating a research question, writing a proposal, peer evaluation, developing evaluation criteria, research and design methods, data collection and analysis, and drawing conclusions. In order to test these skills on the closed-ended portion of the test, the researchers employed an easier to evaluate and more detailed approach than a Likert scale test. Rather, for each skill, participant teachers scored on a 100 mm line with captions “I have not acquired this skill” to “I have acquired this skill” (Fallik et al., p. 572). The participating teachers were asked to reflect on their knowledge of the PBLSAT research skills on two occasions: before they started the workshop and after the workshop. Measurements were recorded by the researchers in millimeters, and then during analysis, were grouped according to the benefits of using PBLSAT for students, for teachers and for the school. Benefits include emotional (such as motivation, curiosity and learning) and social benefits (such as preparation for life and responsibility).

The open-ended responses indicated some interesting data. For example, the teachers in general pointed to many benefits for their students in terms of motivation, engagement and an increase in what was learned as a result of having some choice and empowerment in the process. However, PBL did require some after school and additional time for some students, which was seen as a detriment. For teachers, extra time to learn new material (which included time well beyond the school day and also into weekends and vacations) was discussed as a main detriment. Teachers did, however, indicate that it strengthened their relationships with their students and the teacher interest in the project stood out as a benefit as well. In sum, 57% of the statements indicated perceived
difficulty for the teachers, 13% for schools and 30% for students. 95% of the benefits were for students, 2% for teachers and 3% for the school.

The second phase of the study focused on expert teachers, who had been teaching from 6-27 years and had been working on long-term programs (2-3 years). In addition, these teachers had been working with project-based learning in their schools for 5-7 years. Data collection for this group of seven teachers relied upon open-ended interviews with questions about their experience, difficulties and what was learned in their program. Member checking with three of the seven teachers was conducted by asking them if the responses of the group were generalized appropriately in the article. The teachers in this second study claimed a much more positive impression of the workshop than the previous study. For example, teachers felt they learned much from the process itself—being allowed to make mistakes and learning from them, and especially appreciated the teacher-centered, rather than the program-centered focus.

Noteworthy in this process was the implementation of “mentoring days” which was of benefit for the students and the teachers and allowed the teachers to develop self-confidence. This support by workshop mentors continued for several years. In addition, expert teachers modeled and then assisted with the implementation. Researchers determined the most salient effect for teachers was the empowerment and personal ownership the teachers felt. Teachers also felt that they experienced new learning. As a result, the researchers felt they addressed the initial problem (and this review’s overarching problem); that teachers typically do not enact changes. For example, this process engaged teachers more and thus saw better results in terms of changes, skills and knowledge implemented after the conclusion of the workshop. The researchers felt the
reasons for this success were the long-term support, recognition of teacher learning preferences and assistance for teachers in solving their own problems. Novice teachers acquired the relevant skills but also expressed worries about enacting the program. Nonetheless, the teachers enacted the program and identified unforeseen benefits for themselves and their students. The authors suggest that the CPD model helps teachers develop a sense of personal ownership and customization for the program, through multi-staged support to integrate student free-choice PBLSAT into the formal science curriculum.

According to the study, when teachers felt they learned from the professional development process—by being allowed to make mistakes and learning from them, the teachers gained empowerment and personal ownership (Fallik et al., 2008). As a result, the researchers felt they addressed the initial problem (and this review’s overarching problem); that teachers typically do not enact changes.

When professional development is done correctly, it can enhance teacher attitude and efficacy resulting in benefits for students. However, results of poor professional development processes (Butts & Raun, 1969) incur negative science attitudes, which include lower self-efficacy and result in less teaching about science and a generalized lack of confidence in science. This translates to less engagement of students in science experiences.

**An Alternative Viewpoint about Teacher Professional Development.** With the understanding that teacher attitude pertains to student success, Butts and Raun (1969), sought to understand the impact of teacher attitude on their behaviors. They asked the question: what factors of teacher professional development contribute to the greatest
attitudinal change? They looked to previous knowledge of science, teaching experience and the teachers’ perception of the import of the program to their students. Butts and Raun hypothesized that the attitude of teachers would increase positively due to an increase in knowledge. The professional development was intended to promote the “spirit and philosophy of a curriculum approach” (p. 101), that curriculum being *Science-A Process Approach*. In doing so, they address the attitudes of teachers and inquire; are attitudes of teachers likely to change, or, due to past experiences, are they unable to change? While not elaborating on such past experiences, Butts and Raun chose the participants in their study, according to individuals who would “benefit the most” from the teacher development (p. 101) and were committed by their administrator who joined in the education and pre-testing.

The study variables were school, grade level, teaching experience and hours of previous science course work. The authors studied sixty teachers across seven school districts with teaching experience ranging from zero to 34 years, with median experience of 7.75 years. The teachers taught grade one through grade six. Hours of course work ranged from zero to 30 hours with a median of 11.5 hours. An attitude assessment called the Semantic Differential was administered as a pretest prior to education as well as a post-education test. This test consisted of 12 protocol words and their polar pair on a seven-point scale. Demographics such as years of teaching experience were predictors, while the other variables were held constant. Thirty-six criterion variables emerged but were not elaborated upon by the authors. Data correlated according to the demographic variables emerged in such a way that school location and previous teaching experience did not relate to teacher attitude. This lack of correlation was not elaborated.
However, teacher attitude change was correlated to the grade level taught and to previous course hours in science. The 12 and 7 teachers of grades one and two, respectively, were found to value their teaching much more as a result of the preparation while the 11 teachers of grade five showed only a slight increase in attitude. The eight teachers of grade three, the 14 teachers of grade four and the eight teachers of grade six tended to experience a decrease in attitude, with the third grade teachers showing the greatest decrease in attitude. While the difference between the curricular program of *Science-A Process Approach* and the library and principal’s view of *Science-A Process Approach* was not clarified, there was a significant difference in teachers’ impression of the program related to their years of teaching experience. A greater number of course hours in science resulted in significant but negative (a weight of -.3500) impression of how a teacher perceived the teacher education as it impacted science, her teaching and her reaction to *Science-A Process Approach*. A greater number of course hours in science also resulted in a significant increase (a weight of .3787) in the value a teacher placed on the use of the library and the principal’s view of *Science-A Process Approach*, which was not described.

This study is important to the dissertation research on teacher efficacy in that this particular process of teacher PD did not bring about positive effects in teachers or their teaching of science. The experience was not voluntary nor did it apply a process that has been shown to bring about positive effects for students and teachers.

This literature and the theoretical framework support the need for a study on teacher efficacy and professional development in PBE, with a benefit of increasing student engagement in the environment and student achievement in science. In order to
properly understand the complex and personal components of teacher beliefs and implementation, the qualitative method was used for the current study.

**The Power of the Qualitative Method**

The strength of qualitative research for this study is its ability to provide complex textual descriptions of how individuals experience an issue and the opportunity to explore this lived experience by using open-ended and probing questions through flexible interviews. It provides information about the “human” side of an issue—in this case, teacher efficacy— and their often-contradictory behaviors, beliefs, opinions and emotions. The theoretical framework dictates that a phenomenology is the best methodology to gain a personal and individual insight into teachers’ beliefs, attitudes, knowledge, and implementation of place-based methods. It allows the participants to use their own words and understands a phenomenon across individuals at a shared construct. Additionally, while reviewing the literature for this study, qualitative research designs emerged as a main methodology and frequently used open-ended questions and interviews (Dyment, 2005; Anderson, Lucas and Ginns, 2003). The present research used interviews and observations, a focus group, and field journals.

Additionally, the qualitative method allowed the researcher to collect data through the lens of the teacher as a respondent. Loughran et al. (2012) suggest this perspective as a rarely conducted strength of qualitative research on teacher efficacy. The process enabled the researcher to complete an in-depth analysis of the mismatch between teacher beliefs and practices and examined the role place-based education methods play in teacher efficacy.
Chapter Summary

The literature, in general, identifies issues in education, such as a lack of engagement with the environment, a lack of ability to think critically and to problem-solve both local and global issues. The literature also cites the lack of teacher efficacy and implementation of appropriate methods. The research contends that such issues can be addressed by using place-based methods of teaching and learning.

The literature states that issues in education such as a lack of ability to think critically and to problem solve and a lack of teacher implementation of appropriate methods can be addressed by using place-based methods of teaching and learning. The research illustrates that PBE for teachers can provide better learning for students, and greater motivation and attitude change in teachers than conventional teaching methods. Place-based learning is of benefit to science education and is an appropriate response to issues in science education indicated by research on learning (Morag & Tal, 2012; Scribner & Cole, 1973; Anderson et al., 2003; Dewey 1938; Louv, 2005; Gruenewald, 2003; Dyment, 2005; Knapp, 2005; Smith, 2002; Flaherty, 2007).

Adapted from Farah’s research on teacher efficacy and technology use, the following traits were expected to emerge in the current study (2011, p. 46):

• Personal characteristics such as stress or scares
• Mastery traits such as learn or experiment
• Behavioral words such as risk-taker or innovative
• Environmental characteristics such as support, time or opportunities

Additionally, Munoz’s (2008), phrases to depict traits efficacious teachers were expected to appear.
• Preparing: intentional and thoughtful lesson plans; specific procedures
• Engaging/guiding: puts forth effort to reach, takes responsibility for learning
• Fostering achievement: emphasizes content connections; student-designed lessons
• Ability/confidence: facilitates growth toward desired outcomes
• Daily effort: consistent, daily focus on growth

This review indicates that teacher efficacy can increase when teachers are properly trained (Butts & Raun, 1969; Fallik et al, 2008; Loughran, 2007; VanAalderen-Smeets, et al., 2012; Osborn, Simon and Collins, 2003). Research shows greater confidence results in more positive teachers, leading to better teaching, student attitudes, and improved learning. Observations of place-based lessons looked for indicators of PBE, such as those aforementioned (Smith, 2002 and Woodhouse and Knapp, 2002):

• Thematic
• Community interaction
• Student interest
• Set in place
• Active problem-solving
• Teacher-student interaction
• Student-student interaction
• Student-community interaction
• Authentic engagement in the place
• Content, standards aligned
- Curriculum components of place

- Environmentally focused

These are also the factors examined using the SAMPI lesson observation system (Appendix F).

The important conclusion of the literature on teacher PD as it pertains to the current study is the need for quality in the professional development provided to the teachers. Main characteristics of quality teacher education emerge from this literature review. These characteristics provide benefits not only to teachers but also for their implementation of best practices. They include support provided in the form of lessons and professional mentoring, and time to plan and to apply the new learning. These characteristics are important to the current study as they are generally evident in the place-based PD attended by all participants in the study. For this reason, this quality place-based PD is explored as it affects the implementation of best practices.

The theoretical framework indicates that beliefs, attitudes, knowledge, skills and motivation do not directly link to instructional practices, but are impacted by the perception of environmental hurdles. While teachers’ beliefs, attitudes toward instruction and implementation, epistemologies about PBE as a positive method for teaching science, their knowledge, skills and motivation might impede the implementation of best practice techniques. This literature on efficacy, professional development, and the framework on teacher beliefs and practices, posits that if a teacher with high efficacy believes in practices, such as place-based practices, the teacher will implement such practices despite environmental constraints to doing so. This review highlights the value of PBE as a
method of learning and teaching for classroom teachers and their students. Place-based learning methodology can provide a vast array of benefits cognitively, affectively and socially for both teachers and students, and proper teacher education in place-based methods can improve teacher efficacy. It was therefore expected that an increase in teacher efficacy and beliefs more closely aligned to practices would emerge.

The literature indicates that in order to understand the phenomenon around teacher efficacy and implementation of place-based methods, the qualitative research method, with its ability to develop an understanding of the personal, lived experience and perspectives of teachers and to communicate the teacher voice, is the most appropriate methodology to employ.
CHAPTER III
RESEARCH METHODOLOGY

The type of research being pursued in this dissertation is classified as phenomenology, and is consistent with other research that is analogous (Creswell, 2007; Fallik, Eylon & Rosenfeld, 2008). The research questions are designed to reveal beliefs and practices in professional development (PD) and the ways it affects teacher efficacy. Phenomenological research is appropriate to pursue those questions and is especially effective in obtaining culturally specific information about the values, opinions, behaviors, and social contexts of particular populations. In this regard, the method is qualitative and uses field methods with teachers to collect in-depth information and to pursue critical analysis of the information. This qualitative methodology was selected in order to examine the research questions from the perspective of teachers engaged in professional development.

The Power of the Qualitative Method

The strength of qualitative research is in its use of complex descriptions by individuals engaged in a social or professional learning context (Tschannen-Moran et. al., 2001; Anderson, Lucas and Ginns, 2003). Open-ended, probing questions presented through interviews provide a means to obtain information that would otherwise be difficult to collect using other means. These interviews provide information about the human side of an issue. Qualitative methodology allows the researcher to capture the
teachers’ own words and examine efficacy across individuals based on their shared professional development experience. Qualitative research represents the major methodology, relying on open-ended questions and interviews. The current research uses focus group records, interviews, observations, and field journals, and relies on copious notes and documents, such as the syllabus, for the professional development.

It is suggested (Loughran, 2007) that the teacher’s lens on confidence in teaching is rarely used in qualitative research on teacher efficacy. The qualitative methodology allowed the researcher to collect data partially through the lens of the teacher as a respondent to interview questions. Figure 3 below illustrates the steps conducted in the phenomenological study. These steps were suggested by the literature and were most beneficial to investigate the research questions (Merriam, 2009; Loughran, 2007; Creswell, 2007; Babbie, 2004).

The objective of phenomenology research is to understand and accurately describe the phenomenon of teacher implementation of best-practice methods. Husserl (as cited in Creswell, 2004) suggested refraining from any pre-given concepts and remaining true to the information collected in such studies, thereby seeking to understand experiences of teachers as they relate to place-based PD. The protocol for this study, adhering to the research questions, sought meaningful characteristics about “how” and “why” teacher efficacy and implementation are affected by well-planned professional development (Jones & Carter, 2007, p. 1104).
**Figure 3.** Protocol: Stages of the phenomenological study design (Creswell, 2007; Babbie, 2004).

**Participants in the Research.** The participants for this study include seven K-12 teachers from the western United States. These seven teachers came from a pool of twelve focus group participants. The focus group took place as part of a four day PB professional development opportunity. It was used by the researcher to garner the seven volunteer participants for this study on efficacy and to gain a general overview of teacher beliefs about place-based professional development. Focus group data can be found in Appendix C.

Two beginning teachers (with less than five years of experience), three mid-career teachers (with five-10 years of experience) and two experienced teachers (with 11 or
more years of experience) comprised the study group. The volunteers had different durations of professional teaching experience and were categorized on their years of teaching, a practice applied in similar research (Munoz, 2008; Butts & Raun, 1969; Farah, 2011). Those data were self-reported and verified by the coordinators of the PD and in the focus group. The relationship between level of experience and efficacy, according to Bandura (2000), is based on the confidence inherent in the experience. For example, teachers with more experience might exemplify great efficacy prior to the PD, and for this reason might show little growth in efficacy following the PD. On the other hand, they might show greater implementation after the PD when compared to those who had little prior experience teaching. While there were other differences, the major similarity among the seven teachers was their assignment to teach science during a part of the school year.

**Characteristics of the Teachers’ Schools.** The school districts represented by the seven participants in the research are located in the western United States. These districts enroll a diverse group of students from different ethnic and cultural groups. This region is comprised of White (88%), Latino (8%), American Indian (2%), Black (1%), and Native Hawaiian (1%; personal communication, C. Enright, May 6, 2014). In 2014, these school districts adopted the *Next Generation Science Standards* (NGSS Lead States, 2013) which focus on inquiry and the *doing* of authentic science. As this is a study on “the ability to overcome” (Bandura, 2000), it is important to note that many of the teachers in this study experienced a strike weeks prior to the study. This factor added richness to the hurdles impacting the teachers such as parental, administrative, and time stressors.
Additional information revealed that the science scores on state assessments have declined over the last 3 years. The 5th grade students’ mean scores have declined from 70 to 69, the 8th grade scores have declined from 67 to 66, and the high school science scores declined from 69 to 64. Of students who took a standardized math test, 63% met grade-level standards. The consequence is that math and reading consume much of the instructional time for all students (Oregon Department of Education, 2014; personal communication, C. Enright, May 6, 2014), and other subjects receive less instructional time. Researcher interviews and observations in the classrooms indicate that the elementary students in these districts have from 45 minutes to one hour set aside every other day for science. They study math and reading daily.

The geographic area of the study has numerous sources of information and resources for using PB methodologies. Resource providers are eager to participate with schools and consistently offer workshops in Project WET, WILD, Leopold, and regional topics on a monthly basis. There are also non-profit groups focusing on the natural features of the area: geology, watersheds, invasive and native plants, etc. One of the districts in this study provides a two year coach who serves as a mentor and meets with new teachers weekly for the first two years of their teaching career. Teachers, when attending various PDs such as the area-wide PBE opportunity, were provided stipends, food and transportation funds to support the use of PB lessons. The state and a for-profit state organization also provide school bus funds that permit the transportation of students for place-based learning.

Meet the Participants. There were seven participants in the qualitative research that was completed. Six of the seven completed the entire process. One of the seven
declined to participate in the observation stage due to barriers in his professional setting. Each of the seven teachers are described in some detail.

MJ has been a teacher for 30 years. She teaches high school earth science and has also been a curriculum developer for her school district. She frequently mentors student teachers and works with students who struggle with science. She has up to 42 students in each of her classes. She has been a regular participant in teacher PD and frequently writes grants to fund her PBE opportunities. She experienced a two week strike this year. Her school day schedule is unique. She has multiple lab preps (different types of classes) each day. The lab classes do not meet consecutively and she is regularly setting up lab materials, taking them down, and then setting them up again an hour later. It takes 3 days to get through a lesson with all of her students due to the rotating classes.

BJ has been an upper-elementary teacher for fourteen years. He attends professional development opportunities regularly. His students have been the top achieving students in science in his school district for the past several years. He attempts to guide his fellow teachers in participation of alternative methods of teaching and, despite his students’ high scores, his colleagues are unwilling to change their teaching methods. There is a wide range of abilities in his classroom of over 25 students, and this includes students on the autism spectrum.

SH has been a high school teacher for 9 years. He is the lead teacher of a “discovery” program in which environmental studies is a focus and is developed thematically across multiple subject areas. He works with freshmen students on language arts, but attends PB workshops in order to develop his ability to better design and
coordinate the science/language arts relationship. He left a high-paying career in finance to teach. He experienced a two-week strike this year. He has taught in this district for 9 years. His first two years were spent teaching science. He regularly has over 40 students in each of his classes.

CH is a high school teacher and has been a regular participant in professional development opportunities. She frequently writes grants to supplement her PB opportunities. She works at a “land lab school” in which the focus is on natural resources. A creek, pond, and a farm are on the school site. She works with her colleague and co-teacher to integrate history, English, and environmental science into the curriculum. She has taught for 9 years, 7 of which have been at this land lab. She was formally trained in project-based teaching for a period of two years. She had 40 students in the class during the observation process.

WC has been a teacher irregularly while raising children for the past 21 years. She currently teaches upper-elementary and while she teaches science part of the school day, she largely focuses on social studies. Her students study math and reading daily and rotate days between science and social science. She has been teaching upper-elementary full time for 2 years. She experienced a two week strike this year. WC’s classroom has a field outside her classroom window and a vernal pond in the courtyard outside her classroom.

RC has been an upper-elementary teacher for 7 years. He attended his first PB training professional development last year in response to a need to teach new science, math, and reading curricula. Furthermore, he was asked to implement a new report card system for evaluation, grading, and attendance. He currently works with 35 second grade
students in his classroom. It is important to note: he preferred not to be observed but was willing to further discuss (in a follow-up interview) hurdles to implementation of place-based lessons, and his teaching efficacy.

JZ is a new upper-elementary teacher who experienced a two week strike during this, his first year of teaching. He attended and graduated from this school district and student-taught at the school where he now teaches. He works with a district coach and focuses largely on PB methods. JZ has a field outside his window and there is a vernal pond in the courtyard outside of his classroom.

The Place-based Professional Development (PD)

The teachers in this study attended a three day PB workshop. An overview of the workshop can be found in Appendix D. The researcher attended and observed, but did not lead the PD. The PD syllabus was used to enhance an understanding of the opportunities provided to the teachers. Resource networking opportunities, PB lessons, and the values of PB education were the focus of the four day, voluntary, professional development on PBE that was examined in this research. Forty teachers attended the PD. The greatest participation in the PD was by 7th grade teachers, who comprised 36.84%. The other teachers were diversified across the remaining grades within K-12. The workshop was designed to provide quality PB professional development as suggested in research-based publications by DeWitt & Storksdiek (2008), Morag and Tal (2012), and Penuel et al. (2007). Penuel et al. (2007) identified indicators that resulted in the most effective PD, which led to implementation. They were:

- Teacher study groups rather than large workshops
- Collective participation of teachers from the same school
- Being mentored or coached, even engaging in an internship
- Curriculum-linked or site-based and geared toward teacher-specific curriculum (aligned with teacher goals)
- Duration of time long enough to allow the practice of new skills

The agenda allowed for an understanding of the components of the PD and the five indicators above were depicted in the PD. An understanding of the PD and its components can be found in Appendix D. A focus group was formed from those attending the PB professional development sessions and was part of a prior study. Twelve teachers comprising the focus group volunteered to talk about the PD and to elaborate on their feelings about PBE. The focus group lasted for 39 minutes. Questions asked in the focus group can be found in Appendix C and targeted whether the PD was deemed helpful, revealed what PB lesson implementation might incorporate for the teachers participating, and provided a perspective from which to design the subsequent research interview and observation protocols. The intent of the focus group was also to gain an overall perspective of the PB workshop and teacher investment in the subsequent and current study. It allowed for contact with potential participants for the current study and an opportunity to discuss and develop the research interview and observation topics and protocols. Seven of the teachers in the focus group volunteered to participate in the current study on implementation of the PBE methods learned in the PD and six of the seven completed the entire research process. Important information which was
established in the pre-study (during the professional development) focus group provides assumptions for the presentation of this data. Themes arising from the focus group are:

- Teachers discussed needing time to plan for this new method.
- Attitudes about place-based methods were largely positive.

By voluntarily participating, and as it applies to the theoretical framework, it was questioned if the teachers’ attitudes toward new methodologies, such as PBE, was positive. The question was pursued in the focus group and a positive feeling about PBE was generalized throughout the group, which formed the pool of individuals for this study. Of note, these teachers were not required by their districts to participate in the training so the researcher concluded that the teachers’ volunteer status added significance to findings about their efficacy. Voluntary participants were selected from the focus group and based on the research design. The syllabus was also helpful in determining information teachers would gather while participating in the PD.

**Data Collection and Instrumentation**

Participants were interviewed after the PD and then again after the observation to discuss any differences between the interview (beliefs) and observation (practices). Data collection took place from April-June, after the August professional development, and the timeline can be found in Table 2, below.
Table 2

**Timeline: Data Gathering Process**

<table>
<thead>
<tr>
<th></th>
<th>Interview</th>
<th>Observation</th>
<th>Post-observation interview</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min 21 minutes Max. 57 minutes Average 39 minutes</td>
<td>Min. 52 minutes, Max. 3 hours and 12 minutes. Average observation 2.33 hours</td>
<td>Min. 12 minutes, Max. 37 minutes Average 23 minutes</td>
</tr>
<tr>
<td></td>
<td>(Total 273 minutes 4.55 hours 4 hours and 33 minutes)</td>
<td>(Total 839 minutes 13 hours 59 minutes)</td>
<td>(Total 161 minutes 3 hours and 1 minute)</td>
</tr>
<tr>
<td>MJ</td>
<td>5/16</td>
<td>5/21</td>
<td>5/23</td>
</tr>
<tr>
<td>BJ</td>
<td>4/26</td>
<td>5/9</td>
<td>5/13</td>
</tr>
<tr>
<td>CH</td>
<td>5/16</td>
<td>5/21</td>
<td>5/22</td>
</tr>
<tr>
<td>SH</td>
<td>5/14</td>
<td>5/19</td>
<td>5/20</td>
</tr>
<tr>
<td>WC</td>
<td>5/14</td>
<td>5/21</td>
<td>5/29</td>
</tr>
<tr>
<td>JZ</td>
<td>5/9</td>
<td>5/21</td>
<td>5/22</td>
</tr>
<tr>
<td>RC</td>
<td>5/14</td>
<td>N/A</td>
<td>5/17</td>
</tr>
</tbody>
</table>

Sources include face-to-face and written interviews with participants (which included open-ended responses to researcher questions), observations of the teachers in PB contexts, follow-up interviews, and field notes maintained by the researcher.
Interviews allowed for teacher self-reflection regarding self-efficacy, attitude toward teaching, and attitude and understanding relative to science.

The interviews also examined the teaching of science using PB methodology. Observations of teachers were used to validate the teacher beliefs in so much as verifying that when a teacher reported using a method, it also had to be observable in their teaching behaviors. Six teachers were observed. One teacher, RC, preferred not to be part of this stage in the data collection. While RC preferred not to be observed, he was willing to participate in two interviews and discuss his beliefs and practices. Despite his lack of participation in the observation stage, the integrity of the process was intact. The six teachers who participated in all stages of the data collection process included two teachers from each of the experience groupings (less than 5 years of experience, 5-10 years of experience and 11 or more years of experience). Interestingly, RC’s lack of participation and follow-up interview provided information about his inability to overcome and was informative for the research questions and to the process. He stated “I am too busy and stressed by all of my new programs; attendance, new standards, curriculum. I’m happy to help with the project and talk to you more, but can’t fit in an observation for now.”

A benefit of qualitative methodology is the use of multiple sources of information. Five sources were used in the current study (Figure 4). Information was collected in written (interviews, journals, and field notes), and audio (interviews and observations) forms with participant’s journals as the database. The reliance on different data bases enabled the researcher to triangulate sources and analyze phenomenon and their interactions.
**Interviews.** Interviews were used to gather data for each of the seven participants’ beliefs, attitudes, and feelings about their implementation of PB methods. Prior research in the relationship between PD and teacher self-esteem used interviews as the main protocol for data collection (citation needed to the prior research). In qualitative research, the interview is used to gain deep perspectives about the topic being studied. In the present research, the interviews allowed for the participants to explain their answers, give examples, and further describe their feelings and practices. Because efficacy is grounded in beliefs, knowledge, and attitudes, it is imperative that an understanding of the phenomenon of teacher’s own teaching is acquired. While weaknesses of interviews include reflexivity, inaccuracies due to poor recall, and bias due to poorly constructed questions, strengths include a targeted, personal, and insightful methodological approach (Creswell, 2007; Yin, 2009; Babbie, 2004).
Seven verbal, initial interviews were recorded and then transcribed to elucidate reflections and make the nuances more accessible in written presentation while maintaining researcher contact with the data. The interview followed a specific protocol and consisted of 20 questions (Appendix E). It was adapted from Riggs (1988) and Riggs and Enochs (1990). They based their original instrument (the Science Teaching Efficacy Belief Scale or STEBI-A, for inservice teachers) on Bandura’s theory on personal efficacy (2000) to determine outcome expectancy and self-efficacy components of teacher behavior. The original instrument was adapted by other researchers examining efficacy in specific teaching situations such as the STEBI-CHEM (Bleicher, 2004).

Similar instruments were used in the 2006 study conducted by Kilbarda, which explored how teacher efficacy might change due to professional development in Inquiry Learning as well as Tschannen-Moran and Woolfolk-Hoy (2001) and Farah (2011). However, this instrument was selected for adaptation because of its history of reliability and construct validity in recording efficacy of educators.

The interview questions for the current study were adapted from Likert-style to open-ended questions to enhance the qualitative approach and allow for probing questions that elicited further information. For the current study, the instrument was adapted to explore how teacher efficacy might change due to professional development in PBE. The protocol was developed with the research questions in mind and to enhance content validity. This relationship is elaborated in Table 2, below. This interview protocol is included in Appendix E. It consists of 17 questions, 2 of which refer to teaching experience, 8 directly relate to professional development, 6 refer to efficacy and 6 relate to PBE. Some overlap occurs.
The literature review reported that personal, behavioral and environmental factors affect efficacy (Bandura, 2000; Jones & Carter, 2007; Munoz, 2008). To satisfy that claim, relevant to the current research, the interview protocol included questions designed to address various personal, behavioral and environmental aspects of the participants’ beliefs and practice. For example, “What experiences contributed to your confidence in implementing the lesson?” Other interview questions address experience teaching or how the PB professional development impacts efficacy and implementation of the methods, such as “Have you used place-based methods in teaching prior to the training? (If so, please describe the process).”

Interview questions were reviewed and validated by several experts, including the researcher’s doctoral dissertation committee members. The interview was also field-tested by a teacher colleague. The field testing and reviews resulted in changes, such as eliminating questions that became repetitive and seemed to provide the same answers. For example, the prompt: “To what extent can you make your expectations or information clear to your students? Please explain.” was replaced by the question, “How much can you do to improve the understanding of a student who is failing?” Consistency in the process was maintained as the researcher personally conducted all interviews and observations. An example of a research question and its relationship to the interview question and efficacy is provided below in Table 3.
Table 3

*An Example of an Interview Question and Its Relationship to the Research Questions and Efficacy*

<table>
<thead>
<tr>
<th>Interview Question</th>
<th>Research Question</th>
<th>Related Component of Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do you do with your students that represents place-based learning? What does that look like? How has that process changed?</td>
<td>How does participation in PB professional development affect perceived teacher efficacy in terms of teacher practices?</td>
<td>Behavioral (Farah, 2011) Ability/confidence (Munoz, 2008)</td>
</tr>
</tbody>
</table>

**Observations.** Observations of 6 teachers took place. The seventh teacher did not feel comfortable being observed. Classroom observations were used to validate and further investigate “belief and practice” (Jones & Carter, 2007, p. 1104) in the six teachers who were part of this stage of data collection. While prior researchers specified a mismatch, the present researcher was not guided by preconceptions regarding the relationship between belief and practice. The value added to the research from the observations was to allow the researcher to distinguish between efficacy and implementation using the PB methods. Observation methodologies, on the one hand, include the possibility of reflexivity and the increased expenditure of time on behalf of the researcher. On the other hand, observations are a window for the coverage of real-time events in their context (Yin, 2009).

Fourteen hours of observations were conducted for the six teacher participants who participated in this stage in the research project. One of the seven teachers did not choose to participate in the observation, but was willing to participate in a follow-up
interview in order to further explain his use of PB methods. The shortest observation lasted 52 minutes and the longest lasted for 3 hours and 12 minutes. The average observation was 2.33 hours. The objective of the research was to determine if beliefs held by teachers matched implementation of methodologies. Therefore, the observation process was important in answering the research questions, in particular “What evidence is there that place-based professional development affects teachers in terms of efficacy, namely their beliefs and practices?”

The actual implementation of PB methods by teachers and the consistency of the interview process were validated using the Science and Math Program Improvement (SAMPI) instrument (Jenness & Barley, 2001). This instrument provides consistency with observations and validates the alignment of teacher-made lessons with standards and best-teaching practices. The researcher was trained in the application of this instrument in May, 2011 and approval to use the instrument is given in Appendix F.

Throughout the interview and observation process, researcher and teacher journals were kept. The information in these journals helped guide post-observation discussions about the relationship between the beliefs evident in the interviews and the practices evident in the observations.

**Indicators Sought in the PBE Observations.** A review of the literature on PB methodology revealed the following factors collated from studies conducted by Gruenewald (2003), Dewey (1938), and Knapp, (2005) and Dewitt & Storksdiek (2008) who determined characteristics of and conditions depicting place-based methods. Their research intersects along the following indicators of best-practice PBE which guided and were sought in the observations.
• Thematic
• Student interest
• Set in place
• Active problem solving
• Teacher-student interaction
• Student-student interaction
• Student-community interaction
• Authentic engagement in the place
• Content, standards aligned
• Curriculum components of place
• Environmentally focused

While the SAMPI (adapted from SAMPI, Jenness & Barley, 2001, Appendix G) was designed for math and science contextual observations, it was adjusted by the current researcher to suit the context of PB methodology. The updated instrument (Appendix H) provided a research-based observation protocol applying indicators of PBE (Appendix I). In doing so, it guided observations of behaviors and the implementation of practices by teachers in their instructional settings. This adapted instrument combines observations of teacher methodology and PB classroom context. The instrument guided the researcher to examine PB lesson components such as teacher-student interaction, student-student interaction and science skills. However, it was necessary to revise questions on the instrument to sharpen its focus on efficacy. One change, for example, was the following.
Section 10: “Other comments about lesson planning/organization or other indicators of importance”

The revised question sought evidence based upon the specific indicators. The adapted SAMPI in its revised format asked:

“How did the lesson incorporate the following components of place-based learning; community engagement, resource use, application of student-centered and community-oriented components?”

Environmental interpreters who were specialists in natural resources piloted the revised SAMPI instrument. Redundancy was noted during the lesson reporting. For example, questions on pages 7-10 proved to not be valid for the topic of PB education and they were removed. That left 33 questions for the observer (the researcher) to provide specific evidence in support of the teachers’ behavior.

Other questions in the instrument include the PB indicators:

5. Were investigative tasks essential elements of the lesson plan (e.g., manipulation of information to help make sense of content, elements of problem-solving situations, connections to real-world experiences)?

   |   |   |   |   |   |   |   |
   | Yes | No | Don't Know |

   If yes, what is the evidence?

Questions also included efficacy factors:

11. The teacher appeared confident in facilitating this lesson.

   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
   |   |   |   |   |   |   |   |
   | Limited confidence | Great confidence |

   Supporting evidence for rating:
Accuracy of the patterns emerging from the researcher’s journals was confirmed through post-observation interviews with the participants, and with two qualified individuals (education professors) who reviewed the transcriptions. Two education colleagues examined the researcher’s journals and perception of the data, and both confirmed the researcher’s conclusions.

**Post-observation Interviews.** The seven participants were interviewed a second time in order to clarify any assumptions and to probe into the relationship of the beliefs (initial interview) and observations. Post-observation interviews asked respondents for confirmation of behaviors that were self-reported, such as specific examples of behaviors that support assertions by the participant being interviewed. Member-checking was conducted by verbally confirming the researcher perspective with the participants in the follow-up interview.

Questions in the post-observation interviews were prompted by inconsistencies between the interviews and observations. These interviews were conducted within one week of the observation in order to discuss teacher beliefs about efficacy and PB methods as they emerged from the observation stage. This post-observation interview took place in the form recommended by the teacher: phone call (2), in person (3) and via email (2). The post-observation questions were participant-specific and allowed the individual themes of the phenomenon to emerge more fully. The process determined the questions and these questions were guided by researcher reflections in the research journal. The questions varied according to evidence from the interviews and observations, and in particular differences between the two stages of research.
For example, CH appeared to be efficacious as part of her interview, so efficacious traits were sought in her classroom observations. The post-observation interview was guided by the relationship between her beliefs and her practices. CH was asked “When you talked about your place-based teaching, you mentioned the use of the pond and farm. Can you tell me about how that differs from the lesson I observed? Why do you think that might be?”

The participant journals also provided an opportunity for self-reflection. One participant discussed “I had such a good intention of doing that, but when my class got rolling, it went onto the back burner. I was thinking I did it.”

**Analytic Strategy**

The goal of phenomenological research is to build an understanding of the phenomenon being studied based on evidence (Yin, 2009). The evidence is provided by the sources of data, such as those depicted in Figure 4. In order to enhance the rigor of the present study, the analysis process followed by Creswell (2007), and Babbie (2004) was used to provide greater certainty that the research was completed in using an acceptable paradigm based on the literature. This process included the use of a variety of methods to best examine and interpret these types of data. Merriam (2009) suggested a complex process of “moving back and forth between concrete bits of data and abstract concepts, between inductive and deductive reasoning, between description and interpretation” in order to direct all analysis to the answering of the research questions (p. 176). Creswell (2007) suggested the importance of processing the data and revisiting the research questions for the project. In this case the questions were:
1. What evidence is there that place-based professional development affects teachers in terms of efficacy, namely their beliefs and practices?

2. What factors affect teachers’ self-efficacy?

3. How do teachers account for changes in their efficacy?

Data analysis was an ongoing process throughout the study, applying and exploring new themes as they emerged, with the ultimate task of exploring and explaining the theme of teacher efficacy and behavior or the implementation of PB methods due to the PD.

**Coding.** A critical process in the research was the preparation of the data collected during the field observations for a rigorous analysis. The objective of the analysis is to reveal patterns and associations that are useful in answering the research questions. In qualitative research, coding of the field observations is necessary (Merriam, 2009). The first step in coding was to examine the relationship among the data and the research questions (Yin, 2009). The objective was to allow the design of the research methodology to guide the analysis. The coding software, NVivo 10 (2012) was used for storage and management of data. The software allowed for the exploration of relationships among the data, and the rotation of inquiries regarding relationships among the coded responses of the participants in the research. An additional advantage of using management software was that it allowed the researcher to store and efficiently organize data.

Data were studied for representation of the research questions by examining them line by line, using colors to develop patterns as they emerged from the reading. Unusual
themes and issues were re-examined. Themes were grouped into initial categories. Text was marked, marginal notes were added, and the information was downloaded into NVivo 10 (2012) in the categories of interviews and observations, to allow for constant comparison of all sources of the data and to align with the research questions. A more detailed description of these stages can be found in Appendix J.

An open coding process was used. This allowed the data to emerge as the study progressed and to enable the researcher to look for units of meaning that appeared frequently and addressed the research questions. The process for identifying codes included examining the transcribed or written responses and coding the data into categories that aligned with Farah’s (2011) and Munoz’s (2008) traits of efficacy. Rather than using the research term “code”, NVivo 10 (2012) identified codes as “nodes”. These nodes were described, reviewed, and repetitive nodes were eliminated or combined. Farah (2011) suggests the use of “message units” (Yin, 2009) which for this study align with the concept of efficacy as seen in Figure 1 and address the research questions. These message units are the codes which can be words, phrases, numbers or a combination of these (Merriam, 2009). Message units that emerged as a result of the literature review (Farah, 2011) include personal codes (“attitude, stress, scares”), mastery (“often, learn, use, experiment”), behavioral (“risk-taker, innovative”) and environmental (“support, time, opportunities”) codes. Codes also include items such as years of teaching experience, gender, etc.

NVivo 10 (2012) was also useful in determining coding groups. It allowed the researcher to examine relationships that would permit explanations of observed conditions, such as the lack of confidence among teachers to use PB methodologies (per
Nodes were interconnected and correlated in order to determine how interviews and observations complemented or contrasted one another. The software provided several data processing capabilities using terms, such as those posed by Munoz (2008) and Farah (2011), to compare to the prior research. For example, Farah (2011) used the following personal traits to explore efficacious teachers, and these terms are adapted from her interviews (p. 46): Behavioral words such as risk-taker or innovative,” Munoz (2008) determined that the following traits are indicators of efficacy for teachers who improve their students’ achievement: motivating: encourages, convinces students they can achieve goals (p. 85).

NVivo 10 (2012) required an additional stage of personal contact with the data, due to the downloading and node formulating stage (Merriam, 2009). This required the researcher to be closely aligned with the data. An important stage is to set up case nodes by assigning attributes like demographics (years teaching, etc,) and others (stress, time, student-community interaction, etc.).

The software provided comparisons of data that represented possible relationships among theoretical ideas of PB methodology, teacher beliefs and the implementation of the beliefs. It enhanced the triangulation of data gathered throughout the various stages of the research. Construct validity was confirmed by a colleague who also uses NVivo 10 (2012) and teaches Environmental Studies. He specifically and deliberately examined the data and compared them to the codes (also called “nodes” in Nvivo 10, 2012) identified by the researcher. In doing so, he found repetition and suggested fewer categories. Specifically, in examining nodes of interview, the nodes difficult, strike, stress, challenging, hard and time were grouped as hurdles or barriers. In addition, connection,
authentic, and real were grouped as authentic. In this way, confidence in the validity and reliability of coding was enhanced.

While Nvivo 10 (2012) helps in data management, running queries, and visualization of data patterns, it does not analyze data. For this reason, and appropriate for qualitative research (Yin, 2009; Glaser, 1978) the researcher remained intimately connected to the data for exploration of emerging themes.

Ethical Considerations. The Western Michigan University Protection of Human Subjects policies were implemented during the research. The data were locked in a file cabinet in the researcher’s office and the participants were assigned a pseudonym for confidentiality. In addition, the audio-taped interviews were transcribed by the researcher. Electronic files are password protected. Participation in the study was voluntary and required a letter of consent (Appendix B) which was signed by the participants (Appendices A, B).

Validity. The validity of the data collected in search of an answer to the research questions is important in research on a phenomenology. Golafshani (2003) presented the argument that phenomenology must incorporate discussions of validity to maintain a similar level of rigor as is presented in quantitative methodology. The determination of validity is largely the result of following a well designed process that provides data that are specific to the research and does not depart from being relevant. Yin (2009) stated the necessity for qualitative research to substantiate validity as a component of quality empirical social research. Validity was maintained throughout the data collection and analysis process. Glaser (1978) stresses that data are validated internally by regularly comparing the data across sources and among participants.
The affective validity of the data was verified using expert reviewers and by analyzing and cross-referencing the responses of the participants with the data collection methods and procedures and included interviews, observations, and journals. In order to eliminate any researcher bias an expert familiar with PB learning strategies and another colleague who was not familiar with PB learning strategies review data collection instruments and participants’ responses.

The main method for assuring validity in the current study is member-checking or participant feedback. The process provides confidence of construct validity. The triangulation of the data is also used to corroborate attention to the same element of efficacy (Yin, 2009). For example, interview data are used to validate the context of PB education by triangulating the terminology used in the interview. Terms that are expressive of PB education and efficacy are indications of validity, as compared to terminology that is more generic to education and used during the interview. The PB education workshop attended by the participants introduced them to the terminology and methodologies, and the contemporaneous use of the terms in the interview was used as an indication of similarities between verbal and methodological constructs. In summary, construct validity was estimated using PB education as the source for context (lesson setting), content (PB terminology), attitudes and confidence in teaching.

**Reliability.** The reliability or stability of this design is provided by the clear description of the data collection, methods and protocols. Consistency of procedures throughout the data collection and interpretation of information enhanced reliability. Trustworthiness further enhances the reliability of a study by adhering to the following
aspects of research (Creswell, 2007; Bickman & Rog, 1998, Glaser, 1978). In the present research, the researcher was attentive to:

1. Credibility: The researcher linked emerging theory with literature and the relationships in the analysis underwent persistent and repetitive interaction with the research questions.

2. Transferability: Generalizing to a large sample was not the intention in the phenomenological research pursued. Analogy to similar settings or conditions is dependent on the reader.

3. Dependability: The data were allowed to speak for themselves in the analysis. The researcher enhanced stability and dependability by re-reading the field study narrative data in order to achieve consistency between the data, observations, and conclusions relative to the research questions.

4. Conformability: Analysis for the current research was guided by distilling the data, which was corroborated by other individuals at critical times during data collection and analysis.
CHAPTER IV
RESEARCH RESULTS

The research results are predicated on the data that were collected following the research design and methodologies presented in prior chapters. The data are organized to present the results in an orderly and efficient manner. While the major emphasis is upon the research questions posed as guides for the data collection, the researcher has taken liberty to incorporate other unexpected outcomes of this phenomenological study when appropriate.

The data presented herein has been grouped as evidence of efficacy, factors affecting teachers’ efficacy, impact of the PD, and how teachers account for changes in their efficacy. The data were categorized and analyzed to explore the impact of teacher experience, and teacher efficacy upon the implementation of place-based methodology. Through these analyses, the researcher examined the efficacy when teaching science of individual teachers in the study.

Beliefs held by the participants were gathered through the pre-PD focus group. The participants from the focus group and part of the current study were interviewed after the PD and then again after the observation with the intention of discussing any differences between the interview (beliefs) and observation (practices). Of interest, no teachers in the focus group session, when asked “How might such methods (place-based) help you feel better personally and about your job as a teacher?” could respond about
themselves. Rather, they made a pointed reference to their students and the fact that their students would enjoy the process and learn more. It was apparent that teachers connect their own efficacy to student success. As it pertains to student achievement, and further supported by the TIMSS (2011), Dyment’s (2005) and Morag and Tal’s studies (2012), we must forge ahead in our endeavor to increase teacher efficacy.

Key factors of efficacy were extracted from the interviews and observations with the teachers. The theoretical model suggests that the knowledge acquired in the PD should align with positive attitude and beliefs about PBE in order for instructional practices, rather implementation of the PBE methods to occur. This relationship is confirmed by consistency between the interviews and observations. Triangulation of data sources allowed for examination of the beliefs and practices as they align with the theoretical model.

The following indicators for PBE were sought during the teacher lesson and encouraged as part of the PD. These indicators of PBE are consistent with prior research (Smith, 2002; Woodhouse and Knapp, 2000):

a. Thematic instruction
b. Student interest
c. Set in a geographic place
d. Active problem-solving
e. Teacher-student interaction
f. Student-student interaction
g. Student-community interaction
h. Authentic engagement in the geographic place
i. Content, standards aligned
j. Environmentally focused

The interview asked specifically about experience teaching (questions 1 and 2), feelings, attitudes and beliefs in PBE (interview questions 8, 9, 10, 14-17) and whether the PD impacted their incorporation of specific PB methods (questions 10, 14, 15, and 19). Teachers responded, in general, favorably about the components of PB that they incorporate more frequently or newly incorporate. However, whether the PB concepts were consistent between these interviews and observation is presented in the Table 4 below.

Table 4

PB Concepts Discussed in the Interview and Sought in the Observation

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Interview</th>
<th>Observation</th>
<th>Inconsistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>MJ</td>
<td>a thematic b. student interest c set in place d problem-solving f. student-student g. student-community h. authentic j environment</td>
<td>a,b,c,d,e,f, g,h,i,j</td>
<td>e. teacher-student interaction, i. content, standards aligned not discussed but were present in the observation</td>
</tr>
<tr>
<td>BJ</td>
<td>a, thematic, b, student interest c, set in place d, problem-solving g, student-community h, authentic i. content, standards aligned j environment</td>
<td>a,b,c,d,e,f. g,h,i,j</td>
<td>e. teacher-student interaction f. student-student not mentioned in interview, yet present in the observation.</td>
</tr>
<tr>
<td></td>
<td>a. thematic, b. student interest</td>
<td>c. set in place d. problem-solving e. Teacher-student interaction f. student-student interaction g. student-community interaction h. authentic i. content, standards aligned j. environment</td>
<td>a.d.e.f.i,j</td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td><strong>CH</strong></td>
<td>a. thematic, b. student interest</td>
<td>c. set in place d. problem-solving e. Teacher-student interaction f. student-student interaction g. student-community interaction h. authentic i. content, standards aligned j. environment</td>
<td>a.b.e,g,j</td>
</tr>
<tr>
<td><strong>SH</strong></td>
<td>a. thematic, b. student interest</td>
<td>c. set in place d. problem-solving e. Teacher-student interaction f. student-student interaction g. student-community interaction h. authentic i. content, standards aligned j. environment</td>
<td>a.b,c,d,f,g,h,j</td>
</tr>
<tr>
<td><strong>WC</strong></td>
<td>a. thematic, c. set in place d. problem-solving e. Teacher-student interaction f. student-student interaction g. student-community interaction h. authentic i. content, standards aligned j. environment</td>
<td>a.b,c,d,f,g,h,j</td>
<td>Missing b. student interest c. set in place d. problem-solving g. student-community h. authentic consistent was j environment</td>
</tr>
<tr>
<td><strong>JZ</strong></td>
<td>b. student interest c. set in place d. problem-solving g. student-community interaction h. authentic i. content, standards aligned j. environment</td>
<td>e.f,i,j</td>
<td>chose not to be observed</td>
</tr>
<tr>
<td><strong>RC</strong></td>
<td>a. thematic b. student interest c. set in place d. problem-solving f. student-student g. student-community interaction h. authentic i. content, standards aligned j. environment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4 summarizes key PB concepts discussed in the interview and sought in the observation. The inconsistencies between the interview and observation prompted the follow-up questions. A triangulation of data sources provides a perspective about the level of experience teaching and the belief and practice mismatch. As inconsistencies pertain to a lack of efficacy and therefore the belief and practice mismatch, MJ, the most efficacious and experienced of the teachers, incorporated more PBE indicators in her lesson than she referred to in her interview. She did not discuss teacher-student interaction nor did she discuss standards. These were present in her lesson, however. It is interesting to note that teachers who were most efficacious incorporated PB components in their lessons but may not have discussed them in the interview. These teachers incorporated the most concepts. If concepts were missing from the observations, student choice, student-community interaction, authentic and set in place were missing from those who had low efficacy. A focus on the environment appeared most frequently. This prompts further research into whether PBE and environmental education are explicitly defined and understood by teachers.

BJ, also an efficacious teacher, did not indicate, teacher-student interaction and student-student interaction were important components or things he liked about PB, yet they were present in the observation. Triangulation of the data sources indicates that BJ is conservative about his high efficacy. He insists on continuing to strive for more success.

CH, while she is a mid-career teacher and discussed that she knew much about the method and used it frequently showed multiple inconsistencies. Specifically, student interest, set in place, student-community interaction and authentic were missing in the observation.
SH, also a teacher with mid-level experience and low efficacy discussed set in place and problem solving in addition to content, standards aligned as important to him but these elements were not present in the observation.

WC, a teacher with many years of teaching experience, but considered a beginning teacher due to her new assignment, also showed many inconsistencies in her observation. For example, authentic, student interest, student-student interaction, and student-community interaction were observed, but were not discussed in the interview and may have been a result of the fact that she allowed the experts to take over her class. She interacted with her students minimally in the observation.

JZ, the first-year teacher, discussed his understanding of PBE and pointed to all of the indicators for PBE, except teacher-student interaction. However, in his observation, the emphasis on the environment was the only indicator present.

RC, a mid-career teacher who discussed how simple PBE was to incorporate, but expressed how difficult of a year he was having, declined to participate in the observation.

J, environment was implemented in all six of the participants’ lessons and a, e, f, i (thematic, teacher-student interaction, student-student, and content, standards aligned) were part of five of the six observed lessons. Indicator b, student interest, was a component of two of the participants’ lessons (MJ, BJ, the most efficacious teachers), but for the remaining four, due to state and national standards or “work (ing) around the issue of testing” (WC, interview), curriculum was not based on student interest but was dictated by standards. Indicators c, d, g, and h exemplify authentic learning, and were
missing in observations of four of the participants who were observed (CH, SH, JZ, WC, the less efficacious teachers).

Reasons for a lack of implementation as suggested by the post-observation interview included time to prepare, a lack of connections with resource providers (interestingly, this teacher (CH) previously described wonderful connections with resource providers) and funds. In addition, funds for bussing were part of the PD.

Findings as they refer to the research questions are summarized below. The literature was ripe with references to time as an issue (Dyment, 2005; DeWitt and Storksdiek, 2008; Flaherty, 2007) and when teachers are probed about the issue of time, the issue permeates many levels of teaching; time to plan, time to understand and most importantly, time to assimilate into one’s own teaching.

Data displayed in Tables 5 and 6 revealed differences and similarities between the interview and observation data. If there was a general absence of indicators it suggested low efficacy among the teachers. To the contrary, if there was correspondence between the interview and observation, then it indicated high efficacy. The impact of the PD was explored through the interviews and journals and subsequently through the observations. Teachers’ perspectives about changes in their efficacy are elaborated. The data represent the three major themes in the current study (efficacy, place-based learning and place-based professional development) and, it should be noted, they intersect to add additional credence to the discussion of the research questions.
Research Question 1

How does participation in place-based professional development affect perceived teacher efficacy in terms of teacher practices?

This question examines the impact the professional development had on the teacher’s efficacy, and does so by examining implementation of PB methods as a basis for the examination of efficacy. Teachers were interviewed about their feelings and attitudes about PBE after the PD on PB methods. By definition, (Bandura, 2000) states that efficacy includes beliefs and thoughts about science, and how individuals practice as science professionals. For this reason, the observations attempted to confirm the feelings teachers had about teaching science in a PB way with their implementation and practices as a science teacher.

The interview included questions about whether their goal about PB methods had been met (question 2), whether they had used PB methods prior to the training (question 8), whether and how the PD impacted their teaching (question 10), if the PD impacted their confidence (efficacy) in teaching PB methods (question 13) and whether and how their teaching might be different due to the PB professional development (questions 14, 15, 17, and 19). Their beliefs were further explored through examination of their journals and throughout the interview process. Their practices confirmed or denied their beliefs and are presented in Table 5.
<table>
<thead>
<tr>
<th>Participant &amp; impact</th>
<th>Quote from interview</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MJ</strong> more inspired</td>
<td>“I am actually now more inspired to get technology in the hands of my reluctant learners and get them out of the classroom doing authentic research and citizen science”.</td>
</tr>
<tr>
<td><strong>SH</strong> understand authentic learning of PBE</td>
<td>“Now I get a picture. I can touch smell and breathe place-based education, however I cannot make students get it until I put them in the authentic situation. Placed-based teaching develops impact and experience. Before place-based training I just counted on the fact that kids would get it. Now I can literally see them getting it and I notice that the difference.”</td>
</tr>
<tr>
<td><strong>CH</strong> funding</td>
<td>“I feel like I have been doing “place-based” for the past 7 years, but [the PD] helps by funding a portion of my field trips. I don’t think my teaching has changed tremendously as a result of the training, but I am not a new teacher - this is my wheelhouse. It’s nice to be able to finally say that I have some methods and units in place that work and work well. It’s been my goal to find strategies and content that blend together to meet the needs of students as well as produce measurable learning gains on state-tests and my personal assessments. I will always modify and improve my methods, but overall I think that place-based and project-based learning are the way to go.”</td>
</tr>
<tr>
<td><strong>BJ</strong> take more PB trips</td>
<td>“I take about 10 [PB trips] a year due to the workshop. It's difficult to get more teachers to try to work with me on that. While the test scores indicate that what I am doing is good and I am really intent on learning and moving ahead, it's hard to get the others outside and not show a negative impact to other areas such as reading or math.”</td>
</tr>
</tbody>
</table>
Table 5 Continued…

| RC | It is easier to incorporate | “It is really easy to include place-based methods at our school because we have science curriculums that involve these place-based models. I know it is easier to make time for place-based practices, because I learned more ways to introduce and use it [in the PD]. Teaching in the last year has been very difficult for me. Like I said, having 35 students in a class is stressful, especially since it is the worst-behaved class I have had in 7 years of teaching. On top of this I am learning 3 new curriculums for science.…” |
| WC | More PB lessons | “The science journal, ‘sit spot’, and [outdoor education center] are all new to my classroom this year due to the [PD] I attended. The biggest way my teaching has changed, is I have given my students more exposure to the community we live in, especially our very own Oak Grove “forest”. I started a yearlong project with my students, and due to this experience, they have connected more with nature, and I can’t wait until they do the culminating poster idea I have planned, which will be based on the notes they have taken in their science journals.” |
| JZ | More understanding about PBE | “Before the summer workshop, I was unclear about how to really have effective learning take place while stepping outside the classroom. Being a new teacher trying to facilitate a fun and effective learning environment in the classroom is a new and exciting thing to practice. However, throughout this first year it is a roller coaster of ups and downs trying to learn and grow as a teacher. Placed-based learning was something I have tried to implement throughout this year. However, I have taken an approach to letting the responsibility of teaching during the placed-based teaching opportunities to others and just observing-helping out. I have done this with the help of the people from [an outdoor site]. This has been a great thing for me, because it has helped me observe first hand effective placed-based teaching and has given me the opportunity to reflect on my own teaching compared to a very knowledgeable group of rangers.” |
PBE was described as positive and all seven teachers described ways the PD was helpful in instilling PB opportunities and lessons. Of note, MJ is more inspired to add in an additional element of students using technology in PB way as a result of the PD. CH states that she has been incorporating PBE for years, and appreciates the funding she gets for bussing through the PD. SH learned ways to successfully get students to understand and experience authentic learning of science concepts. BJ more internally takes more trips (10-but I saw evidence of 11), due to his PD connections and suggests that his students have higher test scores as a result of the PBE. WC learned more about connecting her students with their region through PB lessons. RC found PBE methods to be really easy to incorporate due to the PD but the year is too difficult to implement them and to be observed. JZ, a first year teacher, let experts lead the lesson, which allowed him to be confident the content was properly being presented to his students.

The expectation, then, is that efficacious teachers will implement PB lessons. The theoretical framework encourages us to look for a belief and practice match, and by definition of efficacy, we expect that the efficacious teachers will then be implementing these newly learned opportunities and lessons and they will be evident in the observations.

Indicators of Efficacy. Using prior research as a foundation, the evidence that place-based professional development affects teachers’ beliefs was explored in the literature and subsequently through the research design and methodologies reported in Chapter 3. The literature review suggested an exemplary set of traits indicating efficacy
in teachers. These traits emerged from Farah’s study (2011) of teacher efficacy and technology and also Munoz’s study (2008) on teacher efficacy and student achievement. The same traits are sought in the current study and are adapted from the research discussed by Farah (2011, p. 46) in her study of teacher efficacy in teaching technology.

- Personal characteristics such as stress or scares
- Mastery traits such as learn or experiment
- Behavioral words such as risk-taker or innovative
- Environmental characteristics such as support, use of time or opportunities

The characteristics were identified and then extracted from the interview, the journals and the observation reports. If present, the characteristics indicated a match in the belief and practices and therefore, high efficacy. If the matching characteristics did not materialized, then beliefs and practices suggested low efficacy. The analysis of the interview data collected for the current research was coded and analyzed to determine if there were matching or mismatching patterns for each participant in the research group. The importance of Farah’s and Munoz’s traits and their relationship to efficacy were explained further in Chapter 2.

NVivo 10 (2012) was useful in determining coding groups. It allowed the researcher to examine relationships that would permit explanations of observed conditions, such as the lack of confidence among teachers to use PB methodologies (per research question 2). It also allowed exploration of the relationship between years of teaching experience (interview questions 1 and 2). The software provided several data processing capabilities using terms, such as those posed by Munoz (2008) and Farah (2011), to compare to the prior research. For example, Farah (2011) used the following personal trait to explore
efficacious teachers, and these terms are adapted from her interviews (p. 46): “stress” or “scares.” Munoz (2008) determined that the following trait is an indicator of efficacy for teachers who improve their students’ achievement-motivating: encourages, convinces students they can achieve goals (p. 85). Nodes were interconnected and correlated in order to determine how interviews and observations complemented or contrasted one another.

These characteristics are listed in Table 6, per participant who discussed and/or illustrated them. The characteristics depicted by Farah (2011) were sought in the relationship between the interview and the observation, indicating efficacy of the teacher. As this table attends to the practices of the teachers, it answers Research Question 1. How does participation in place-based professional development affect perceived teacher efficacy in terms of teacher practices? Tables 6 and 7 below provide examples using quotes to show the interview responses indicating teacher efficacy by the terms or phrases they use as has been presented in Farah’s (2011) and Munoz’s (2008) research.
<table>
<thead>
<tr>
<th>Participant</th>
<th>CH (9 years teaching experience, 7 years teaching PBE)</th>
<th>SH (9 years teaching, 8 teaching PBE)</th>
<th>BJ (14 years teaching, 2 teaching PBE)</th>
<th>MJ (30 years teaching, 7 teaching PBE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicator/example per interview</strong></td>
<td>“For some reason they get that. They’d rather have me in their corner than in the opposite corner.” “I think it’s deferred gratification, for sure, but when those kids come back to visit year after year and tell you how important the lessons were, it really feels like you’re changing lives.”</td>
<td>“Those kids will fall through the cracks or fall out of the program and fail” “First I was a (career) and I left the field to go into teaching. I always wanted to teach”</td>
<td>“I developmentally align the subject matter to where I think those kids are and I keep altering it as we move through the year” “While I have the plan on what I need to do I work it around the kids “ “They did very good and they were some of the best in the whole school on the …standards but I want better, I want great”</td>
<td>“I can do an enormous amount.” “After 30 years I still am passionate about sharing the love of learning!”</td>
</tr>
<tr>
<td><strong>Indicator/example per observation and/or follow-up</strong></td>
<td>“We go out and get a feel for the trends, but we don’t take it (data collection) anything further.”</td>
<td>“It is our system and we have lots of support because people have seen that it works and choose to impart in place based teaching. It can now work for everyone”.</td>
<td>We get out into the community about 11 times year due to the workshop. It’s difficult to get more teachers to try to work with me on that. The test scores indicate that what I am doing is good and I am really intent on learning and moving ahead.”</td>
<td>“Water shed curriculum allows me to take students to (the) watershed, we design water filters using various soils and then take a fields experience to the water treatment facility and sewage treatment plant”</td>
</tr>
<tr>
<td><strong>Related aspect of efficacy</strong></td>
<td>Environmental, personal</td>
<td>Environmental</td>
<td>Mastery, Behavioral</td>
<td>Mastery</td>
</tr>
<tr>
<td>Participant</td>
<td>JZ (1 year teaching, 1 year teaching PBE)</td>
<td>WC (21 years teaching, 2 years teaching this grade full time, 1 year teaching PBE)</td>
<td>RC (9 years teaching, 1 year teaching PBE)</td>
<td></td>
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<td>-------------</td>
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<tr>
<td><strong>Indicator/example per interview</strong></td>
<td>“No, I am not in survival mode. I just do too many things though, and overplan”. “I like science. Yes, I teach like I was taught, and I was taught by the teacher of the year, who does Place-based things.”</td>
<td>“If a student is failing, then it is my responsibility to find out why. If students don’t understand the expectations, I repeat, or have the expectations written on the wall or worksheet a student is completing.” “I love teaching. For me, teaching is something I was ‘called’ to do, it is my life’s joy to be with children, to teach, and help them to grow in their desire to want to learn. I am also a lifelong learner because of my love of teaching.”</td>
<td>“It (giving clear explanations) is a little more difficult for science.” “(I) also send information home to parents on how they can help their child succeed.” (II) “Teaching is a difficult task. There are many different attributes and tasks to be completed. Depending on your teaching style it may work for some kids and it may not for others, therefore, you have to change your teaching style.”</td>
<td></td>
</tr>
<tr>
<td><strong>Indicator/example per observation and/or follow-up</strong></td>
<td>When asked if he uses the outdoors for teaching about plant and water concepts, he said “Absolutely!”. Yet, While a vernal pond sits outside his door, he has never used it. He taught photosynthesis inside, and had kids make diagrams and grew their own plants</td>
<td>When asked the goals of the PB lesson, she said “I am just glad to get these kids on snowshoes.” Further, in a follow up visit, when discussing the science of the place-based lesson, I tried to clarify the term symbiosis as found in lichen for the students. She said “No, that goes with the next question”.</td>
<td>Not comfortable with an observation, but in a follow up interview. “Place Based Education helps the kids learn about their surroundings and it also relaxes them, whereas they can be out of hand sometimes. When teaching PBE they are calm and wanting to learn even more (most of them that is). With that said, it also relaxes me as my year is a little crazy with 35 students and learning so much new curriculum. It is great to get out and teach the kids about PB and learn about our environment.”</td>
<td></td>
</tr>
<tr>
<td><strong>Related aspect of efficacy (Farah, 2011)</strong></td>
<td>Mastery, Personal</td>
<td></td>
<td>Personal</td>
<td></td>
</tr>
</tbody>
</table>
These indicators are traits and behaviors illustrated by efficacious teachers and guided the analysis of data in the current research. In addition to Farah’s (2011) indicators of efficacy, indicators of efficacy can be described in the following categories, per Munoz (2008) and also address research question 1. Additionally and as the comparison allowed, Farah’s and Munoz’s references to efficacious traits were applied to the relationship when observed and also guided the analysis process in the determination of codes.

- Preparing: intentional and thoughtful lesson plans; specific procedures
- Engaging/guiding: puts forth effort to reach, takes responsibility for learning
- Fostering achievement: emphasize content connections; student-designed lessons
- Ability/confidence: facilitate growth toward desired outcomes
- Daily effort: consistent, daily focus on growth

Table 7 presents a comparison of place-based methods between the interviews and the observations. In doing so, it illustrates the belief and practice match which indicates efficacy or a belief and practice mismatch, which, as discussed by Jones and Carter (2007) indicates a lack of efficacy. As it pertains to the theoretical model, quotes illustrating teacher beliefs and attitudes are revealed through participant interviews and journals, and are given below. These beliefs and attitudes were then verified through lesson implementation in the observation.
Table 7

**Indicators of Efficacy as They Relate to Efficacious Skills and Munoz’s (2008) Study**

*Interviews as verified in the observation*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Indicator of efficacy in interview (belief)</th>
<th>Indicator of efficacy in implementation (practice)</th>
<th>Efficacy traits, according to Munoz (2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MJ</strong> (30 year teacher, taught earth science for 30 years)</td>
<td>“It is very difficult to teach science by stand and deliver...students come into the class ‘hating’ or ‘liking’ science, thinking all sciences are the same because that is how they have learned them throughout their education—by a book and worksheets...no real direct application of the concepts.” “After teaching for 30 years, I am comfortable knowing I don’t know it all.” Thinking, problem solving, dynamic, seeking solutions to real problems.</td>
<td>Thinking, problem solving, dynamic, seeking solutions to real problems.</td>
<td>Preparing, engaging and fostering daily growth.</td>
</tr>
<tr>
<td><strong>BJ</strong> (14 year teacher, taught 5th grade for 14 years)</td>
<td>“I developmentally align the subject matter to where I think those kids are and I keep altering it as we move through the year while I have the plan on what I need to do. I work it around the kids...they did very well and they were the best in the whole school on the fifth grade standards but I want better—I want great.” Lessons illustrate constant connections. “We live here” is the class theme. Students worked throughout the year incorporating science, social studies and reading to design a presentation of the ten place-based trips they took.</td>
<td>Lessons illustrate constant connections. “We live here” is the class theme. Students worked throughout the year incorporating science, social studies and reading to design a presentation of the ten place-based trips they took.</td>
<td>Preparing, engaging, fostering and daily growth.</td>
</tr>
<tr>
<td><strong>CH</strong> (9 year teacher, taught science at this school for seven years)</td>
<td>“Very little connection to local agencies” And “We have many local agencies to support us.” While the pond and farm are out the door, much of the PB lesson took place indoors. However, the lesson had a community, historic, and thematic focus.</td>
<td>While the pond and farm are out the door, much of the PB lesson took place indoors. However, the lesson had a community, historic, and thematic focus.</td>
<td>Preparing, engaging, fostering and daily growth.</td>
</tr>
</tbody>
</table>
Table 7 Continued…

<table>
<thead>
<tr>
<th>Participant</th>
<th>JZ (new teacher, first year)</th>
<th>WC (21 year teacher, and taught 5th grade for two years)</th>
<th>RC (9 year teacher, taught second grade for two years)</th>
<th>SH (9 year teacher, taught science for seven years and language arts for two years)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicator of efficacy in interview (belief)</strong></td>
<td>“letting the responsibility of teaching during place-based to others and just observing….helped me observe first hand effective PB teaching and has given me the opportunity to reflect on my own teaching.”</td>
<td>“It is my responsibility I want more of it (PBE) for my class. It’s my responsibility to differentiate my instruction so that all may learn, whether they are difficult students or not.”</td>
<td>“I know it is easier to make time for place-based practices, because I learned more ways to introduce and use it too many new things I need to incorporate into this classroom, lots of students” (35 2nd graders)</td>
<td>“Those kids will fall through the cracks or fall out of the program and fail”</td>
</tr>
<tr>
<td><strong>Indicator of efficacy in implementation (practice)</strong></td>
<td>Participant displayed confidence in his ability to conduct lessons as he was taught, feeling his mentor had trained him in PB methods. How own teaching revealed hands on methods but did not foster connections within the local environment. JZ did not use the resources outside his classroom.</td>
<td>When asked what her goals for the outdoor lesson were, she responded “I am just happy to get them on snowshoes”</td>
<td>Chose not to be observed</td>
<td>Lessons illustrate a connection due to team work in the program, guided by the science instructor. The program is set up as an option.</td>
</tr>
<tr>
<td><strong>Efficacy traits, according to Munoz (2008)</strong></td>
<td>Daily effort</td>
<td>Engaging</td>
<td>Preparing and fostering</td>
<td>Fostering</td>
</tr>
</tbody>
</table>
The importance of Farah’s and Munoz’s traits and their relationship to efficacy were explained further in Chapter 2. The theoretical model illustrates efficacy is indicated by beliefs and attitudes that support science teaching and knowledge about teaching-in this study-with PB methods which were provided in the PD. Additionally indicators such as those emerging from Farah and Munoz’s studies allowed the researcher to identify whether and to what extent the participants were efficacious. Distilling Tables 6 and 7 provides an understanding of the level of efficacy of the participants.

**MJ** has a high level of efficacy. According to the efficacy indicators, she masterfully prepared a unit that included the observed lesson in which her students were engaged. This place-based lesson was taught as discussed and fostered student-community interaction based on water studies.

**BJ** Masterfully incorporated thematic and community-based field trips. He spent time prior to the lesson observation preparing his students throughout the school year. Behaviorally, he was innovative in terms of designing place-based, map-focused lessons and engaging them in language arts, math and social studies to foster an understanding of their role in their region. BJ strives daily to align his lessons in a PB way, rather than the way he has been teaching for much of 14 years. He has a high level of efficacy.

**CH** works at a land lab facility. She has the opportunity and responsibility to design lessons appropriate to her environment. However, while she was confident in her ability to conduct lessons in a PB way, the networking and use of authentic tools to collect authentic data with community members, such was not evident in her lesson. In fact, she discussed these factors as barriers to teaching in a place-based way in that this was not possible in her teaching. Additionally, she suggested that while the PD offered
bussing, she did not have the funds to conduct PB lessons, yet did not use her land lab facility to teach the lesson. Her personal intention for her lessons was not incorporated in the observed lesson. She did, however, foster student-student interaction and a local theme, which was taught in the classroom rather than the land lab facility. She has low efficacy.

**SH** has low-medium efficacy. **Environmental** opportunities, such as the support from his school (his classroom is part of a PB focused mini-school), and a co-teacher who is skilled in conducting PB methods assist SH in his efficacy. He fosters community interactions and has high expectations for his students, but does not take responsibility for their success.

**WC** Personally, she has low expectations for her students. She does however, engage them with the resource providers and while she has weak science skills, she is a master teacher in designing lessons that incorporate standards and takes a personal responsibility for their learning. She has low efficacy.

**JZ** relies on the environmental support of his mentor teacher. He is aware that he has much to learn about PBE and therefore exerts daily effort to understand teaching, teaching of science and teaching with PB methods. He has low efficacy.

**RC** While RC’s efforts are on preparing student-focused lessons (fostering) that align with the many new objectives he is asked to teach, he is personally struggling with stress and chose not to be observed.
Research Question 2

What factors affected teachers’ self-efficacy?

By definition, efficacy means the “ability to overcome” barriers (Bandura, 2000). The theoretical framework reminds us that efficacy includes beliefs, attitudes and knowledge. The effects of the PD on teacher efficacy among the teachers were also analyzed by years of teaching experience. While more experience in teaching is expected to generate greater and more knowledge about science, knowledge about teaching and knowledge about learning, it is one factor that was explored as part of the efficacy of the participants in this study and presented in Tables 6 and 7. How and whether efficacy was demonstrated at each experience level is presented here. The intent was to determine if any particular experience category of teachers responded differently to the PD than another group. Experience in years teaching was the criterion used for this analysis.

Experienced (11 or more years teaching): MJ showed a high level of efficacy. She incorporated the indicators mastery, preparing, engaging and fostering. After 30 years of teaching she discussed her joy of teaching and her understanding of the great impact she has on students. “I am more inspired to get them out of the classroom doing authentic research and citizen science. It is very difficult to teach science by stand and deliver….After teaching for 30 years, I am comfortable knowing I don’t know it all.”

BJ has been teaching for 14 years and had high efficacy despite the fact that when he discussed it, he was conservative about his efficacy. Through his interview/observation relationship, he indicated mastery of teaching, behavioral aspects of efficacy, preparing for student success, engaging, and fostering growth in his students.
Mid-career (5-10 years of experience): SH had medium to low efficacy. While he feels supported in using PBE and works in an environment that expects PBE, he does not consider himself responsible for the success or failure of the students. He fostered achievement in his students, but rather than taking on the responsibility for learning, he limited himself to environmental constraints. “While I believe in the methodology and the PB professional development provided great support for PBE, I am limited by the teaming aspect. I am here more as a support to the science teacher who is doing more PBE.” As a lead teacher coordinating language arts, science and social science, HS seemed a bit unsure of how to implement the methods without relying on the science teacher.

CH has much experience teaching PBE. She was very confident about her personal abilities and environmental aspects of her facility should enhance what she is capable of doing with her students. However, she did not maximize her opportunities. While she was educated in a similar methodology (project-based learning), she does not use her resource opportunities fully; facility opportunities are not fully utilized and authentic data is not expected from students. While teaching natural resources at a land lab facility, a great portion of what she does is indoors, yet focused on the region. While this is based on the place, and some aspects of place-based learning are being utilized; the methods of PBE do not specifically apply.

RC finds that teaching is difficult. While he has been teaching for many years (9), the vast array of changes he is asked to incorporate into the teaching of such a large class of students puts him into a situation of a beginning teacher. Furthermore, while he experiences benefits through teaching in a PB way, he does not feel fully comfortable
doing so (and chose to not be observed), and does not take full responsibility for success
or failure for the students. RC is struggling to overcome the barriers to teaching in a PB
way (Bandura, 2000). Preparing, fostering, and personal aspects of efficacy emerged
from discussion with RC.

**WC: While WC has been teaching for many years (on and off for 21), she is new
to teaching full time, in the 5th grade. Teaching science in a place-based way is new to her
as well. Traits she exemplified included engaging, mastery and personal. Her expectations in
teaching with PBE are low and her knowledge of science concepts can improve.
However, she loves to teach, which is evident in her class, and feels responsible for her
students’ learning, which is one indicator of efficacy. WC, when asked why she might
not have implemented the PD lessons when observed, said the lessons “did not exactly
suit her kids or what [she] need[s] to teach”. Alternatively, her journal indicated “It’s my
responsibility to differentiate my instruction so that all may learn, whether they are difficult
students or not.”

**JZ, a first year teacher is relatively confident in his teaching and enjoying his new
job. Traits he indicated in his interview/observation are: daily effort in that he keeps
working toward efficacy and student success and environmental in which he is limited by
his surroundings. However, while he has PBE resources literally outside his classroom
door, he does not access them. His mentor provides assistance in active learning, but
while JZ demonstrates confidence in general, it does not translate into his implementation
of PB lessons. JZ stated that he does implement the lessons from the PD, “but they might
look a little different from what we saw in the PD. I might have to do some of the lessons
inside instead, and spend much more of my time on math and reading instead.” The lack of consistency in JZ’s remarks and observation indicate a lack of efficacy.

**Factors Affecting Implementation of Place-based Methods: Benefits and Barriers.** Participants were part of a focus group, which took place prior to the PD to determine positive beliefs about PBE. They were also interviewed after the PD and then again after the observation. NVivo 10 software (2012) was used to identify the common terminology used to describe place-based education by the teachers during the interviews. The data was re-read and examined for new themes that emerged, such as the ability of teachers to rely on the resource providers and community members for difficult content rather than applying one’s own confidence in teaching the lesson. This concept is noteworthy in a study such as this on efficacy as confidence in teaching is an integral component. If the teacher can be assured that the knowledge they have will be supported and supplemented by experts, confidence can be directly impacted. “The researcher then repeated the process for observations and follow-up interviews, finally grouping the terminology into two categories entitled benefits and barriers s 5 and 6). Each of the terminology sets was then analyzed for patterns and consistencies in the theoretical framework, or more particularly in beliefs and attitudes toward instruction and implementation as they are evident in journals, interviews and observations. By doing so, triangulation occurred.

The research also relied on the prior work of Dyment (2005) and Morag and Tal (2012) to structure the final stage of analysis. In brief, Dyment (2005) identified benefits to include engaged learning of science content in a variety of out-of-school settings. These settings can be aligned to the curriculum and when facilitated properly can provide
authenticity in field study that is absent when students remain in the conventional classroom setting. Morag and Tal (2012) listed benefits from out-of-doors trips as cognitive, affective, social, physical and behavioral for the students. Teacher benefits included expert mentoring and active teaching.

Benefits: All seven teachers in the study state place-based education was a benefit to their teaching and student learning. The focus group, the teacher journals and interviews indicated they had positive beliefs about science teaching and positive attitudes about the instruction and implementation of PBE. For example, interview questions 9 and 15-17 explicitly inquire about those beliefs and attitudes and all teachers in the study expressed positive factors for students and positive factors for teachers, further supporting their use of place-based methods. Examples of their perceived benefits and hurdles are elaborated in the tables below. The interviews with teachers revealed benefits that motivated them to begin or continue teaching using place-based methodologies (Table 8).
Table 8

Evidence and Examples of Benefits of PB Methods from Interviews and Participant Journals (based in part on interview questions 9, 10, 14-17)

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Evidence</th>
<th>Number reporting (out of 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connections for students</td>
<td>“Anytime I can take a group of children outside of the 4 walls of a classroom to learn, I’m expanding their horizons, and understanding of the world we all live in.” (WC interview) [Students] are better able to interact with one another and the subject being studied more completely. (MJ interview)</td>
<td>6</td>
</tr>
<tr>
<td>More memorable</td>
<td>“The kids may not remember what we discussed or read, but when we experience it like this, they always remember the experience, and the information sticks too.” (CW interview)</td>
<td>6</td>
</tr>
<tr>
<td>More authentic</td>
<td>“What better way to understand our region than by being in it!” (MJ journal)</td>
<td>4</td>
</tr>
<tr>
<td>Supported by school</td>
<td>…our school adopted a PB methodology” (RC interview)</td>
<td>4</td>
</tr>
<tr>
<td>Students are more engaged</td>
<td>“Kids have more of a will to learn” (HS journal)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>“These methods engage students more completely than other methods because it involves all of their senses more completely, and they are able to interact with one other and the subject being studied more completely.” (MJ, journal)</td>
<td></td>
</tr>
<tr>
<td>Thematic</td>
<td>“It allows us to integrate history, English, and environmental science” (SH interview)</td>
<td>2</td>
</tr>
<tr>
<td>Easy to align with curriculum</td>
<td>“It is really easy to include PB methods at our school because we have science curriculum that involve these PB methods.” (RC journal)</td>
<td>2</td>
</tr>
<tr>
<td>Increased science scores</td>
<td>“More kids pass science now than ever.” (BJ journal)</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 8 Continued…

<table>
<thead>
<tr>
<th>Increased attendance</th>
<th>“They really enjoy and show up for the field days.” (CH journal)</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource providers supply difficult content</td>
<td>“I can leave the responsibility of teaching during the PB experiences to others and observe -[and] help out” (WC interview)</td>
<td>1</td>
</tr>
<tr>
<td>More fun to teach</td>
<td>“Makes me want to teach science more” (JZ journal)</td>
<td>1</td>
</tr>
<tr>
<td>Can align with student interests</td>
<td>“I can cater my units to individual class’s interests” (CH interview)</td>
<td>1</td>
</tr>
<tr>
<td>More fun to learn</td>
<td>“The kids understand science more and they have a will to learn. Science has already been the most interesting subject, but when you incorporate PBE, it makes it more fun and exciting.” (BJ journal)</td>
<td>1</td>
</tr>
<tr>
<td>Outside more</td>
<td>“Experiencing learning in the field is so much more effective than any day in the classroom….no child left indoors! I am more inspired to get them out of the classroom doing authentic research and citizen science.” (MJ journal)</td>
<td>1</td>
</tr>
<tr>
<td>Easy to fund</td>
<td>“We have had very little trouble funding these trips.” (CW interview)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total references to benefits</strong></td>
<td><strong>37</strong></td>
<td></td>
</tr>
</tbody>
</table>
engaging for students, and that their school supports PBE. Only one or two found many of the other characteristics of PBE to be beneficial, such as its out-of-doors learning and increased science scores. Of interest, there were several benefits that emerged for the teachers such as; easy to fund, more fun to teach, increased attendance and scores.

As it pertains to the theoretical model, WC noted a benefit of teaching with PBE methods (gained from the PD) was the ability to have lesson content taught by experts. This opportunity does not build her knowledge, as the theoretical model suggests, but directly impacts her confidence in implementing the lesson. In her follow-up interview, she discussed her appreciation for the experts who directly taught her students and it was noted that she interacted minimally with her students during the observation of her PB lesson.

Barriers to engaging students in place-based education were also specified in the interviews (Table 9). Dyment (2005) reported the barriers to best practices in teaching. Dyment’s research focused on the deeper beliefs held by the teachers, rather than the management of transportation for field trips, curriculum alignment and weather issues. According to Dyment’s research, if teachers can maximize the personal benefits and minimize the barriers when applying an approach, such as PBE, then there may be impetus to change personal teaching methodologies. In sum, Dyment suggested “external training will do little for those whose internal values and perceptions do not include outdoor learning. (Dyment, 2005, p. 41).

Of interest, teachers SH, MJ, CH, JZ, and WC experienced a strike for two weeks just prior to the data collection phase. It is noteworthy that as it pertains to efficacy and the ability to overcome, none of the teachers referenced issues surrounding the strike,
except for a reference about in-class time by HS who said parents support the implementation of PB methods, but after the strike are concerned about their students leaving the classroom on place-based trips.

Table 9

Evidence of Barriers with PB Methods, as Revealed During Analysis of Interviews and Journals (based partly on interview questions 9, 10, 14-17).

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Evidence</th>
<th>Number reporting (out of 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires funding</td>
<td>“Bussing is covered but there is very little funding for anything else.” (HS interview)</td>
<td>2</td>
</tr>
<tr>
<td>Students miss other classes/schedule is an issue</td>
<td>“Due to the schedule, it takes me three days to get through all of one class.” (MJ, interview)</td>
<td>2</td>
</tr>
<tr>
<td>Students do not always take the process seriously</td>
<td>“I have had trips totally bomb because of bad behavior.” (CH, interview)</td>
<td>2</td>
</tr>
<tr>
<td>Lack of access to authentic data and storage</td>
<td>“There is very little accountability to be accurate in data collection.” (CH, interview)</td>
<td>1</td>
</tr>
<tr>
<td>I don’t feel I am good at it as I don’t do it enough</td>
<td>“I still don’t know if I do it well. I want better I want great” (BJ, journal)</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 9 Continued…

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Example</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too many new processes to take on in addition to PBE</td>
<td>“Teaching in the last year has been difficult for me. I am learning three new curriculums, I am being asked to learn a new evaluation, grading and attendance system. I have also been asked to make a social media account for my classroom along with creating a classroom website. We have instituted new standards and report cards, which has also been a challenge to me.” (RC interview)</td>
<td>1</td>
</tr>
<tr>
<td>Standards take precedence and prevent PBE</td>
<td>“We have to work around the issue of testing. There are times when the challenges of fitting everything we are required to do cause us to limit PBE.” (WC, interview)</td>
<td>1</td>
</tr>
<tr>
<td>Some things need to be front-loaded and debriefed</td>
<td>“Lessons really need to be front-loaded then they need to be debriefed in some sort of data analysis.” (CH, interview)</td>
<td>1</td>
</tr>
<tr>
<td>Weather</td>
<td>“real science did or could not take place due to weather” (CH, journal)</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total references to barriers** 12

Of note, the teachers who were determined efficacious because of consistent beliefs and practices and the prevalence of efficacy indicators (Farah, 2011; Munoz,
such as MJ and BJ also listed *more* benefits and fewer barriers than those who were not considered efficacious after the PD such as RC, WC, JZ. HS and CH grew in their efficacy as a result of the PD according to the observation, but as explained previously, CH illustrated inconsistency in her interview and her observation. This point is important in terms of the definition of efficacy (Bandura, 2000) which refers to the “ability to overcome” barriers and in doing so enjoy the benefits of the PB methods.

While 9 barriers emerged from the interviews and journals, each was described by no more than one or two individuals. Of note, CH shared the most barriers and did not illustrate consistent beliefs and practice. Most of the barriers were suggested by those who were not determined efficacious according to Farah’s (2011) and Munoz’s (2008) indicators and consistency between the interview and observations. Of those who were determined efficacious, BJ, who was very conservative about his own abilities, said “I still don’t know if I do it well. I want better- I want great” and the most efficacious teacher, MJ, lamented “Due to the schedule, it takes me three days to get through all of one class.”

It is noteworthy that MJ also stated that due to scheduling conflicts, her class load and a district strike, stated, “I am the worst teacher I have ever been in seven years!”

The review of literature determined positive cognitive, affective, interpersonal/social, and physical/behavioral impacts for students *and teachers* in addition to fewer barriers when using the “place” in the form of green school grounds. The current study agreed with the literature and also found an increased ability to think creatively, use higher order thinking, achieving greater performance on standardized tests. As the literature suggested, liability and resources did not appear as barriers and
while larger class sizes and a movement to “back to the basics” did appear as barriers in previous research, they did not appear in the current study. For example, participants suggested that teachers are not confident teaching out-of-doors, especially if they never learned in an outdoor setting. Similar to the research literature, the current study also determined positive cognitive, affective, interpersonal/social, and physical/behavioral benefits for students and teachers teaching with PB methods including benefits as a result of the PD. Benefits emerging from the current study are:

**Cognitive:** Students connecting to each other and their region, the learning is authentic, the experience is memorable and it is thematic. Further benefits for students include increased science scores. Benefits for the teacher are that it is easy to align with the curriculum, difficult content is supplied by the resource provider and students have increased attendance.

**Affective:** students are more engaged, the lessons are aligned with their interests, and it is more fun to learn

**Interpersonal/Social:** students are interacting with one another and the resource providers who provide the valuable content.

**Physical/behavioral:** students are outside more, and are engaged.

However, supported by the school, and easy to fund, according to one teacher, which were barriers in Rickinson’s study (2003, cited by Dyment, 2005) and were actually assets in the current study, largely as a result of the PD, and its long-standing relationship with the school districts (Linda Hilligoss, May 16, 2013). On the other hand, two teachers thought the PBE lessons were difficult to fund. Bussing was provided by the PD, but nothing else. Further barriers included student behavior and attendance issues,
lack of authentic data, too many new systemic processes (new curricula, for example),
standards and the time for a PBE lesson to be incorporated into the learning and teaching
process. Importantly, confidence emerged as a barrier for only 1 of the teachers and this
teacher was a teacher who exemplified high efficacy.

**Research Question 3**

**How do teachers account for changes in their efficacy?**

This question was pursued explicitly in the follow-up interviews conducted with
all seven of the participating teachers. The researcher journals provided insight and
specific references in the observations and/or interviews that allowed for further
investigation about whether and how the PD impacted a change in efficacy. Triangulation
of all data sources allowed for exploration of efficacy as seen in the observations and
how the PD might have brought about a change in the participants’ efficacy. The
theoretical framework suggests a change in teacher efficacy when beliefs are positive,
(confirmed by the focus group, interviews and Table 8: Benefits) and knowledge is
increased. It was assumed that the PD would provide the knowledge and thereby the
impetus for implementation of the PB methods by increasing efficacy.

An important point to consider in terms of changes in efficacy is how much
confidence and experience one might have prior to the PD. This is often related to
experience teaching.

While one might assume that efficacy is a direct result of years of experience
teaching, we are reminded that even the most experienced teachers illustrate a lack of
efficacy due to the teaching of new curriculum, age level and subject matter (Lockard,
1993). Therefore, allowing for a lack of efficacy due to new teaching assignments,
teachers have been grouped according to experience teaching their current curriculum and/or age level. The effects of the PD on teacher efficacy were also analyzed by years of teaching experience. The intent was to determine if any particular experience category of teachers responded differently to the PD than another group. Experience in years teaching was the criterion used for this analysis. To explore efficacy in terms of experience, information about each teacher is elaborated below.

**Experienced (11 or more years teaching):** MJ showed high level of efficacy, due to her apparent joy of teaching and understanding of the great impact she has on students. “Experiencing learning in the field is so much more effective than any day in the classroom….no child left indoors! I am more inspired to get them out of the classroom doing authentic research and citizen science. It is very difficult to teach science by stand and deliver. …Students come into the class ‘hating’ or ‘liking’ science thinking all sciences are the same because that is how they have learned them throughout their education-by a book and worksheets…no real direct application of the concepts. After teaching for 30 years, I am comfortable knowing I don’t know it all.”

MJ suggested little change due to the PD; she has been using these methods but seeks to improve. The most efficacious teacher in the study, based on consistency between interview and observation and indicators of efficacy (Farah, 2011 and Munoz, 2008), MJ found that she continues to learn and develop into a more efficacious teacher; and it has taken many years to do so. While she is undergoing a considerable amount of stress due to district strikes, and her daily schedule and the student overall schedule are not conducive to teaching lab based classes. However, because she valued it, she attended the PD, networked with resource providers, and wrote grants recommended in the PD.
She demonstrated efficacy during her lesson in which students worked with local professionals to examine the ecology of the local area, and planned survival in hazardous weather using technology purchased through grant funding. However, she stated that in terms of stress and barriers, "I am the worst teacher I have ever been in seven years.” She indicated “the ability to overcome” stressors and barriers (such as 42 secondary students in a class) and therefore a high level of efficacy.

**BJ** has a conservative estimation of his efficacy. While BJ, an experienced teacher aligns his teaching directly to student success, he did not feel he was as successful as he had hoped in teaching in a place-based way. Change occurred due to the PD, however; BJ has a greater intention to use PB as it engages students and makes sense of textual content. He gained further understanding of the value of PBE and the need to incorporate it consistently into his classroom. Observation indicated that BJ does incorporate these methods in the class by incorporating 11 PB trips throughout the year and restructuring his curriculum to thematic instruction based on the geography of the place.

“This is different from teaching prior to the PB training because it is more intentional. I may not be using the lessons suggested in the training, but we learned about the value of PB training and while I may not be doing a perfect job I am thinking about it more and focusing my efforts in that area. I am now more intentional, [seeing] more obvious connections and a need to change. What I was doing before was superficial. Maybe what I was doing was okay. I didn’t feel like it. I couldn’t say why we did it or make them understand it.”
Mid-career (5-10 years of experience): **SH** had medium to low efficacy and suggested “While I believe in the methodology and the PB professional development provided great support for PBE, I am limited by the teaming aspect. I am here more as a support to the science teacher who is doing more PBE.” The science teacher did not attend the PD but **HS** did show me some PBE lessons conducted by the science teacher such as running a small greenhouse and herb sale. Very little change occurred due to the PD. As a lead teacher coordinating language arts, science and social science, **HS** seems a bit unsure of how to implement the methods without relying on the science teacher. “The focus is on thematic interaction between the subject and this is not different than before the place-based training.”

**CH**: Very little change occurred in CH due to the PD. CH was trained in and had been using PB methods and works at a land lab facility, which is ideal for PBE, but during the observation, it was noted that CH does not use PB to its potential by accessing resource providers or on site resources. When CH discusses why she might not have implemented place-based methods when observed, she states that it is because she has not been asked to practice the methods, make them their own and thereby assimilate them as her own knowledge. CH wrote in her journal “It is a much bigger process than just going outside. I now have some methods and units in place that work and work well” (because she has been teaching in this location and with this assignment for seven years).

However, when I inquired about the lack of PB lessons during the observation, she responded “I don’t use them (lessons from the PBE training). They just handed it to us and we never implemented it.”
Beginning (with less than five years of experience): RC finds that teaching is difficult. While he has been teaching for 9 years, the vast array of changes he was asked to incorporate into the teaching of such a large class of students denotes him as a beginning teacher. Furthermore, while he experiences benefits through teaching in a PB way, he does not feel fully comfortable doing so (and chose not to be observed). RC is struggling to overcome the barriers to teaching in a PB way (Bandura, 2000). RC speaks of change and the great value in PBE, but cannot overcome the many systematic and personal hurdles he is enduring in order to incorporate more PB into the classroom. RC chose not to be observed. “I know it is easier to make time for place-based practices because I learned more ways to introduce and use it. I like getting out of the classroom and using real-world problems.” RC was overwhelmed this year, and did not have the efficacy to overcome his many barriers to teaching in a PB way. He declined to be observed. However, according to RC, he benefitted from the PD and PBE was presented as an easy method to incorporate “I know it is easier to make time for place-based practices, because I learned more ways to introduce and use it.”

WC: While WC has been teaching for many years (on and off for 21), she is new to teaching full time, in the 5th grade. Teaching science in a place-based way is new to her as well. Her expectations in this arena are low and her knowledge of science concepts can improve. Change did occur in WC as a result of the PD; WC seeks ways in which to incorporate more PB methods, and is in the process of continuing to learn new science concepts and methods. However, WC, when asked why she might not have implemented the PD lessons when observed, said the lessons “did not exactly suit her kids or what [she] need[s] to teach.” However, she also said. “We have had to curtail experiences like
our [PB activity], and even change our visits to [PB location] to work around the issue of testing. It is my responsibility. I want more of it (PBE) for my class. It’s my responsibility to differentiate my instruction so that all may learn, whether they are difficult students or not.” This comment illustrates a need to assimilate the lessons presented in the PD into her own knowledge.

**JZ**, a first year teacher, while confident in his role as a teacher and enjoying his new job, does not yet see the opportunities he has available and what place-based methods look like in a classroom setting. However, JZ speaks of the values of PB. JZ notes how the professional development opportunity provided resources and ideas and that the district mentor has modeled PB methods. His mentor provides assistance in active learning, and while JZ demonstrates confidence in general, it does not translate into his implementation of PB lessons. JZ stated that he does implement the lessons from the PD, “but they might look a little different from what we saw in the PD. I might have to do some of the lessons inside instead, and spend much more of my time on math and reading instead.” The lack of consistency in JZ’s remarks and lack of visible efficacy traits indicate that PB methods are not being implemented, but JZ feels they are. “I love place-based learning and I would love to incorporate it more next year.”

Data indicate that experience in teaching enhances the applicability of resources and benefits from the PD for those who have 11 or more years of experience. Benefits provided by the PD that suited their teaching, such as grants and opportunities to take students on PB trips became integral to the teaching of those who had 11 or more years of teaching experience. Teachers who had mid-level experience, however, illustrated that while they discussed their efficacy in implementing the PD lessons confidently, the observations indicated low implementation and
therefore low efficacy. Beginning teachers who were new to teaching the subject area or age group indicated an intention to implement the PD, but an inability to do so.

Barriers to implementation such as standards, unclear understanding of how to properly implement the PD opportunities, stress and a lack of confidence in the subject area competed with the ability to implement the PB methods learned in the PD. By looking at the relationship between beliefs and practices, one can distinguish the impact efficacy has on the ability to overcome barriers to teaching in best practice ways. In discussion with teachers about barriers, and why their perception of how they wish to teach may or may not align with how they are teaching, factors that affect their efficacy can be probed.

This exploration resulted in a discrepancy in belief and practice, or rather, the “belief and practice mismatch” (Jones and Carter, 2007, p. 1082) for teachers with lower experience and therefore lower efficacy. It is exemplified in the inconsistencies between the beliefs and practices of JZ and CH, and in WC and the inability “to overcome” (Bandura, 2000) for RC. For example observations of these teachers indicated:

- errors in science
- minimal expectations for students’ learning and experience
- failure to incorporate even the most accessible opportunities
- failure to authenticate data
- responsibility for student learning is given to resource providers

In general, while experienced teachers identified changes that occurred due to the professional development opportunity in their interviews, the following changes were validated through observations and therefore bridge the “belief and practice mismatch”.
They are:

- More relationships with and a network of resource providers
- The ability to understand the connections with the place
- A greater intention of incorporating the methodology in daily practice due to an understanding of its importance
- Responsibility for student learning
- Grants for travel and supplies
CHAPTER V
CONCLUSIONS AND DISCUSSION

This research was initiated with a literature review focusing on (1) place-based education, (2) efficacy, and (3) teacher professional development. The literature review was followed by a field study that engaged seven teachers in their PBE professional development experience. The research data were then processed and analyzed using qualitative methodology to explore the phenomenon of efficacy.

This chapter revisits the literature and the theoretical framework which, taken with the results, provides a solution to the question addressed in this study. The compelling problem addressed by the research was: What impacts teachers’ efficacy in the implementation of science best practices introduced through professional development in PBE? The research assumed that if the characteristics of place-based teacher education were applied, teachers would be properly prepared to teach with confidence and improved efficacy and the taken with the application of PBE improvements in science teaching would result. The participants’ efficacy is discussed here as a result of the place-based professional development in relationship to three research questions that were used to investigate the overarching problem stated above. The research questions analyzed the relationships between teacher practices (research question 1), factors affecting efficacy (research question 2) and how teachers account for
changes in efficacy (research question 3). Those relationships provided the evidence for the discussion in this chapter.

Data analysis was an ongoing process throughout the study, applying and exploring new themes as they emerged, with the ultimate task of understanding and explaining the theme of teacher efficacy and behavior or the implementation of PB methods due to the PD.

Coding required the examination of the relationship among data and the research questions (Yin, 2009). The coding software, NVivo 10 (2012) was used for storage and management of data. Data were studied for representation of the research questions by examining them line by line. This information was downloaded into NVivo 10 (2012) in the categories of interviews and observations, to allow for constant comparison of all sources of the data, triangulation of data with participant and researcher journals and to align with the research questions.

An open coding process allowed the data to emerge and the researcher to look for units of meaning that appeared frequently to address the research questions. The process for identifying codes included examining the transcribed or written responses and coding the data into categories that aligned with Farah’s (2011) and Munoz’s (2008) traits of efficacy.

NVivo 10 (2012) allowed the researcher to examine the relationships between the components of the theoretical framework, namely beliefs, attitudes and knowledge, as they impact instructional practices. Nodes were interconnected and correlated in order to determine how interviews and observations complemented or contrasted one another. The software and further analysis sought key terms, such as those posed by Munoz (2008) and
Farah (2011), to compare to the prior research. Message units that emerged as a result of the literature review (Farah, 2011; Munoz, 2008) include personal codes (“attitude, stress, scares”), mastery (“often, learn, use, experiment”), behavioral (“risk-taker, innovative”) and environmental (“support, time, opportunities”) codes. Codes also include items such as years of teaching experience, gender, etc. NVivo 10 (2012) required the researcher to be closely aligned with the data by requiring the personal alignment of case nodes and the assigning of attributes like demographics (years teaching, etc.,) and others (stress, time, confidence, etc.). A more detailed description of these stages can be found in Appendix J.

**Revisiting the Problem**

The major problem addressed in this dissertation research is the issue of teacher efficacy and how it impacts science learning through professional development in place-based learning strategies. Despite teacher education in best practices, research shows that teachers, in general, may not have the confidence to utilize them in their teaching. Prior researchers have noted that teachers do not incorporate lessons in and about the environment, yet those same teachers believe they are successfully doing so (Loughran, Mulhall, and Berry, 2012).

Why are elementary teachers not teaching science? Why are teachers not incorporating the best practices they have been trained to use? Why do teachers believe they are implementing best practices, yet observations do not confirm their implementation? (Abell & Lederman, 2007; Van Aalderen-Smeets, et al., 2012; Jones & Carter, 2007). TIMSS (2011) study draws attention to the important relationship between student achievement and teacher efficacy. This represents a “belief and practice
mismatch” according to some researchers (Jones and Carter, 2007, p. 1082).

Furthermore, students who are not fully engaged with environmental science are not reaching the potential of place-based education (NGSS, Lead States, 2013; Louv, 2005; Nabhan and Trimble, 1994; Van Aalderen-Smeets, et al., 2012; Osborn, Simon and Collins, 2003; Jones and Carter, 2007). The Next Generation Science Standards (NGSS Lead States, 2013) attempt to address a lack of authentic science learning and experience by incorporating more doing of authentic science and the current study also investigated that relationship.

**Observations and Conclusions**

Seven teachers who participated in a professional development focused on PBE were studied using the qualitative research design to determine the effects of the PD on teacher efficacy. Data were collected using journals and personal interviews, and questions before and about the professional development workshops. Observations were made of their classroom teaching and the implementation of the PBE.

Reflecting on the observed impact of the professional development, one teacher improved in efficacy (BJ), aligning all lessons to students and connecting them to their place-based setting in an intentional, engaging way. Three of the teachers had medium-high or high efficacy prior to the PD (BJ, CH, MJ) and two (CH, MJ) of them did not improve their efficacy as a result of the PD. As a matter of fact, CH appeared to have high efficacy in the focus group, journals and the interview, but showed major inconsistencies in the implementation of her PB lessons through the observations. Therefore, as a result of the PD, while teachers may have positive attitudes about PBE
(according to the focus group data) and beliefs and knowledge of PBE were supported in the PD, the efficacy of six of the teachers did not improve as a result of the PD.

**Research Question 1**

**What evidence is there that place-based professional development affects teachers in terms of efficacy, namely their beliefs and practices?**

In drawing conclusions for research question 1, the researcher interviewed the participants after the place-based staff development about their beliefs. Open-ended questions allowed for an understanding of *perceived* teacher efficacy. Teachers and the researcher kept research journals, which enhanced the question and answer process, increased attention on the professional development and best practices and allowed the teacher to determine when to invite the researcher into the classroom for observations. Observations then sought consistency between the perceived teacher beliefs and the implementation of these beliefs, addressing teacher efficacy.

**Traits of Efficacious Teachers.** In more than half of the cases, teacher journal and interview data were not in agreement with the observations as indicated by Tables 6 and 7. Importantly, triangulation of the interviews, research journals and the focus group responses suggest teacher attitudes and beliefs in and about science and science teaching (in this case about place-based practices) were positive. Analyses of the multiple sources of data revealed the effects of the PD on teacher efficacy.

Additionally, to answer this question, a comparison of teacher beliefs and implementation was made. Observations allowed for investigation of efficacy impacts on implementation of methods learned, and follow up interviews allowed for clarification and further inquiry regarding distinctions between beliefs (interview) and implementation
(observations). Traits and actions emerging from the observations and discussed in follow-up interviews and are:

- Engaging/guiding: puts forth effort to reach, takes responsibility for learning
- Fostering achievement: emphasizes content connections, student designed lessons
- Ability: facilitates growth toward desired outcomes
- Daily effort: consistent, daily focus on growth
- Preparing: intentional and thoughtful lesson plans, specific procedures

The theoretical model points to the instructional practices as the indicator for efficacy. The information presented in Chapter 4 (Table 4), specified Indicators of Efficacy as related to efficacy skills and implementation. Each of the six observed teachers demonstrated a range of certain traits and actions depicting efficacy, but only three of the six implemented specific methods resulting from the PD. Two of those teachers had prior experience with PBE and its methodology. The more efficacious teachers implemented place-based methods and more efficacy traits were evident in their teaching. Implementation of beliefs was evident in three of the six teachers during the observation. One of the seven teachers asked not to be observed.

In this study, teachers who implemented the place-based practices became more confident, thus demonstrating improved efficacy as a teacher practitioner. Teachers who are efficacious did implement the lessons. As it relates to the literature (Farah, 2011; Munoz, 2008) classroom observations and interviews in the current study revealed that efficacy resulted in the following traits:
• engaging the students in multiple, connected field opportunities, incorporating
pre-and post-lessons and reflection.
• applying the benefits of the lesson/method and attempted to integrate the method,
despite feeling they did not fully understand how to do it well.
• intentional, thorough desire and need to learn about the methodology and
practices. These teachers specifically and consistently worked to make the
connections between the geographical place as the focus of place-based
education, content and the students.
• allowed the resource providers (the mentors) to facilitate the lessons, learning by
giving up some of the control of their classroom and taking on a mentee role. In
such situations, efficacious teachers maintain their teacher-student contact and
incorporate contact with the experts. Those who are not efficacious, rather,
eliminate the teacher-student contact and become more like a chaperone
encouraging the expert-student contact.
• capitalized on the opportunity to develop the lesson according to students’ needs
and professional expectations. For example, BJ suggested: “This is different from
teaching prior to the PB training because it is more intentional so while I may not
be doing a perfect job I am thinking about it more and focusing my efforts in that
area. We get out into the community about eleven times a year. I use a map
constantly and we always stop to see where we fit into the region. Kids need to
know how and where they fit in.”
When BJ was observed, his students were presenting to the community about all of the work they had done for the area in water, soil and land management. According to the definition of efficacy, BJ believes in and has a positive attitude about science teaching, but while he feels he can continue to improve, he values and strives to implement the PB lessons he learned about in the PD.

**Lack of Efficacy Indicators in Participants.** Alternatively, teachers who did not implement the methodology suggested that while the PD offered some time for networking and discussion about how to implement the lesson, these teachers did not intentionally pursue development of the lessons neither on their own time nor in the workshop. For example, CH, when asked about her use of the lessons presented in the PD stated “There they are (pointing to a binder on a shelf. They have been there since I got them.”

In the interviews, three participants explained why they did not implement the place-based methods. The participants confirmed that they were given the initial skills to apply the methodology, but had not assimilated the methods. For example, the interviews revealed the following:

CH stated: “I don’t use them [lessons from the PD]. They just handed it to us and we never practiced it” (CH, interview,).

WC stated: “I love knowing about it, but there is no additional time given. I want to keep my students safe. Networking, websites, funding. [I need] more direct contact with the professionals in so I don’t re-create the wheel” “It would be great if the [resource providers] could come into my classroom. They could have given me more for my kids” (WC, interview)
The information from the interviews, particularly Tables 5 and 6 clearly indicate that there are behavioral and environmental factors that intervene as progress towards assimilation of place-based education as provided through the PD. For example, the teachers in this study who are not yet efficacious did not access an opportunity for place-based education literally outside their classroom door, did not develop a personal lesson nor practice the implementation of such a lesson as part of the PD.

Teachers must have a positive attitude about science and an opportunity or expectation that they practice the new method in order to increase in efficacy. This study revealed that for teachers to develop efficacy, they required professional development that lead to explicit and intentional assimilation of the methodologies presented in the PD. The current study revealed that teachers who are implementing best practices are those who have been able to assimilate their new knowledge gained through PD. This occurs while fostering changes in their own teaching practices.

Teachers with low efficacy suggest that the PD did provide the knowledge about, but did not provide the opportunity, expectation, time and intention to assimilate the lessons provided into user friendly, personal lessons, appropriate for their own students. CH, a low efficacy teacher, suggests that the PD did not encourage assimilation. I don’t use them (lessons from the PD). They just handed it to us and we never implemented it.”

Alternatively, BJ, a high efficacy teacher who improved due to the PD stated that it was his intentional investment in incorporation of lessons for his students. “I am now more intentional, [seeing] more obvious connections and a need to change. What I was doing before was superficial. Maybe what I was doing was okay. I didn’t feel like it. I couldn’t say why we did it or make them understand it.”
By definition, it is possible to improve teacher efficacy, if the teacher’s belief is such that his or her actions can enhance student learning (Bandura, 2000). Believing one is responsible for learning and implementing best practices can and will impact their students’ learning. In addition, making the process intentional requires metacognition of one’s teaching and must occur in order to improve efficacy.

**Research Question 2**

**What factors affect teacher self-efficacy?**

Participants were part of a focus group that took place prior to the PD. They were also interviewed after the PD and then again after the observation to confirm and verify the observed data, in particular the relationship between the beliefs (interviews) and practices (observations). For example, why might the teacher not have implemented the lesson as provided by the PD and suggested by the teacher in the interview? A lack of consistency between the interview and the observation is an indicator of low efficacy, and the main problem pursued in this work; why are teachers not implementing best practices? If they believe in the best practices presented in the PD, know how to implement them due to the PD, then why is implementation not taking place?

**Benefits.** The interviews with the participants in the research group produced 31 direct references to the benefits of PBE-for both teachers and their students. All seven teachers provided verbal and written reflections on the positive aspects of incorporating PBE as presented in the PD. The benefits included:

- Connections for students, more memorable
- More authentic
• Supported by school
• Students are more engaged
• Thematic
• Easy to align with curriculum
• Increased science scores
• Increased attendance
• Students have a need to learn where they live
• Resource providers supply difficult content
• More fun to teach
• Can align with student interests
• More fun to learn
• Outside more
• Easy to fund

The interviews and journals produced specific words, such as connections and authenticity that are related. Dewey (1938) believed the term thematic also referred to authentic learning. The word connections appeared more often; a total of 6 times in the interviews and authentic was discussed 4 times. Taking all of these references in sum, there were 10 references to the authentic benefits of learning through PBE. One of the main characteristics of PBE is it is an “authentic” (MJ interview and journal) method of teaching about the thematic geographic place a student lives in. Teachers discussed how PBE helps their students make “connections” (BJ, journal and interview) between the text and the content, between subjects such as science and social science (WC, interview), and
between themselves and the region (BJ, interview). In doing so, the PBE methods made learning “more memorable” (CH interview). PBE is appealing to those with low (WC, CH) efficacy as well as high (JM, BJ) efficacy and good for students.

**Barriers.** The theoretical framework (Figure 1) illustrates efficacy, attitudes, knowledge and skills, and perceptions of barriers as factors affecting implementation. These hurdles include the learning of skills and knowledge (the professional development), as well as personal and work factors. Barriers emerging from the current study on the implementation of best practices suggested in the PD are listed here:

- Requires funding
- Time (to plan, to understand, and to assimilate)
- Students miss other classes; schedule is an issue
- *Students do not always take the process seriously*
- *Lack of access to authentic data and storage from resource providers*
- Lack of confidence
- Too many new processes to take on in addition to PBE
- Standards take precedence and prevent PBE
- Some things need to be front-loaded and debriefed
- Weather

The literature on implementation of best practices in teaching with PBE methods listed the following barriers: time to plan, availability of curriculum, weather, and structural and administrative issues such as standardized tests and bussing (Dyment,
2005; DeWitt and Storksdiek, 2008; Flaherty, 2007). Time emerges as a barrier similar to previous research. By definition, efficacy is the ability to overcome (Bandura, 1994) such hurdles and barriers. It is interesting to note the barriers for one are benefits for another (easy to fund, resource providers supply difficult content, for example). The data reveals that the professional development opportunity, while it provided funds, resources and ideas (as explained in Table 6, Benefits) did not increase the efficacy for most of the teachers in the study and therefore, three of six teachers, when observed, were not fully overcoming hurdles.

The Place-based Professional Development: Factors Affecting Implementation. The researcher experienced the place-based PD attended by the teachers, which was designed to provide skills and knowledge for implementation. It was imperative to experience the PD these teachers attended in order to understand the knowledge and skills presented. The literature states that characteristics of quality professional development should include (DeWitt & Storksdiek, 2008; Penuel et al., 2007):

- Teacher study groups rather than large workshops
- Collective participation of teachers from the same school
- Being mentored or coached, even engaging in an internship
- Curriculum-linked or site-based professional development geared toward teacher-specific curriculum (aligned with teacher goals)

However, the interviews and observations presented previously revealed needs that were not fully met by the PD.
Factors that were present in the PD from the list above include:

- Teacher study groups rather than large workshops
- Collective participation of teachers from the same school
- Curriculum-linked or site-based professional development geared toward teacher-specific curriculum (aligned with teacher goals)

Factors missing from the PD, as suggested by the triangulation of interviews, journals and follow-up interviews and mentioned previously by the teachers who were not efficacious:

- Mentoring or coaching, even engaging in an internship
- Duration of time long enough to allow practice of new skills

The literature and the theoretical framework suggest that these factors, designed to enhance knowledge and efficacy, must be aligned with perceptual filters such as personal and work factors in order to result in implementation. The personal factors contribute to efficacy and therefore implementation and are indicators distinguishing those with low efficacy from those with high efficacy.

The personal factors revealed in the current study and related to the theoretical framework are:

- Belief in the benefits of the lesson/method
- An intentional desire and need to learn about the methods

The work factors emerged as barriers to those with low efficacy. The work factors revealed in the current study are:

- The opportunity to develop the lesson according to their own students and setting
- Funding for bussing
- Opportunities on school grounds and in neighboring region
- Education and development which includes time to plan and prepare
- Time in schedule
- Support from administration
- Support from resource providers
- Opportunity to practice
- Lessons can be aligned with standards

Of note, the teachers who were most efficacious in this study (BF and MJ started as most efficacious and BJ grew most in efficacy) were those who recognized that they had much to learn about teaching and place-based methods in general and therefore gained much from the PD; resources, knowledge and attitude. Their personal efficacy allowed them to overcome work factors that might prevent implementation of PBE methods for those with low efficacy. BJ did not think he did a good job of incorporating PB methods, but because he valued it so much for his students, he intentionally continued to work to improve his skills and understanding. MJ, while her work factors made implementation difficult, stated “There are so many things going on this year [her daily schedule and the students’ overall schedule are not conducive to teaching lab based classes], I am the worst teacher I have been in seven years! I realize I don’t know it all, and have to keep trying to figure it out!” (MJ, interview). However, her high efficacy allowed her to persevere and to overcome the barriers of her difficult year and her positive attitude and knowledge were efficacious. She illustrated consistency in her
interview and observation and despite the stress implemented more PBE indicators than any other teacher.

**Research Question 3**

**How do teachers account for changes in their efficacy?**

While efficacy may be considered to improve with years of teaching experience, that correlation was not revealed in the research. Efficacy did not correspond directly with years of teaching experience (Table 3). The research participants’ teaching experiences ranged from 1-30 years.

Varying levels of efficacy were illustrated in the seven teacher participants in the research. For example, WC had been teaching for 21 years and had two years of experience teaching fifth grade. She takes her role as a teacher seriously, but her implementation of PBE and level efficacy were low. This was due to a lack of confidence, knowledge, and skills in implementation of the PBE method. This translated to low efficacy for the lesson. Those conclusions were made based on comments from the interview and visible data from her lesson observation: When asked the goals of the PBE lesson, she said “I am just glad to get these kids on snowshoes.” Further, in a follow up visit, when discussing the science of the place-based lesson, she provided inaccurate scientific information to the students.

RC had been teaching for nine years, but was overwhelmed by all of the district and classroom changes he was asked to make. Therefore, his efficacy in implementing these methods was low. On the other hand, BJ, who had been teaching for 14 years, did not feel he had high implementation skills, but supplemented a lack of perceived skills with a dedicated intention to incorporate those methods. He was the only teacher who
improved in efficacy after the PD. CH, while she had nine years of experience teaching, and seven years’ experience teaching in a PB way, did not incorporate key components of PB methodology: authentic engagement in the place, student-community interaction and active problem solving. She did, however, incorporate thematic and environmental lessons but remained a low-efficacy teacher due to inconsistencies in her interview and the observation of her lesson. The lesson failed to incorporate indicators of PBE, yet these indicators were discussed in her interview. Further, several benefits to teaching PBE presented in the interview (access to resource providers, authentic data storage and funding) were the same barriers she posed in the post-observation interview.

Positive Attitudes, Intention, and Assimilation. All teachers participating in this study expressed positive attitudes about and intention to teach place-based methods in the focus group. This information is presented in Table 6, Evidence of hurdles with PBE methods. As described in the previous section, a key theme that responds to all research questions is the desire and ability of teachers to assimilate and use new knowledge. According to the SAMPI and lesson observation, four of the teachers mistakenly thought they were implementing these PBE methods (SH, WC, CH and JZ) but were not doing so according to the data collected in the study. One participant thought he was not doing so, yet the observation provided evidence that he was (BJ) doing so. Another teacher (MJ) made implementation a clear goal, and measured herself against that goal. While she had participated in the PD and had experience working with place-based methods (in addition to much experience teaching) she demonstrated efficacious behavior during the observations and interviews. RC had intentions of incorporating place-based methods but recognized that he simply could not overcome the hurdles he was experiencing and
therefore chose not participate in the observation. This information is correlated in Table 6, Evidence of hurdles with PB methods. As described in the previous section, a key theme that responds to all research questions is the desire and ability to assimilate the teacher’s new knowledge. This theme aligns with a component of the definition of efficacy (Bandura, 2000), in the ability to overcome both personal and work factors that prevent implementation of PBE. For this reason, it is imperative that professional development opportunities focus on these factors. Regarding structural and administrative issues, an additional hurdle occurred in the planning process; the largest of the school districts in the study went on strike for two weeks. Interestingly, this issue did not emerge from the study as a factor impeding teacher implementation of place-based lessons.

Revisiting the Theoretical Framework

The theoretical framework for this study comes from research on teacher efficacy (Jones and Carter, 2007; Bandura, 1994, 2000). The focus group indicated that the teachers in this study have a positive attitude toward implementation of place-based methods, which is the first component of the efficacy framework. In terms of behaviors, such as implementation of methods (for this study, PBE methods), the teachers in the present research value (believe in) science and believed they were enacting best practices, however, the observation data suggested those methodologies were not being implemented. A mismatch between belief and practice was apparent to the researcher. Generally, beliefs, attitudes, knowledge, skills and motivation do not directly link to instructional practices for the current study, but are impacted by the perception of hurdles or barriers. These barriers limit what he or she can or cannot do.

The model presents an option in which attitudes, knowledge and motivation may
enable teachers to overcome hurdles (Bandura, 2000) and implement best practice techniques, including PBE. The focus group discussions suggested that the teachers in this study have a positive attitude toward implementation of place-based methods, which is the first component of the efficacy framework. The data in the current study indicate that teachers’ knowledge and skills need to be a greater focus in staff development.

*Figure 1. Efficacy as it guides instructional practices. Taken from Jones, M. G., & Carter, G. (2007, p. 1074).*
**Implications for Efficacy**

Building upon Jones and Carter’s theoretical framework (2007), key components specific to this study on professional development and teacher efficacy include:

1. **Efficacy and barriers** that may have impeded implementation of place-based methods. These barriers include time, a lack of resource providers and funds. Time is a well-known issue of concern and a lack of time for teachers pervades education. Time can refer to time to teach and to plan, but this study was noteworthy as it referenced time to learn the new method in a way that PBE could be successfully and confidently implemented. For those with low efficacy, the list of barriers includes a lack of time to assimilate the PBE methodology in addition to curricular constraints, but teachers with high efficacy overcame the issue of time and as a result, curriculum aligned with *the geographical place* was assimilated.

2. **Science epistemology:** Teacher beliefs impacting science learning and teaching may be determined by how the teacher learned science. For example, ZJ shared his tendency to revert back to his default method of teaching which consists of *how he learned* science.

3. **Attitudes toward the goal of implementation:** A positive attitude is important for the theoretical process to move beyond efficacy to epistemology, and all teachers in this study indicated a positive attitude about PBE and about the implementation of PBE.

4. **Knowledge:** Does the teacher have appropriate science knowledge to teach the science concepts, or in the case of PB methods, to facilitate these concepts? Also, are the skills to properly facilitate lessons in a PB manner learned and assimilated by the teacher? Those with high efficacy have science knowledge and are able to properly facilitate lessons aligning with this knowledge.
(5) **Perceptions and feedback:** The model illustrates perceptions of teachers and feedback from students and the greater school community as filters through which or hurdles preventing implementation from taking place. How is this method impacting the students? How is the PBE method impacting teachers? PB methods were reported to positively impact students in cognitive, social and affective ways, such as improved science scores and attendance. Teachers in this study experienced an increased enjoyment of their job, a network of experts with which to work and increased attendance in their students, for example.

The data illustrates that when and if all of these factors align positively in the professional development, the teacher can and will implement the PB method. In doing so, teachers’ efficacy increases.

**Solving the Problem**

Students have a minimal, at best, relationship with the natural world and have corresponding low science scores (NGSS Lead States, 2013; UNESCO, 2013; Louv, 2005; Nabhan and Trimble, 1994). Teachers know about best practices in and about the environment, but, as this study confirms, do not always incorporate them into their teaching (Loughran, et.al., 2012). The Next Generation Science Standards (NGSS) attempt to address a lack of authentic science learning and experience by incorporating more doing of authentic science (NGSS, Lead States, 2013) and therefore place-based methods are an appropriate practice through which to view teacher efficacy. With knowledge of these standards and a desire to solve the issue of such a minimal relationship with nature and low science scores, professional development opportunities
for teachers must focus on the implementation of authentic science and bridge the belief and practice gap.

This question permeates science research literature as Abell and Lederman (2007) in The Handbook of Research on Science Education remind us: Why are elementary teachers not teaching science? Why are these teachers not incorporating the best practices they have been trained to use? Why do they believe they are implementing best practices, yet observations do not confirm such an implementation? Delving into the issue of efficacy provided clarity.

Importantly, a key theme that responds to all research questions is the desire and ability to assimilate the teacher’s new knowledge. This takes time and intention. For this reason, it is imperative that professional development opportunities focus on these factors. In doing so, the teachers who are most efficacious have the ability to overcome the barriers of implementation, completing the efficacy process as depicted in the theoretical framework. According to Dyment’s research, if teachers can maximize personal benefits and minimize the barriers (standardized tests, lack of confidence) when applying an approach such as PBE, implementation of best-practice approaches is expected to develop. Revisiting the theoretical framework encourages a discussion on how the different components of the framework apply to this study on efficacy.

Of the seven teachers, three (MJ, BJ and CH) had high efficacy prior to the professional development, and of those three, two were observed making the most of their PD opportunities (MJ, BJ). One teacher was so overwhelmed by changes and expectations (RC); the teacher chose not to be observed. The other three (SH, WC and JZ) thought they were implementing PB methods while they were not doing so.
Contextual conditions that affect efficacy or implementation and contributed to participants’ levels of efficacy did play a major role in the effects of the PD on individual teachers. They can be found in Tables 7 and 8 as they pertain to the theoretical model and are summarized here:

- belief in the benefits of the lesson/method; this was an expected outcome of the PD, but it materialized in only three of the teacher participants.

- (attitude, knowledge) were intentional about their desire and need to learn about them. The effects of the PD were contingent upon coming with an open, receptive attitude towards the PBE being presented by the professional development. It materialized in three of the teachers who implemented PBE, and were efficacious.

- (skills, filter) and had the opportunity and time to develop the lesson according to their own students and setting. The observation of the PBE methodologies being implemented by the research participants suggested that while all (six) of those observed implemented PBE methodologies, three teachers assimilated them into lessons.

The condition that Jones & Carter described as a “belief and practice mismatch” (2007, p. 1082) was evident in most of the teachers in this research. As Jones and Carter’s framework (Fig.1, 2007) illustrates, while attitudes toward instruction and implementation were positive, low efficacy resulted in magnifying perceived hurdles (filters) and a lack of skill formation impacted the ability to implement instructional practices as presented in the PD.

**Implications for Teacher as Learner**

Fallik, et al. (2008) and Loughran (2005) remind us to focus our efforts on the *teacher as learner*. While science educators and science education researchers attend to
learning opportunities, we rarely adhere to our knowledge of *how individuals learn* and we fail to incorporate such knowledge in the design of teacher education. If we expect teachers to believe in and then implement a new method of teaching, they must learn it, and feel confident in their ability to apply it. The place-based methods are *what* are learned and a quality professional development opportunity is the means by which these methods are assimilated, thereby increasing efficacy. The teachers can thereafter, with higher efficacy and new knowledge, facilitate learning in their students.

Current learning theory focuses on constructivism and interestingly, Bandura’s classic work on learning (1986) discussed constructivism as a social way to learn by modeling others. In conjunction with his more recent work on efficacy (2000), such constructivist experiences ultimately impact the development of knowledge as a component of efficacy. In consideration of the teacher as learner, constructivism emphasizes the importance of connecting learning to previous knowledge and experience, and depends on authentic problem solving in real situations (Bandura, 2000).

In terms of constructivism, two key principles relate to teaching and learning. Learning is active. Direct experience, for example, with the place-based resource providers and new methods, is a key component of assimilation and accommodation of information in the form of new teaching methods. How information is presented is important. When information is presented as a solution to a problem, such as low test scores or a lack of student engagement with nature, the information functions as a tool and can be further assimilated. Learning should be authentic, and "real". Meaning is constructed as learners interact by being engaged in meaningful activities, such as intentional practice of the lessons one will ultimately teach. Whole and authentic
activities, rather than isolated skill activities, result in something that can be used by the learner.

Cognitive learning theory assumes that learners use prior knowledge, linking it to new knowledge to develop understanding (Vygotsky, 1978; Dewey, 1938). Socio-cultural learning theory is community-based and depends on how individuals interact in the context of their community, be it discourse among a group of teachers or learning new data collection techniques through apprenticeship (Bandura, 1986). In particular, Vygotsky (1978), Dewey (1938), Brown, Collins, and Duguid (1989) inform science education with an emphasis on social and situated learning in which learning takes place as a result of the interaction and collaboration with others (such as in the PD), in authentic situations (practicing the application of methods with one’s curriculum and geographic place), and in the form of discussion, banter, and explanation (reflecting throughout the PD). Aligning this methodology with the constructivist view and its implications for science pedagogy, science researchers can find benefits in the place-based paradigm for student learners and can use these factors for teacher professional development.

A key theme emerging from the data is the desire and ability to assimilate the teacher’s new knowledge. For this reason, it is imperative that professional development opportunities focus on these factors. In doing so, the teachers who are most efficacious have the ability to overcome the barriers. In sum, professional development can enable teachers to assimilate the skills needed to teach in a PB way if it includes:

- Personal opportunities to verify the new information
- Social discourse among community members or learning of new skills through apprenticeship
- Physical, direct, sensory experiences with the external world
- Time to assimilate and accommodate the new information.
- Opportunity to practice the new skill in an authentic context.

The enhanced theoretical framework (Figure 5) illustrates that a teacher’s belief is limited by their personal experience in teaching in this new way and determines the ability to assimilate and then implement the new method of teaching. For example, MJ, a highly efficacious teacher suggests “Train teachers how to implement it just like a job”. This is an interesting perspective, as teaching science so that teachers and students learn it is the job.

Taking another look at the original theoretical framework (Fig.1) and incorporating constructivism, one can examine how teachers learn to implement their new methods. By definition, efficacy refers to confidence and attitude. Increasing confidence and improving attitude in a teacher may not be feasible until the teacher feels comfortable using a new methodology. One way to improve confidence is by apprenticeship with resource providers in learning and practicing the new skill. Additionally, when students improve their attitudes, attendance and engagement, teacher attitude about using the new methodology is expected to improve.

From the theoretical framework above, stages three and four in the process toward implementation become most relevant to the teacher as learner (Fallik, et al., 2008; Loughran, 2005) and formulate an effective model for professional development.
(3) Attitudes toward the goal of implementation. A positive attitude is of course important for the process to continue past efficacy and epistemology, and all teachers in this study indicated a positive attitude about the implementation of PBE.

(4) Knowledge: does the teacher have appropriate science knowledge to teach the concepts, or in the case of PB methods, to facilitate them? Also, are the skills to properly facilitate lessons in a PB manner assimilated for implementation?

As a result of this study, with teacher learning in mind, and an outcome of professional development that is reinforced in the teachers’ behavior, a new framework for professional development emerges.

Implications for Professional Development

Indicators for the teacher professional development explored in the current study were aligned with literature on quality PB professional development such as Penuel, Fishman, Yamaguchi and Gallagher’s (2007) study of professional development programs. The explicit intent was to determine effectiveness, which was defined as the implementation of the skills and curriculum comprising the workshop. Implementation therefore provides a gauge to examine this study on the implementation of PBE methods. In researching the most effective study, Penuel and colleagues also examined traits of professional development opportunities that provided an impetus for the implementation of methods learned by the teachers.

According to Penuel et al. (2007), traits present in the most effective of 28 professional development opportunities are:

- Teacher study groups rather than large workshops
Collective participation of teachers from the same school

Being mentored or coached, even engaging in an internship

Curriculum-linked or site-based professional development geared toward teacher-specific curriculum (aligned with teacher goals)

Duration of time long enough to allow practice of new skills (assimilation)

While many of the traits of a quality teacher education experience persisted in the PD attended by the teachers in this study, others were lacking. Components accessed by efficacious teachers, and suggested by those who were not efficacious are:

- Being mentored or coached, even engaging in an internship
- Duration of time long enough to allow practice of new skills

Penuel et al., (2007) found the incorporation of time to plan and support for assimilation as main factors allowing for implementation of the given program and these factors were present in the current study as well. While Penuel et al. (2007) determined the traits above as effective for implementation of best-practices, data gathered here point to additional components that should be considered in future teacher PDs. Of note, the intention and ability to assimilate new knowledge should be a focus. By doing so, the teachers who are most efficacious would have the tools to overcome the barriers.

In the current study, when determining why PBE was not implemented, reasons included a lack of time to adjust and practice the new skills and curriculum, a need to teach to and practice for state tests, and a lack of engagement with resource providers. Most importantly, teachers in the current study said they simply did not have or did not
spend the time to incorporate the lessons they were given in the teacher professional
development as their own.

Issues in implementation, or rather the “belief and practice mismatch”, (Jones &
Carter, 2007, p. 1082) emerged in 4 out of 7 teachers in this study. Of the three who did
not have issues with implementation, two had efficacy prior to the PD and were able to
build on their “toolbox” (CH, personal conversation, May 6) of lessons and connections,
and only one teacher became more efficacious. Therefore, the PD attended by all teachers
in this study should be restructured in light of the information provided. It is expected
that efficacy of all seven of the teachers in the study would improve and therefore
implementation of the PB methods would be evident.

Recommendations for the Profession

Recommendations for teachers and teacher educators include the following:

- The TIMSS study (2011) calls for a new perspective on teacher education, job
  satisfaction and staff development. Staff development should be designed along the
  components suggested by Penuel, et al. (2007) and should emphasize collaboration, time
to learn, application to one’s practice, and an apprentice-like focus with experts in the
field.

- Teachers should gain more experiences to enhance their confidence in natural
  environments including, but not limited to, the school community.

In providing this, staff development should allow for authentic experiences to
engage
with resource providers, experts and the resource itself-natural environments. This might include networking, camping, backpacking and hiking opportunities as they intersect with content knowledge and skills.

- Alignment of teacher education to the implementation of best-practice methods is encouraged by the Next Generation Science Standards (NGSS Lead States, 2013).

**For Further Research**

Through the review of literature, research was synthesized, themes arose, and new questions emerged. Questions are classified within the following categories: student achievement, teacher education in PB methods, and teacher efficacy.

**Student achievement.** What are the effects on student achievement after teacher-focused professional development? Data should be used to further understand the relationship between place-based methods (such as those suggested by the NGSS, 2013) and student achievement, and this information should be directly provided to pre-service teachers, teachers in the field, and particularly to those who design staff development and pre-service science education programs. Using larger teacher samples, student cognitive, social and affective growth could be assessed after teachers attend staff development explicitly designed to meet teachers’ needs as learners.

**Teacher education in place-based methods.** How best can teachers connect with the communities in which they teach so as to overcome barriers to teaching in place-based ways? Additionally, what resources are available to provide authentic data collection and accessibility for data analysis, so as to further the goals of the Next
Generation Science Standards (NGSS, Lead Schools, 2013)? This effort might focus on PB methods or perhaps other skills aligned with the Next Generation Science Standards.

Teacher efficacy. Do the use of various efficacy scales and long term studies in other school districts or regions across the United States illustrate a different perspective? Prompted by Dyment’s research (2005), if teachers can maximize the personal benefits and minimize the barriers (curriculum, confidence) when applying an approach such as PBE, might this provide an impetus to change the teaching approach and align practices with these beliefs?

In response to CH’s suggestion that sometimes PB experiences are not beneficial due to poor student behavior and/or lack of authentic data collection: How can students learn to maximize their field trips? This might include teacher education in the use of tools and equipment for gathering authentic data, safety instruction, and students’ ability to self-monitor in an outdoor environment when working with resource providers and other community members.

As JZ suggested, teachers rely on a default method, or rather methods they experienced as students. As the model for best practice teaching changes and is better communicated and implemented, what can we learn from pre-service educators who have versus those have not learned in PB ways in recent years?

As these themes intersect (PBE, efficacy and teacher professional development) transformation is taking place in teachers. A teacher’s personal experience can interact with beliefs, school culture, resources, etc. and can spark a personal and pedagogical transformation. How does each teacher's life history influence his or her evolution as a place-based educator? Also, How might action research studies enable teachers to
become more intentional and use metacognition to enhance their efficacy? In response to the connection between experience, situated cognition, and efficacy: How might more experience in nature improve efficacy for new and experienced teachers of all grade levels?

An aspiration of this research is that PBE is viewed as a valuable method to increase the learning of science and that more teachers will increase efficacy by receiving quality professional development. This aspiration is prompted as a mechanism for meeting the Next Generation Science Standards (NGSS Lead States, 2013) and other national and state standards by teaching science for increased rigor, authenticity and experiences in nature.

Limitations and Delimitations of the Study. While the current research provides an in-depth examination of teacher efficacy and how it is affected by professional practice, there have been limitations. Only teachers from the Western United States participated in the research. This qualitative study was limited to a small number of participants. Additionally, the teachers participating in this study were volunteers who attended a PB teacher professional development workshop. Although one of the aims of the current study was to distinguish between beliefs and implementation, it is important to note that observations in this study risk reflexivity in which teachers may teach differently because they are being observed (Yin, 2009). Researcher bias also provides a limitation despite making preparations and setting conditions to reduce its occurrence (Glaser, 1978). The nature of qualitative research limits the study by positioning the researcher deeply into the study, and within the lived experience of the participants.
Alternatively, this study is delimited by the data analysis tool. NVivo 10 (2012) allowed the researcher to manage the data rather than to remain separate from it. The research did not include teachers who had not participated in PBE methods PD. Thus there was no comparison of teacher efficacy for a group of teachers who did not participate in the professional development. As a result of these delimitations, and due to limitations of qualitative methodology, the results of this study cannot be generalized across the population of teachers. Generalizability of results is thus limited to the context of the study and research participants.

The researcher is aware of bias that can be problematic to any research and has designed the research to avoid such bias. Issues associated with bias result from a lack of planning an explicit research plan and objectives and a lack of secondary research in preparation for the data collection and analysis. To avoid such issues, the researcher allowed the research questions to guide the process and crafted a research process with multiple stages. In addition, the researcher journaled thoughts throughout the process and confirmed perceptions of the data prior to moving on to the next stages in the process.

**Researcher Experiences.** The researcher’s desire to conduct this study stems from experiences with teachers and PB learning in the capacity of Director of Outdoor Education for a school district in western Michigan. The researcher held this post for four years and has been a teacher in the area of science for almost 25 years. The researcher developed curriculum about the environment and has designed and conducted multiple in-service and pre-service teacher workshops to develop teacher skills in the implementation of such curriculum. Additionally and interestingly, anecdotal evidence about teacher beliefs culminated in the early years of her teaching career. This evidence
highlighted a need for teachers to develop efficacy in science and nature and was later confirmed by research (Jones & Carter, 2007). The researcher worked with elementary teachers who were afraid of teaching science and also teachers who believed they were implementing best practices while these best practices were not evident in the class setting. This anecdotal evidence permeated her experience at the outdoor education center and developed into this dissertation.

Implications of these experiences include a lens into the life of a teacher, and an understanding of barriers to teaching. They also allowed for a personal interaction with the teachers, an understanding of the PB methods and of high quality professional development.

Summary

Overarching themes emerging from this research are:

- PBE is perceived by teachers as a positive methodology connecting students in an engaging relationship with authentic learning about their environment.
- Experience in teaching does not equate with efficacy, nor with confidence.
- It is possible to overcome barriers in teaching with an intentional focus on student learning and personal growth.
- Efficacy can improve, when teachers are properly trained in best-practice methods. This includes intentional time to assimilate knowledge and skills and practice implementing the best-practice methods.

Teachers must become empowered to apply methods to their classrooms in a way that science knowledge is achieved. For such reasons, science education research must
seek to improve student science learning but also to improve teachers’ learning. If teachers, who become learners in professional development settings can better practice what they believe they are teaching through improved education, then they are better able to facilitate the authentic, situated learning that our science students so desperately need. If we can understand and apply the best characteristics of PBE and teachers can be properly trained to teach effectively, then we have begun to reach our goal of science education.
REFERENCES


http://unesdoc.unesco.org/images/0022/002210/221008e.pdf


Woodhouse, J.& Knapp, C. (2000). Place-based curriculum and outdoor and environmental education approaches. ERIC Digest,
APPENDIX A

IRB APPROVAL SOU
July 30, 2013

TO: Dr. Joseph Stolte
Ms. Tamara Chase Coleman

RE: Project #1314001
Place-based methods in teaching science; teacher efficacy and student success

Dear Dr. Stolte and Ms Coleman,

The above-referenced project was reviewed by Southern Oregon University's Institutional Review Board (SOU/IRB) in accordance with the Code of Federal Regulations on the Protection of Human Subjects (45 CFR 46). As presented, your proposal is in compliance with SOU Federal Wide Assurance and DHHS Regulations for the Protection of Human Subjects. The study has been classified as exempt and approved. You are authorized to begin data collection at the referenced workshops and sites.

This approval is limited to the activities described in the Review Request form and extends to performance of these activities at the sites identified.

Date of IRB review and approval: 07/30/2013
Approval Valid until: complete
SOU Federal Wide Assurance: FWA 0009361

IRB approval does not constitute funding or other institutional required approvals. Should your study involve other review committees such as Conflict of Interest (COI), Occupational Safety Advisory, and/or Chemical Hygiene Committees, it is the researcher's responsibility to ensure that all approvals are in place prior to conducting research involving human subjects or their related specimens.

No procedural changes or document modifications may be made without prior review and approval. Any unanticipated problems and/or adverse events involving risks to participants must be reported to the IRB olo Deborah d'Este Hofer #106 Churchill Hall, 541.552.8662.

We wish you the best of luck in your project.

Deborah d'Este Hofer MM
Deborah d'Este Hofer MM
IRB Administrator

Grants & Sponsored Programs
1250 Siskiyou Boulevard
Ashland, Oregon 97520-5045
T: 541.552.8662
F: 541.552.6115
APPENDIX B

HSIRB APPROVAL WMU
Western Michigan University

Date: July 27, 2013

To: Joseph Stoltman, Principal Investigator
    Tammy Coleman, Student Investigator

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number 13-07-21

This letter will serve as confirmation that your research project titled "Place-based Methods in Teaching Science; Teacher Efficiency, Administrator Support and Student Success" has been approved under the expedited category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may only be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., you must request a post approval change to enroll subjects beyond the number stated in your application under "Number of subjects you want to complete the study"). Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: July 27, 2014
APPENDIX C

FOCUS GROUP QUESTIONS
Focus group (guiding) questions:

1. What brought you to this training?
   - I wanted a summer networking opportunity with using our local area.
   - I love knowing about it, and after 30 years know that I still have lots to learn.
   - I believe in it. I see great potential for kids and am always trying to learn. I am a lifetime learner.

2. How do you feel about place-based learning?
   - We are here because we believe in it. They are preaching to the choir.
   - This Institute is helpful, as I don’t know what resources are out there.
   - The networking is helpful and seeing how they do it (teach using the local resource).
   - I have done it before and I think I can use a brushing up of my lessons.

3. Is the training providing opportunities for you to learn and use various tools and techniques for place-based learning at your own site? Please tell me about it.
   - Yes, but I need to prep my kids
   - Yes, but now I need to incorporate Common Core, Environmental Literacy Standards and also the NGSS (Next Generation Science Standards). I need help with that.
   - I really want to be sure I can keep my students safe. Networking is helpful, yes, websites, and how to get funding. I need direct contact with the professionals in order to determine how to make sure I don’t re-create the wheel.

4. In what ways will you implement this training? What suggestions do you have for others teaching in this way?
   - It depends on how often I get to do this.
   - As professionals, we have less time to do this.
I will cycle a large project throughout the year.
...
I love and look forward to being outside.
It is lots of work, but know that it is good for kids.
I still need the texts so I can convey the vocab.

5. What do you hope to see in your students as a result of implementation of these materials? How will you know when you see success?

- I think the scores will go up.
- They should do better in science, and maybe social science.
- Kids will be having fun...engaged and involved.

6. How does place-based learning impact you personally? Does it reduce or add to your stress?

(this question did not draw answers about teachers personally, but rather the teachers in the group kept referring to their “kids”-success, interest and motivation. They spoke of it with a positive tone, but would not talk about themselves.

- It is good for kids. They like to be outside and so do I.
- I can see the kids really wanting to do this, and having fun too.
- I see it being helpful to students who have a hard time succeeding.

7. Are you willing or interested in participating in a further study on PBE and professional development?

- What does it entail? What do we need to do for it?

It involves me talking with you about your feelings about lace-based education, science and teaching, and then observing place-based lessons of your choice.
o  Sure
o  Can I let you know?
o  No thank you
o  Sure, I can if you need me
APPENDIX D

OVERVIEW OF PD
# APPENDIX D. Environmental Education August Institute

## Week-at-a-Glance August 12-15, 2013

*Schoolyard Learning: Harnessing Nature to Deliver the Common Core!*

<table>
<thead>
<tr>
<th>Date</th>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thurs</th>
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<tbody>
<tr>
<td></td>
<td>8:30 am</td>
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<td>Optional Field Trips (Details provided at the Institute)</td>
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<td>Location X</td>
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<td><strong>Morning</strong></td>
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<td>• Welcome &amp; introductions</td>
<td>Field Sessions:</td>
<td>Field Sessions:</td>
<td>Half Day:</td>
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<td></td>
<td>• Pre-survey, focus group</td>
<td>Option 1:</td>
<td>Option 1:</td>
<td>Options:</td>
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<td></td>
<td>• Institute Goals</td>
<td>Stewardship Alive</td>
<td>Trip Planning &amp; Teaching</td>
<td>• Farm site X</td>
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<td></td>
<td><strong>Key Note Speaker: XXX</strong> Environmental Literacy Plan &amp; Standards Alignment</td>
<td>Citizen Science</td>
<td>Outdoors: Strategies for Success!</td>
<td>• Nature Center Y</td>
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<tr>
<td></td>
<td><strong>Guest Speaker: XXX</strong> Success Stories: What does research say about</td>
<td>Option 2:</td>
<td>Option 2:</td>
<td>• Restoration project Z</td>
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<td></td>
<td>Place Based Ed and student learning gains?</td>
<td>Service Learning &amp;</td>
<td>Schoolyard Inquiry: Ah Ha! (Presented by local science museum)</td>
<td>Please bring your lunch &amp; snack</td>
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<tr>
<td></td>
<td><strong>Noon</strong></td>
<td>Bring a Lunch</td>
<td>Bring a Lunch</td>
<td><strong>Full Day:</strong></td>
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<td></td>
<td>Lunch Provided</td>
<td>RESOURCE FAIR</td>
<td>RESOURCE FAIR</td>
<td>Options:</td>
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<tr>
<td></td>
<td>(Dress for a picnic)</td>
<td>Lecture: All provided – Schedule printouts</td>
<td>Lecture: All provided – Schedule printouts</td>
<td>• Overnight camp Y</td>
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<tr>
<td></td>
<td><strong>Afternoon</strong></td>
<td>Field Sessions:</td>
<td>Kicking the excitement alive (2:00 pm – 4:00 pm)</td>
<td>• Wilderness Area Y with EE graduate students</td>
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<td></td>
<td>• Guest Speaker: XXX Demystifying the new Next Generation Science Standards!</td>
<td>Option 1:</td>
<td>• Weaving EE into a year long plan</td>
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<td></td>
<td>• Identifying barriers to Environmental Ed</td>
<td>Designing a School Garden</td>
<td>• Planning quarterly workshops</td>
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<td></td>
<td>• Creating strong administrator partnerships</td>
<td>Option 2:</td>
<td>• Credit Expectations</td>
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<td></td>
<td>• Funding Opportunities for Environmental Ed: (Show me the money)!</td>
<td>Schoolyard Mapping</td>
<td>• Institute Post-survey &amp; Exxra</td>
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<td>• Aligning Common Core to EE: Easy as can be!</td>
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<tr>
<td></td>
<td>4:20 pm</td>
<td>Thanks for a great day!</td>
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APPENDIX E

INDICATORS
DEFINITIONS OF INDICATORS
FOR A MATHEMATICS LESSON

A TOOL TO HELP OBSERVERS
COMPLETE THE LESSON OBSERVATION DEBRIEFING INSTRUMENT

The K-12 Lesson Observation Debriefing Instrument is divided into five sections: Information About the Lesson and Classroom, Planning/Organization of the Lesson, Implementation of the Lesson, Content of the Lesson, and Classroom Culture in Which the Lesson Was Conducted. Additionally, if technology is being used in a major way to support the lesson, observers complete the Use of Technology to Support the Lesson section. In each area there are several classroom practices that are observed and rated. These are the indicators relative to standards-based inquiry-oriented teaching and learning. The observer is also asked to provide supporting evidence for the rating (i.e., what the observer noted that led to the rating). If the mentoring/coaching version (Version A) is being used, space is given to note suggestions for improvement.

Because not everyone interprets the indicators in exactly the same way, this guide to the indicators is designed to more fully define and describe each of the indicators. It is to be used as a reference tool when completing the debriefing form. The definitions are not exhaustive, but should help observers focus their observations and judgments. Remember that this observation system is designed to gather information about inquiry-oriented approaches to teaching and learning.

WHAT IS AN INDICATOR?

The term INDICATOR is commonly used in education in assessing progress toward intended goals and objectives. For example, the annual report of the U.S. Department of Education, The Condition of Education, reports on more than 60 indicators of educational success. The annual Michigan Kids Count Data Book says it "examines many indicators of child and family well-being." The Council of Chief State School Officers produces annual reports, State Indicators of Science and Mathematics Education.

A definition. In general, indicators are descriptions of what will tell us that progress is being made toward an intended goal or objective. Indicators describe the evidence we can use to determine whether progress is being made toward that goal or objective. Indicators represent the valued attributes and characteristics of something, such as inquiry-oriented teaching and learning practices.

An example. The topical area is "Content of a Lesson." The objective is, "The content of a lesson will reflect teaching/learning that is standards-based and investigative." Indicators might include: Success will be reflected if a lesson includes important and worthwhile content, engages students intellectually with important ideas related to the lesson, portrays the subject matter as a dynamic body of knowledge, shows an understanding of the concepts/content of the lesson, makes connections between concepts/content of the lesson and previous and/or future lessons in the overall unit or to other subjects, and incorporates applications of the content/concepts to real-world situations.

Measures describe the specifics of how the dimensions of the indicator will actually be measured. Measures are the first step in operationalizing the procedures to be used to gather information pertinent to the indicator. For
teaching and learning practices, the method of data collection will be observation of a lesson and completion of the Observation Debriefing Instrument, which is based on a rating system for a set of indicators, with the observer providing supporting evidence for the rating.

SAMPI—WESTERN MICHIGAN UNIVERSITY

K-12 LESSON OBSERVATION SYSTEM—VERSION A AND B

DEFINITIONS OF INDICATORS

FOR A MATHEMATICS LESSON

What follows are the definitions for the indicators from the Lesson Observation Debriefing Form related to MATHEMATICS lessons—Versions A and B. For each mathematics indicator, there are focus questions/statements and pertinent examples of practices and behaviors related to the indicator. The examples are not considered to be exhaustive. The observer will likely see other pertinent practices and behaviors. THE OBSERVER SHOULD REFER TO THIS CHART TO BETTER UNDERSTAND THE INDICATORS. USE IT AS A REFERENCE TOOL WHEN COMPLETING THE LESSON OBSERVATION DEBRIEFING FORM.

INFORMATION ABOUT THE MATHEMATICS LESSON AND CLASSROOM

→ NOTE: A FEW OF THESE ITEMS ARE NOT INCLUDED ON THE MENTORING/COACHING VERSION (Version A) ←

| CODE NUMBER | The observer may want to assign a code number to the lesson being observed so it can be retraced later if needed. DO NOT PUT TEACHER’S NAME OR OTHER OBVIOUS IDENTIFIER ON THE FORM. The observer may want to keep a codebook. |
| DATE OF OBSERVATION, OBSERVER TIME OF OBSERVATION GRADE LEVEL NUMBER OF STUDENTS IN CLASS | Note date of the observation. Put your own name as observer. Note begin and end time for the observation. Note grade level(s) of students involved in the lesson. Note the number of students in the class. |
| Core subject matter of the lesson. | Indicate science, mathematics, social studies, language arts, or other. If Other, describe the subject area. |
| In a few sentences, describe the lesson observed—objectives, primary activities, where this lesson fits in the overall unit of study. | What mathematics subject area is being addressed—number sense, algebra, geometry, statistics, etc.? What is the unit of study of which this lesson is a part? What specific concept(s) and/or skill(s) is/are the focus of the lesson? What are the objectives for the lesson? Is this an introductory lesson, in the middle of a sequence, or a review lesson? |
| Indicate the primary intended purpose(s)—not specific objectives—of this lesson based on the pre-and post-observation interviews and what is learned during the observation. | Indicate only the major purpose(s) of the lesson. Many lessons may include all the listed purposes, but most are likely peripheral. Mark only those purposes central to the lesson. Select only from the left-hand list under item 3. |
| Briefly describe the instructional materials used in the lesson (e.g., textbooks, manipulatives, supplies, audio-visuals). Give specific names of materials being used. | List the name of textbook, program/project (such as Connected Math), kit materials, videos or other A-V materials being used. If the materials have been teacher-generated or teacher-assembled from various sources, indicate that. |
| Indicate MAJOR ways student activities were | Mark only major activity formats that apply. Some lessons include more... |
conducted over the entire course of the lesson. than one format during the lesson. Mark only those that are the primary formats central to the lesson.

6. Rate the arrangement of the room relative to how well it facilitates student interactions. Interactions include dialog between teacher and students and among students. They occur during small group work, pairing, and whole group work. How are desks/seats arranged – in straight rows, clusters of desks, tables, lab stations? Are the desks rearranged during the lesson to facilitate interactions? Consider the entire lesson period when assessing room arrangement.

PLANNING/ORGANIZATION OF THE MATHEMATICS LESSON
From pages 2 and 3 of the Debriefing Instrument

PLANNING/ORGANIZATION is concerned with the planning for, organization of, and structure of the lesson, not a written lesson plan. How were the activities organized and structured? Was it based on a pre-packaged program or was it teacher generated? How much time was allowed for specific activities or elements of the lesson? Were instructional strategies consistent with the activities or other elements of the lesson? Did the lesson take full advantage of available resources? Did the lesson take the developmental level and needs of the students into consideration? Did the design support the intended roles of teacher and students? Were appropriate safety precautions taken? Did the lesson incorporate use of technology?

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<tr>
<td>1. Does the lesson come directly from a pre-packaged mathematics program (i.e., kit, text series, modules, web-based program) with very few teacher modifications?</td>
<td>Lessons come from many sources. Was the lesson based on a pre-packaged commercial text series; district/school-produced materials, program, kit; or teacher-developed materials? Was the lesson taught as written, or was it modified in significant ways?</td>
<td>Schools/districts often purchase commercial programs with the necessary materials to conduct the lessons. Teacher teams may develop local materials. With new materials, teachers may be asked to teach them as written or it may be optional or necessary for the teacher to use or adapt materials from various sources.</td>
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<tr>
<td>2. Rate the adequacy of classroom resources (supplies, equipment) to support the lesson.</td>
<td>During the lesson, were appropriate and adequate resources available to conduct the lesson? This should include supplies, equipment, manipulatives, printed instructional materials, A-V materials, or technology (if used to support the lesson).</td>
<td>Deficiencies might include: insufficient or inappropriate equipment, measuring tools, or supplies; worksheets not clearly related to the objectives of the lesson nor that stimulate student thinking; texts and other printed materials irrelevant or inappropriate for the lesson; audio-visual materials not related to the lesson; not enough supplies, equipment, or materials to effectively complete the lesson.</td>
</tr>
<tr>
<td>3. Was the lesson organized to provide substantive teacher-student interactions?</td>
<td>Did the lesson build in opportunities for interactions between students and the teacher? This interaction can occur between the teacher and individual students, pairs, small groups, or the whole group.</td>
<td>Interactions with students focus on substantive lesson-related concepts, content, skills, and tasks. Interactions are not dominated by the teacher. There is adequate time for students to interact with the teacher (who may also facilitate student-student interactions). Interactions are not limited to giving instructions or casually exchanging information.</td>
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<tr>
<td>4. Was the lesson organized to provide substantive student-student interactions?</td>
<td>Did the lesson build in opportunities for students to interact and work with other students on lesson-related ideas/tasks? This can occur in pairs or small groups as well as whole group activities (often facilitated by the teacher). Does the lesson encourage student-student interaction, rather than focusing only on individual or whole group work?</td>
<td>Students actively work together in small groups or pairs to complete tasks; students converse about what they are learning; the teacher raises questions and poses problems that encourage student-student interaction on lesson-related topics and tasks as students work on tasks.</td>
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<tr>
<td>5. Were investigative</td>
<td>Investigative mathematics is characterized</td>
<td>Students pose questions and gather, record, analyze,</td>
</tr>
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### Mathematics Tasks

**Essential Elements of the Lesson Plan (e.g., Manipulation of Information to Help Make Sense of Content, Elements of Problem-Solving Situations, Connections to Real-World Experiences)?**

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<td>7. Was the lesson organized so that it appropriately addressed students' experiences, developmental levels, preparedness, and/or learning styles?</td>
<td>Were the instructional strategies and activities appropriate for the developmental level of the students? Did the lesson build on previous experiences of students? Were students previously engaged in activities that would have prepared them for this lesson? Was it designed as part of a sequence of activities and did it build on activities from previous units?</td>
<td>Both when a task is posed and during the work on it, the teacher reminds or asks students to recall relevant learning from earlier lessons or out-of-school experiences. Students with special knowledge or experience are called upon to serve as resources. Students demonstrate competence with the tools and processes they are expected to use (including cooperative learning) or are able to get assistance. Lessons include, as appropriate, activities involving individuals, pairs, small groups, and the whole group. A variety of activity formats (e.g., reading, writing, illustration, small groups, hands-on) are included.</td>
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<tr>
<td>8. Were adequate precautions taken and procedures incorporated to assure student safety in conducting the lesson?</td>
<td>Activities using mathematics equipment and/or manipulatives were designed to eliminate or minimize misuse or potential accidents. They were conducted to minimize possible injury to students or teacher.</td>
<td>As appropriate, the teacher carefully discusses safety rules and procedures for the activity. Safety rules are enforced during the lesson. Students use equipment appropriately and with regard for others.</td>
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<tr>
<td>9. Did the lesson incorporate student and/or teacher use of technology (i.e., computers, calculators, detectors/monitoring equipment)?</td>
<td>Some mathematics lessons incorporate the use of computers, calculators, digital (computer-based) detectors and monitoring equipment, or other electronic technologies in the lesson itself. Was technology used in a significant way—either by students or the teacher—to support student learning of lesson concepts or skills?</td>
<td>Students use calculators individually, in pairs, and/or small groups to support problem-solving. Calculators are used by the teacher for demonstration or presentation. Students may use computers individually or in small groups or lab settings (to access the Internet, communicate with others, use mathematics software). The teacher may use computers for demonstration or presentation with whole class or small groups to manipulate or access information. Teacher or students may use monitoring equipment connected to computers or calculators; students and/or teacher may use video/digital camera equipment.</td>
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**Planning/Organization of the Mathematics Lesson Continued...**

From pages 2 and 3 of the Debriefing Instrument
IMPLEMENTATION OF THE MATHEMATICS LESSON
Pages 5 and 6 of 12 of the Debriefing Instrument

IMPLEMENTATION is concerned with how the teacher actually carries out the lesson based on the design. Are there effective and engaging interactions during the lesson? Is implementation likely to enhance student learning? Are the intended/planned strategies carried out effectively? Was there effective closure to the lesson?

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<td>1. The teacher appeared confident in facilitating this mathematics lesson.</td>
<td>Did the teacher seem knowledgeable about the topic of the lesson and able to respond to student questions? Did the teacher have the associated skills needed to investigate it? Was the teacher comfortable and fluent with the instructional strategies being used? If difficulties occurred, was the teacher able to regroup and refocus activities (or students) effectively?</td>
<td>Goals and objectives of the lesson are clear. The lesson is implemented in a seamless manner. The teacher isn’t hesitant about activities or concepts and, when not sure of an answer or problem, responds by trying to find an answer or seek a solution. The teacher accepts alternative solutions or ideas and knows how to help students evaluate their appropriateness.</td>
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<tr>
<td>2. Periods of student-teacher interaction were probing and substantive (questioning and dialog emphasized higher-order thinking and deep understanding and exposed students’ prior knowledge).</td>
<td>High-level questions (application, analysis, synthesis, evaluation) are used to challenge student thinking; other forms of dialog are used that lead to student understanding of the lesson concepts (impacting information, offering ideas about where to search out more information, asking for more explanation, etc.).</td>
<td>Substantive questions are asked of individuals or small groups, and the whole group; questions challenge students to justify or provide evidence for their ideas and contentions, apply their ideas to other mathematics and/or real-world situations, gather ideas from various experiences to understand something, and/or evaluate a situation; questions challenge students to think about alternative solutions and differences of opinion.</td>
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IMPLEMENTATION OF THE MATHEMATICS LESSON CONTINUED . . .
Pages 5 and 6 of 12 of the Debriefing Instrument

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<td>3. Classroom management was effective in engaging students in the lesson.</td>
<td>Classroom activities are managed in ways that engage students in their own learning. Needed materials are readily available. Individual and small group work is monitored to assess progress and problems. The focus is on managing for learning, not just managing behavior.</td>
<td>Classroom instruction and behavioral expectations are clear. Students are engaged in substantive whole group, small group, and/or individual activities with the teacher coaching, facilitating, and challenging students to learn, but not dominating the conversation and interaction. A level of order is maintained that is conducive to learning without imposing heavy-handed discipline procedures. There is appropriate order, but also enough freedom and flexibility for students to engage with each other and with the materials and equipment.</td>
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<td>4. The pace of the lesson was appropriate for the developmental levels of the students.</td>
<td>The lesson is carried out with enough time for students to complete tasks and converse about their work. Time is not so short that activities cannot be adequately completed nor so long that students lose interest or the lesson drags on.</td>
<td>All students have sufficient time to engage in the tasks. The teacher monitors student progress and adjusts time periods during the lesson to accommodate the pace at which students complete tasks. Long tasks are broken up as appropriate and refocused using summary or reflection periods.</td>
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<tr>
<td>5. Periods of student-student interaction were focused on pertinent lesson</td>
<td>Small group work and cooperative learning groups are organized and arranged so that there is appropriate and substantive student interactions that lead to improved understanding.</td>
<td>Students in small groups work together to solve a problem or seek an answer, sharing with each other what they are learning, and helping each other, especially those having difficulty; students support each other during the lesson.</td>
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content and enhanced individual understanding of it.  

| 6. The lesson was organized so there was adequate time for students and/or the teacher to reflect on the lesson and its content. | Did students – individually, in small groups, or the whole group with the teacher – have time and appropriate structure to think about and discuss what they were learning as a result of the lesson? Did they pull together what they have learned so far and perhaps identify questions they still have? Did they make connections between this lesson and prior learning? | Time is set aside for reflection. Students compare and discuss solutions, debate the pros and cons of their solutions, or discuss what they have learned. The teacher solicits ideas or alternate solutions to a problem or question, and challenges students' ideas. Students might write in journals. Reflection can occur at any point in the lesson. It might be part of a KWL exercise. |

| 7. The lesson was organized so there was adequate time for wrap-up and closure of the lesson. | Was time provided for students and/or the teacher to bring an appropriate level of closure to the lesson? If full closure is not expected until future lessons are complete, was there adequate wrap-up of this lesson in preparation for future lessons? If the work is ongoing, did students have a chance to assess their progress and plan next steps? If homework was assigned, did it contribute to helping students bring closure to lesson ideas? | The teacher reviews student work progress, what students said they have learned, or student solutions to a problem. Students in small groups or individually complete charts, graphs, or other representations of their conclusions about the work. Student work is related back to lesson objectives. The teacher challenges students to apply ideas from the lesson to new circumstances or real-world situations. Homework is assigned in a way that leads to students’ confirming or reinforcing what they have learned. |

CONTENT OF THE MATHEMATICS LESSON

From pages 6, 7, 8, and 9 of 15 of the Debriefing Instrument

CONTENT is concerned with the basic ideas and concepts associated with a lesson, as well as the necessary skills needed to accomplish the tasks of the lesson. The conceptual understanding and skills that students are expected to acquire will depend on the purpose of the lesson.

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<td>1. The mathematics content was important and worthwhile.</td>
<td>Content of the lesson is not focused on trivial or extraneous concepts and skills. Concepts are significant and directly relevant to curriculum standards and benchmarks and what students are expected to know. Skills are important and necessary to help students engage in the processes and procedures of mathematics that provide information and insight into the concepts being addressed.</td>
<td>Lesson concepts are consistent with accepted state and national mathematics standards or curriculum objectives; the lesson does not focus on trivial or minor concepts and is not focused largely or only on facts and factoids; skills developed during the lesson might include problem-solving, computation, comparing and contrasting, hypothesizing, questioning, collecting and recording data, communicating (i.e., listening, discourse, writing), reading, logical thinking, organizing and representing findings.</td>
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<tr>
<td>2. Students were intellectually engaged with important ideas related to the focus of the lesson.</td>
<td>Students seek answers to important questions or problems relevant to the lesson, gather appropriate information to address them, and discuss what they find with other students and the teacher.</td>
<td>Students are engaged in substantive discourse with each other and the teacher about the concepts, their findings from the exercises, or their ideas about what they have learned, or the meaning of key concepts. Students do more than just guess. They consider multiple perspectives.</td>
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<td>3. Mathematics was portrayed as a dynamic body of knowledge enriched by conjecture, investigation, analysis,</td>
<td>Were tasks and activities complex and open-ended, or did they lead to obvious or &quot;canned&quot; answers or solutions? Were alternative solutions explored? Was the point made that investigations do not always yield &quot;right&quot; answers? Were students expected and able to defend</td>
<td>The teacher and students raise questions and issues around alternative solutions, introduce confounding factors, or challenge each other’s contentions; students question each other’s ideas and offer alternative solutions; students do more than just provide &quot;canned&quot; answers to questions.</td>
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<td>and/or proof/justification.</td>
<td>their ideas and solutions?</td>
<td>Lesson activities, questions, and assignments reflect substantive understanding of the concepts. Information about important concepts – whether provided by the teacher or students – is accurate or it is subjected to careful examination. Teacher questions challenge students to think more deeply rather than simply recite facts and “canned” answers.</td>
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<td>4. The teacher showed an understanding of the mathematics concepts and content that were the focus of the lesson and the topical/conceptual area being addressed by the lesson.</td>
<td>The teacher has adequate grasp of the lesson concepts to help facilitate student learning without giving or expecting “canned” answers or solutions. The teacher’s presentation of mathematics concepts/content is accurate. The teacher understands the skills needed to effectively accomplish the activities and tasks in the lesson.</td>
<td>In teacher presentations and questioning, connections are made to past activities and units as well as how the current lesson builds knowledge, understanding and skills for future lessons. Students are challenged to make connections to deepen their understanding.</td>
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<td>5. The lesson included connections between concepts/content in this lesson and/or previous or future lessons in the overall unit or topic being addressed.</td>
<td>Substantive connections are made between the key ideas and processes of the current lesson and previous or future mathematics units/topics. Connections are made to show how the current mathematics topic intersects with others. Activities or discussion are used to show how mathematics supports other subjects and vice versa.</td>
<td>The teacher asks questions or discusses how the core ideas of the current lesson relate to previous or future mathematics units/topics. Students and teacher identify and/or discuss connections to other subjects.</td>
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<tr>
<td>6. The lesson included connections between this lesson and other areas of mathematics and/or other subjects.</td>
<td>The teacher incorporates applications of the mathematics content/concepts to real-world situations. Activities and/or discussions exhibit or address ways to apply lesson concepts to real-world situations. Where appropriate, school and classroom settings, were used to illustrate relevant concepts.</td>
<td>Students may be given real-world scenarios in which to apply the concepts of the lesson. Students may be asked to identify ways in which the ideas of the lesson are pertinent to their lives. Students may be asked to design something that incorporates the ideas of the lesson. Examples from engineering or other applied sciences, or the social sciences, might be used. Students discuss with each other or the teacher how what they have learned applies to the real world; the teacher solicits or provides examples of how lesson concepts apply to real world situations; activities might incorporate or be actual real world applications.</td>
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<tr>
<td>7. The lesson incorporated applications of the mathematics content/concepts to real-world situations.</td>
<td>The teacher puts the lesson concepts in larger contexts, such as more general theories or mathematical principles. Solutions to problems or answers to questions may require students to create a &quot;model&quot; (drawings, descriptions, physical models) that represents their findings or understandings of the concepts.</td>
<td>There is discussion about how the concepts fit within a mathematical theory; students create models that depict the concept or set of concepts; students discuss with the teacher or each other the relationship of the lesson’s concepts to mathematical theories. (Note: Theories are ideas that explain, predict, or describe a natural phenomenon. Models are representations of an idea or concept, not replicas or miniature versions of a natural or human-produced object.) In mathematics, models are represented in graphs, data sets and data tables, algorithms and formulas, mathematical</td>
</tr>
<tr>
<td>8. The lesson included abstractions (mathematical theories and models) as appropriate.</td>
<td>Activities and/or discussions exhibit or address ways to apply lesson concepts to real-world situations. Where appropriate, school and classroom settings, were used to illustrate relevant concepts.</td>
<td>Students may be given real-world scenarios in which to apply the concepts of the lesson. Students may be asked to identify ways in which the ideas of the lesson are pertinent to their lives. Students may be asked to design something that incorporates the ideas of the lesson. Examples from engineering or other applied sciences, or the social sciences, might be used. Students discuss with each other or the teacher how what they have learned applies to the real world; the teacher solicits or provides examples of how lesson concepts apply to real world situations; activities might incorporate or be actual real world applications.</td>
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CLASSROOM CULTURE IN WHICH THE MATHEMATICS LESSON WAS CONDUCTED

Pages 10 and 11 of the Debriefing Instrument

**CLASSROOM CULTURE** is concerned with the classroom climate, the level of engagement of students in activities and tasks, and the nature of the working relationships among students and between students and the teacher.

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<tr>
<td><strong>1. Active participation of all students was encouraged and valued.</strong></td>
<td>Students are actively engaged in activities and tasks. Specific efforts are made to engage all students, including connecting their prior experiences, interests, and personal lives. There is appropriate recognition of that participation. Teaching/learning accommodations are made for students with special needs.</td>
<td>All students are actively involved in small group activities, engaged in small group and whole group instruction, engaged and motivated to participate in activities; the teacher actively seeks to involve reticent or unmotivated students; the teacher verbally and in other ways recognizes appropriate and exceptional participation; special needs students receive assistance or the lesson or activities are modified to more fully engage special needs students.</td>
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<tr>
<td><strong>2. The teacher showed respect for and valued students' ideas, questions, and/or contributions to the lesson.</strong></td>
<td>The teacher accepts all ideas without making judgments or until there has been more discussion. Students are encouraged to offer alternative solutions. No ideas are dismissed out of hand. Students are expected to &quot;make a case&quot; for their ideas.</td>
<td>The teacher solicits ideas from all students, accepting them without judging them immediately. Students are expected to discuss and defend their ideas. The teacher values the discussion and encourages conversation among students about the ideas.</td>
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<tr>
<td><strong>3. Students showed respect for and valued each other's ideas, questions, and/or contributions to the lesson.</strong></td>
<td>Discourse associated with sharing ideas valued. Students accept each other's ideas without ridicule, &quot;put downs,&quot; or trying to impose their own ideas. Students feel sufficiently comfortable and committed to ask for explanations. They attempt to understand others' reasoning. They explore other ideas or alternative explanations.</td>
<td>Students in small or whole group interactions accept and discuss alternative ideas; students do not dismiss someone else’s ideas out of hand; students may challenge the idea with counter-arguments. The teacher encourages constructive conversation and debate.</td>
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**CLASSROOM CULTURE IN WHICH THE MATHEMATICS LESSON WAS CONDUCTED CONTINUED . . .**

Pages 10 and 11 of the Debriefing Instrument

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<td><strong>4. The classroom climate for the lesson encouraged all students to generate ideas, questions, conjectures, and/or propositions.</strong></td>
<td>There is a trusting, risk-taking atmosphere in the classroom. Students are not afraid to express their opinions and share their ideas. Multiple perspectives are considered thoughtfully rather than arguing stubbornly for one's own position. Dominating voices were reminded to allow for alternative opinions.</td>
<td>Students readily share ideas and the teacher solicits ideas and recognizes and values them; the teacher provides adequate time for discussion of alternative ideas; students and the teacher challenge each other’s ideas.</td>
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<tr>
<td><strong>5. Student-student interactions reflected collaborative working relationships.</strong></td>
<td>Students work together in pairs and small groups or as teams to complete assignments, activities, and tasks. In whole group sessions, student interactions and discussions are constructive and contribute to task completion and improved understanding. Students know</td>
<td>Students coordinate their effort and work as a team, making assignments, soliciting ideas from each other, sharing responsibilities, challenging each other's ideas; students are able to identify the tasks and go about completing them as a group; no one student dominates the group or pair; all students have a role to play in the group. In whole group</td>
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how to engage each other in discussion and action, and question each other respectfully. sessions, students are actively engaged in the discussion or other interactions, with no student pre-empting the others.

6. Teacher-student interactions reflected collaborative working relationships. The teacher and students work together to solve problems and seek answers to questions as they develop conceptual understanding and scientific skills. Teachers facilitate, but do not dominate, the discourse or activities. The teacher and students coordinate their efforts, interacting in open and non-judgmental ways, and accepting each other’s ideas. Once the task is defined and understood, the teacher supports students in their work and facilitates (but does not do) their work.

7. Sensitivity to issues of gender, race/ethnicity, special needs, and/or socio-economic status is shown by the teacher and students. In language and behavior, the teacher recognizes and values differences in students and encourages students to recognize and value differences among their fellow students. The teacher does not stereotype students nor favor particular students. Disrespectful actions are promptly dealt with. Unique perspectives are recognized and valued. The teacher respectfully addresses students and encourages mutual respect among students. Opportunities are taken to debunk stereotypes, to discourage dominance of individual students in class activities and to encourage reticent students to be more involved. Special needs of individual students are appropriately addressed.

USE OF TECHNOLOGY TO SUPPORT THE LESSON
Pages 12, 13, and 14 of the Debriefing Instrument

USE OF TECHNOLOGY TO SUPPORT THE LESSON is concerned with the ways and degree to which information and other electronic technology is used to support teaching and learning in the context of the lesson.

1. List the major type(s) of technology hardware being used by the teacher and students to support the lesson. Indicate what hardware is being used, separately for the teacher and students. Examples: computers, computer and projector combination, calculator, electronic sensor (probes, detectors, etc.), video cameras, digital cameras.

2. List the major type(s) of software or programs being used to support this lesson (such as word processing, spreadsheets, mapping software, desktop publishing, PowerPoint, video production). Be as specific as possible about the software version being used. In addition to the general types of software as listed to the left, indicate specific software name, such as Microsoft Office, PowerPoint, Excel, Geometer Sketchpad, etc. Only the major types should be listed.

3. Student technology use arrangement. Mark only major use arrangements that apply. Some lessons may include more than one arrangement during the lesson. Mark only those that are the primary arrangements and central to the lesson.

4. Indicate the primary intended purpose(s) for which technology was used. Indicate only the major purpose(s) for which technology is used. Occasionally a lesson may use technology in more than one way to support the teaching and learning. However, only those purposes central to the lesson should be checked.

5. If this lesson is part of a curriculum unit or series of lessons, is technology used to support other lessons in the unit or series? In the pre- or post-observation interview, determine if technology is used to support other lessons in the unit. Or is this the only time technology is used?

USE OF TECHNOLOGY TO SUPPORT THE LESSON CONTINUED . . .
Pages 12, 13, and 14 of the Debriefing Instrument

6. In using the technology and/or accessing information through technology, were students limited to specific procedures or sources devised by the teacher or dictated by the Indicate whether students had some discretion or opportunity to go beyond prescribed procedures, websites, particular exercises, or specific tasks. Or were they confined to a relatively narrow range of options/
# Instructional materials?  (Note: This may vary by grade or student skill level.)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Focus Questions/Statements</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Technology resources were adequate to support the lesson.</td>
<td>During the lesson, were appropriate and adequate technology resources available to conduct the lesson? Were there enough computers or other hardware for students to reasonably complete the assignments or tasks (even if sharing was necessary)? Was the equipment adequate to support the software? Was the equipment in reasonably good working condition? Was the equipment or software adequate to support the assignments or tasks?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Focus Questions/Statements</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Technology use was effectively integrated into this lesson (not an “add-on” or novelty).</td>
<td>Did technology use seem to be a natural progression of lesson activities, or did it seem to be used as a novelty or as an activity to teach technology use rather than to develop lesson-related concepts?</td>
<td>The teacher introduces technology use in the context of the lesson purposes or objectives. Students use technology to gather background information; to collect, store, share, and/or analyze data; or to organize information for presentation.</td>
</tr>
<tr>
<td>9. The use of technology enhanced student learning of the lesson’s core concepts/content.</td>
<td>Did technology use play a significant role in advancing student learning relative to the goal of the lesson? If technology use was the focus of instruction, was the purpose of its ultimate use in the classroom also made clear?</td>
<td>Students use technology to access or collect information otherwise unavailable or to organize information for presentation. Students use technology to document and reflect on their increased understanding of concepts. The teacher uses technology to present information otherwise unavailable to students or to demonstrate its use to students.</td>
</tr>
<tr>
<td>10. The use of technology supported real-world application of the lesson concepts/content.</td>
<td>Was technology use associated with real-world applications of the lesson content rather than with a “school-only” use? Did it widen access for information gathering – especially to information that might have immediate or local usefulness? Did it provide a venue for information sharing? Did it help students practice the work of scientists?</td>
<td>Technology use provides access to information sources related to students’ lives or to local issues and concerns; to professionals in the field; or to appropriate public forums for information sharing. Technology use duplicates processes scientists use to conduct and disseminate their work, enabling students to “do” mathematics.</td>
</tr>
<tr>
<td>11. Technology use enhanced the ability of students to collaborate with each other.</td>
<td>Did technology use assist students in working together? Did it improve their ability to access and share unique or specialized information that could contribute to completion of the group’s task? Did it allow for review and questioning among all students?</td>
<td>Students use e-mail or list-servs to communicate with each other or with professionals about a lesson or project. Students use technology to access information that they will then share with each other to improve understanding of course concepts or content. Students contribute to a shared database from which all students work to see patterns and make sense of data.</td>
</tr>
<tr>
<td>12. Classroom management was effective in engaging students in the use of the technology.</td>
<td>Did the teacher manage classroom activities in ways that engaged all students in the use of technology to support learning of the lesson?</td>
<td>Students understand how to use the technology and proceed to use it as intended to support the lesson. If instruction is needed in its use, it is handled effectively and efficiently by the teacher or other students. If students have to take turns using technology, there are other tasks to perform while waiting.</td>
</tr>
<tr>
<td>13. The teacher shows skills and ability in using the technology to support student learning (consider both technical skills and lesson design).</td>
<td>Did the teacher operate the technology effectively? Did the teacher problem solve or adapt if technology failed? Did the teacher explain the benefits of technology use in engaging students or assisting them in learning lesson concepts?</td>
<td>The teacher clearly explains the steps and/or rationale for technology use. Usage questions are quickly answered. If the technology isn’t working properly, the teacher can fix it or suggest an alternative approach to continuing work on the task. The benefits of using technology have been carefully thought out and are explained to students.</td>
</tr>
</tbody>
</table>
APPENDIX F

INTERVIEW PROTOCOL
APPENDIX F. Interview protocol, probing questions included.

1. (Experience) How long and in what capacity have you been in education?
2. (Experience) What subject area/grade level do you teach?
3. (PD) Was your goal met in the place-based professional development?
4. (Efficacy) To what extent can you make your expectations or information clear to your students?
5. (Efficacy) How much can you do to improve the understanding of a student who is failing?
6. (Efficacy) How much can you do to get through to the most difficult students?
7. (Efficacy) Please tell me how you feel about teaching in general.
8. (PD) Have you used place-based methods in teaching prior to the training?
   (If so, please describe the process).
9. (PBE) What interests you in terms of using place-based methods in your own teaching?
10. (PBE, PD) What do you do with your students that represents place-based learning?
    What does that look like? How has that process changed?
11. (PD) What, if anything, do you find challenging about using PBE?
    (Why?)
12. (PD) Describe the local support you have with the use of place-based methods.
13. (Efficacy, PD) What experiences contribute to your confidence in implementing a place-based lesson?
14. (PD, PBE) How or in what ways do place-based methods impact your teaching? (How is this different from your teaching prior to your place-based training?)

15. (PBE) How would you describe your attitude toward place-based education in regard to its role in science education as an instructional tool? (How is this different from your attitude prior to your place-based training?)

16. (PBE) Do you feel place-based methods engage students more so than other instructional methods? (Why or why not?)

17. (PBE) What more can you tell me about your experiences with the use of place-based methods?

18. (Efficacy) What more can you tell me about your feelings about teaching science, in general?

19. (PD) What more can you tell me about how your teaching has changed in the past year?
APPENDIX G

UPDATED OBSERVATION DEBRIEFING FORM
FOR USE ONLY BY THOSE WHO HAVE COMPLETED CERTIFIED TRAINING
This form is only one component of a comprehensive lesson observation system.

SAMPI—WESTERN MICHIGAN UNIVERSITY
K-12 LESSON OBSERVATION DEBRIEFING FORM—PLACE-BASED VERSION
Complete this form using the observer’s notes and information from the pre- and post-observation interviews. Use the “Definitions of Indicators” tool as a reference. Complete as soon after the observation session as possible.

DATE OF OBSERVATION ______________________  OBSERVER ________________________

TIME OF OBSERVATION: Start ___________ End ___________ GRADE LEVEL ________ No. Students in
Class __

Place-Based Indicators:
* PB lessons should include a majority of these components

Thematic
Student interest
Set in place
Active, problem solving
Teacher-student interaction
Student-student interaction
Student community interaction
Authentic engagement in the place
Content, standards aligned
Environmentally focused

INFORMATION ABOUT THE SCIENCE LESSON AND CLASSROOM

1. Secondary subject matter of the lesson: □ Mathematics  □ Social Studies  □ Language Arts
□ Other. Please describe: ________________________________

2. In a few sentences, describe the lesson observed—objectives, primary activities, where this lesson fits in
the overall unit of study.

Description:

<table>
<thead>
<tr>
<th>If a Social Studies lesson, what general area:</th>
<th>If Language Arts lesson: What did you observe?</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ History  □ Geography  □ Economics  □ Civics/Political Science</td>
<td>□ Entire class only  □ Subgroup only  □ Multiple subgroups</td>
</tr>
</tbody>
</table>

3. Indicate MAJOR ways that student activities were conducted over the entire course of the lesson.

□ Whole group activity □ Small group activity □ Pairs of students □ As individuals
4. Rate the setting of the lesson relative to how well it facilitates student, community and teacher interactions.

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<tr>
<td></td>
<td>Inhibits interactions</td>
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<td></td>
<td>Facilitates interactions</td>
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</tbody>
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5. Indicate the primary intended purpose(s)—not specific objectives—of this lesson based on the pre- and post-observation interviews and what’s learned during the observation.

- [ ] Identify prior student knowledge
- [ ] Introduce new concepts
- [ ] Develop understanding of concepts
- [ ] Review concepts
- [ ] Learn processes/skills related to the subject matter
- [ ] Learn vocabulary/specific facts
- [ ] Show how a concept applies in the real-world
- [ ] Develop appreciation for the core ideas of the subject matter of the lesson
- [ ] Develop awareness of contributions of experts in the subject matter from diverse backgrounds
- [ ] Other. Describe: ____________________________

If a Language Arts lesson, check all that apply:
- [ ] Identify prior student knowledge
- [ ] Introduce/practice word recognition strategies
- [ ] Introduce/practice comprehension strategies
- [ ] Vocabulary development
- [ ] Development of spelling strategies
- [ ] Handwriting practice
- [ ] Composition
- [ ] Grammar
- [ ] Assessment of reading skills
- [ ] Assessment of writing skills
- [ ] Development of oral presentation skills
- [ ] Other. Describe: ____________________________

If a Social Studies lesson, also check any of the following that apply:
- [ ] Develop respect for democratic values
- [ ] Conduct a social science investigation
- [ ] Analyze public issues

6. Briefly describe the instructional materials used in the lesson (e.g., data collection tools, textbooks, modules, kits, software, web-based materials, equipment/supplies, audio-visuals). Give specific names/publishers of materials being used if available.

KEY ELEMENTS OF THE LESSON

In this section, rate each of the indicators or answer the questions in four areas: planning/organization, implementation, content, and classroom culture. Note that any single lesson may not provide enough evidence for every indicator or question. In that case, check the DON'T KNOW box (but only as a last resort). Note any other indicators you consider important to the lesson. Use the "Definitions of the Indicators" tool for clarification.

PLANNING/ORGANIZATION OF THE LESSON

1. Does the lesson come directly from a pre-packaged program (i.e., kit, text series, modules, web-based program) with very few teacher modifications?

   Yes  No  Don't Know
If yes, name of program and specific lesson.

2. Rate the adequacy of classroom resources (supplies, equipment) to support the lesson.

<p>| | | | | | | |</p>
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</table>

Few resources | Many resources

Supporting evidence for rating:

3. Indicate MAJOR ways that student activities were conducted over the entire course of the lesson.

- Whole group activity
- Small group activity
- Pairs of students
- As individuals

If yes, what is the evidence?

4. Was the lesson organized to provide substantive student-student interactions?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
</table>

If yes, what is the evidence?

5. Were investigative tasks essential elements of the lesson plan (e.g., manipulation of information to help make sense of content, elements of problem-solving situations, connections to real-world experiences)?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
</table>

If yes, what is the evidence?

6. Was the lesson organized so that it appropriately addressed students’ experiences, developmental levels, preparedness, and/or learning styles?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
</table>

If yes, what is the evidence?

Planning and Organization Continued . . .

7. Was the lesson organized so that it appropriately addressed issues of access, equity, and/or diversity?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
</table>

If yes, what is the evidence?
8. Were adequate precautions taken and procedures incorporated to assure student safety in conducting the lesson?  
Yes No Don't Know

   If yes, what is the evidence?

9. Did the lesson incorporate student and/or teacher use of technology (i.e., computers, video/digital cameras, monitoring equipment, calculators)?  
Yes No Don't Know

   Note: If incorporation of technology was a major part of the lesson, complete the TECHNOLOGY TO SUPPORT THE LESSON section on PAGE 12 of this form.

10. Other comments about lesson planning/organization or other indicators of importance. Specifically, how did the lesson incorporate components of place-based learning; community engagement, resource use, application of student centered and community oriented components?

   IMPLEMENTATION OF THE LESSON Page 4 of 7

11. The teacher appeared confident in facilitating this lesson.  

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<tbody>
<tr>
<td>Limited confidence</td>
<td>Great confidence</td>
<td></td>
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</table>

   Supporting evidence for rating:  

   Don't Know

12. Periods of teacher-student interaction were probing and substantive (questioning and dialog emphasized higher-order thinking and deep understanding and exposed students' prior knowledge).

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<tbody>
<tr>
<td>Weak student-teacher interaction</td>
<td>Strong student-teacher interaction</td>
<td></td>
<td></td>
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</tbody>
</table>

   Supporting evidence for rating:  

   Don't Know

13. Classroom management was effective in engaging students in the lesson.

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<tbody>
<tr>
<td>Limited effectiveness</td>
<td>Very effective</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

   Supporting evidence for rating:  

   Don't Know
14. The pace of the lesson was appropriate for the developmental levels of the students.

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<tbody>
<tr>
<td>Poorly paced</td>
<td>Well paced</td>
<td></td>
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</table>

Supporting evidence for rating:

15. Periods of student-student interaction were focused on pertinent lesson content and enhanced individual understanding of it.

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</tr>
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<tbody>
<tr>
<td>Interaction not productive</td>
<td>Interaction very productive</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Supporting evidence for rating:

**IMPLEMENTATION CONTINUED**

Page 5 of 7

16. The lesson was organized so there was adequate time for students and/or the teacher to reflect on the lesson and its content.

<table>
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<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little or no time devoted to reflection</td>
<td>Considerable time devoted to reflection</td>
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<td></td>
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</table>

Supporting evidence for rating:

17. The lesson was organized so there was adequate time for wrap-up and closure of the lesson.

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<tbody>
<tr>
<td>Little or no time devoted to closure</td>
<td>Considerable time devoted to closure</td>
<td></td>
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</table>

Supporting evidence for rating:

18. Other comments about lesson implementation or other indicators of importance.
OVERALL RATING FOR IMPLEMENTATION OF THE PLACE-BASED LESSON

The overall rating represents the observer’s best summary judgment of the appropriateness and quality of the lesson IMPLEMENTATION. Overall ratings are not necessarily intended to be the numerical average of the ratings of the indicators for Implementation of the Lesson. There may be other factors that influence an overall rating.

Implementation of the lesson
not at all consistent with best practice in standards-based inquiry-oriented teaching and learning

Implementation of the lesson
very consistent with best practice in standards-based inquiry-oriented teaching and learning

CONTENT OF THE LESSON

1. The content of the lesson was important and worthwhile.

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</tr>
</thead>
</table>
   Important content
   Trivial content

   Supporting evidence for rating:

   Don’t Know

2. Students were intellectually engaged with important ideas related to the focus of the lesson.

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<thead>
<tr>
<th>1</th>
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<th>7</th>
</tr>
</thead>
</table>
   Significant engagement
   Limited engagement

   Supporting evidence for rating:

   Don’t Know

3. The subject matter was portrayed as a dynamic body of knowledge enriched by conjecture, investigation, analysis, and/or proof/justification.

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</tr>
</thead>
</table>
   Strong portrayal
   Limited portrayal

   Supporting evidence for rating:

   Don’t Know

4. The teacher showed an understanding of the concepts and content that were the focus of the lesson and the topical/conceptual area being addressed by the lesson.

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<tr>
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</tr>
</thead>
</table>
Limited understanding

Strong understanding

Supporting evidence for rating:

Don't Know

5. The lesson included connections between concepts/content in this lesson and/or previous or future lessons in the overall unit or topic being addressed.

1 2 3 4 5 6 7
Weak connections Strong connections

Supporting evidence for rating:

Don't Know

CONTENT CONTINUED . . .

Page 7 of 7

7. The lesson incorporated applications of the content/concepts of the lesson to real-world situations.

1 2 3 4 5 6 7
Limited applications Strong applications

Supporting evidence for rating:

Don't Know

OVERALL RATING FOR CONTENT OF THE LESSON

The overall rating represents the observer’s best summary judgment of the appropriateness and quality of the lesson CONTENT. Overall ratings are not necessarily intended to be the numerical average of the ratings of the indicators for Content of the Lesson. There may be other factors that influence an overall rating.

1 2 3 4 5 6 7
Insignificant or trivial content addressed in the lesson Significant content consistent with standards and benchmarks addressed in this lesson
APPENDIX H

SAMPI APPROVAL LETTER
October 23, 2014

Tamara Coleman
677 Lovett Ave SE
Grand Rapids, MI 49506

Dear Tamara,

This letter is to confirm that Tamara Coleman participated in the SAMPI Lesson Observation System workshop in May 2011. The purpose of the workshop was to learn about observation of inquiry-based teaching and learning in K-12 classrooms and how to measure it with the Observation system.

Having been trained on the use of the Lesson Observation system, you are allowed to use the system for your own research and evaluation activities.

SAMPI (Science and Mathematics Program Improvement) is an outreach Center of the Mallinson Institute for Science Education and Western Michigan University. SAMPI focuses on evaluation of STEM education programming at the K-12 and higher education levels.

Questions about the workshop can be directed to Dr. Mark Jenness (mark.jennness@wmich.edu).

Sincerely,

[Signature]
Mark Jenness, Ed.D.
Senior Researcher
APPENDIX I

NVIVO 10 ANALYTIC STRATEGY
APPENDIX H: NVivo 10 Analytic Strategy.

In order to enhance the rigor of this study, an overview of the analysis process is guided by Yin (2003, 2009). According to Yin (2003), the goal of analysis is the building of an explanation or answers to the research questions, based on evidence. The evidence is determined by the sources of data, depicted in Figure 4. The steps in this process as they pertain to this study include:

1. Teacher and researcher reflections were hand-written. Six verbal, initial interviews were recorded using Dragon Naturally Speaking and then transcribed to elucidate reflections and make the nuances more accessible in written presentation and to maintain researcher contact with the data. These interviews were studied for nuances of language, inflection, and speech patterns in discussions of place-based education and its interaction with teacher efficacy by examining them line by line, using colors to develop patterns as they emerged from the reading.

2. Six observations, totaling 14 hours, were recorded using Dragon Naturally Speaking and then transcribed. After the transcription was complete, accuracy was confirmed through discussion with the participants and interrater reliability with two qualified individuals who reviewed the transcripts and transcriptions.

3. Cross-checking codes: Codes were cross-checked in a systematic manner by participants and interraters so that validity and reliability of coding was assured. The interraters are a colleague who works in the education department and holds a PhD in Science Education and
Evaluation and a colleague who holds an Ed D and is the director of a place-based program.

4. Post-observation interviews asked respondents for confirmation of behaviors that are self reported, such as clarifying specific examples of behaviors that support assertions by the participant being interviewed. Member checking was conducted by verbally confirming the researcher perspective with participants in a follow up interview.

**Coding.** Coding is a process of organizing the data and discovering patterns within the structure of the study. Coding is at the heart of qualitative research because it is during this process that the data provide answers to the research questions (Merriam, 2009). The first step in coding is to read through the research questions (Yin, 2009) to highlight the design of the study and to allow the research questions to guide the process. Farah (2011) suggests the use of “message units” (Yin, 2003) which for this study align with the concept of efficacy as seen in Figure 1 and address the research questions. These message units are the codes which can be words, phrases, numbers or a combination of these (Merriam, 2009). Message units that were expected to emerge from this study as a result of the literature review (Farah, 2011) include **personal codes** (“attitude, stress, scares”), **mastery** (“often, learn, use, experiment”), **behavioral** (“risk-taker, innovative”) and **environmental** (“support, time, opportunities”) codes. Codes also include items such as years of teaching experience, gender, etc.

The process for identifying codes included examining the transcribed or written data line by line and the use of colors to code each message unit, eventually moving the coded data into categories as they align with Farah’s (2011) suggested use of efficacy
concepts. An open coding process was used to allow the data to emerge as the study progressed and to enable me to look for units of meaning that appeared frequently and related to the research questions. Merriam (2009) suggests open coding, being mindful of the fact that the data for this study is expansive.

Coding software, NVivo 10 assisted in the storage and management of data. A disadvantage of using the software is that it separates the researcher from the data and may, when used inappropriately, limit personal contact with the data, but advantages of using management software is that it allows the researcher to store and efficiently organize the vast amount of data emerging from a study such as this. It is not intended to replace the researcher’s relationship to and analysis of the data (Merriam, 2009), however. The codes were revised and constantly reviewed as more text was examined. Trends and repeating units were examined and compared throughout the process. This is useful when attending to differences that might exist such as the levels of experience of the teachers.