

MOTIVATION AND PEDAGOGICAL ECOLOGY OF
SCHOOL-BASED OUTDOOR SCIENCE TEACHING:
A MULTIPLE CASE STUDY

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree

of

Doctor of Education

in

Curriculum and Instruction

MONTANA STATE UNIVERSITY
Bozeman, Montana

April 2019

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DEDICATION

I'd like to dedicate this work to two groups of individuals, without whom this dissertation would not exist. First, I dedicate this work to the three truly exceptional teachers I was fortunate to observe, learn and write about in this research. I am glad I had the opportunity to tell their stories. Their efforts to provide outstanding outdoor experiences for their students are inspiring to me, and I hope to other teachers who choose to take their students outdoors to learn about the amazing natural world outside their doors.

Finally, I dedicate this dissertation to my family who have supported me and believed in me through this whole process. My husband Greg and my daughter Fiona are the foundations for my inspiration and tenacity to complete this work. One of the best moments for me of doing this work was after they attended my dissertation defense, they let me know how much they understood my passion for the subject and how impressed they were with the results of my research. You two are my world, and I could not be more thankful.

ACKNOWLEDGEMENTS

A doctoral degree is a journey as well as a destination, and I can't imagine this journey without the exceptional, inspirational people I have met along the way. I think of you all with heartfelt thanks and appreciation.

In particular, I want to thank my advisor and my committee members for working with me with encouragement throughout my dissertation. Their collective guidance, insights, and enthusiasm were instrumental to my success. First, I want to thank Dr. Ann Ewbank, my advisor, whose unwavering, generous support and scholarly guidance made all the difference. I'm very pleased to be on the roster of her graduate advisees. I've been fortunate to have Dr. Bryce Hughes on my committee. His methodology help was critical, and sharing my insights with him helped me formulate my findings. When Dr. Jayne Downey agreed to join my committee I had the good fortune to work with someone with compassion, a discerning eye and deep integrity. Dr. Sarah Schmitt Wilson has been a solid presence in my graduate process from the start. She always brought her staunch support and strong sense of excellence to bear on my work, for which I deeply thank her.

Sharing the journey are the graduate students who mentored, commiserated and celebrated with me along the way. Amanda Obery, Catherine Gibbons Johnson, Spencer Johnson, and Kayte Kaminski, you are my heroes. Michelle Knickerbocker, Danette Long, Brett Tallman, Romola Bernard, and the rest of the Middle Earth denizens, I always felt at home with you all. For everyone, I'm proud to know such outstanding people and scholars

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ABSTRACT

This study examines why and how teachers incorporate school-based outdoor teaching in their pedagogies. Research demonstrates that students gain in a range of areas when learning outdoors, but teachers can face multiple barriers when considering outdoor teaching, and many choose not to teach outdoors. There is limited research about why and how successful teachers choose to plan and manage outdoor teaching. Using a multiple case study of three public-school teachers, in grades 4, 7, and high school, who have consistently taught outdoors for over 15 years each, the study addressed why exemplary teachers choose to teach outdoors and how exemplary teachers accomplish outdoor teaching. Each teacher constituted an individual case. Semi-structured interview responses, questionnaires, field observation notes, and video-recall interviews were coded and analyzed using NVivo software. Analytic narratives based on themes within the coded data were then developed for individual cases, followed by cross-case analysis of the three cases. The findings indicated that the teachers were motivated to teach outdoors by perceived positive student impacts, by outstanding available outdoor spaces, and by their personal connections to the natural world. Teachers plan and manage outdoor teaching, with administration and community cooperation, to take advantage of opportunities for students to engage in their local environment. These findings were synthesized into the Pedagogical Ecology of Outdoor Teaching (PEOT) model. The PEOT model includes teachers' motivations, contextual factors, and teacher-operational factors in sequential, iterative relationship, and illustrates the complexity and uniqueness of teachers' situations when considering outdoor teaching. Future research incorporating the PEOT model could analyze teachers' contexts and environmental connections to determine assets and needs in their situations. Action plans to address those needs could then be developed to assist teachers and districts to develop outdoor teaching opportunities.

CHAPTER ONE: INTRODUCTION

The raised bed vegetable garden at the local elementary school has been in place since the school was finished. When the school was built, edible berry bushes and fruit trees were chosen by the committee of teachers and parents as landscape elements, along with native shrubs and trees. Wetlands with an intermittent stream fill the front lawn; a walkway along the stream leads to a nearby city park, with ponds filled with fish and surrounded by groves of trees. The school board, principal and school district all support the use of the outdoor spaces on the school's campus at all grade levels. Of the more than 30 teachers in the school, only three teach outdoors with any regularity. Why do those teachers teach outdoors, and not the others? Little research has focused on why and how public school teachers successfully incorporate outdoor teaching in their pedagogy. Using a multiple case study method, I examine why and how three exemplary science teachers successfully incorporate outdoor teaching in their pedagogy.

The Case for Outdoor Science Teaching

The benefits of outdoor learning for students have been shown in the range of cognitive, social, behavioral, affective and physical areas. Evidence of the benefits of learning outdoors to students is shown in number of research reviews (Dillon et al., 2006; Malone, 2008; Rea & Waite, 2009; Rickinson, 2001). Evidence is strongest in cognitive, affective, psychological and physical areas, while there has been less attention given to social and spiritual benefits (Keniger, Gaston, Irvine, & Fuller, 2013).

Benefits in cognitive areas include increased student engagement (Kuo, Browning, & Penner, 2018), lasting knowledge gains, and higher skill attainment (Bentsen, Schipperijn, & Jensen, 2013; Cronin-Jones, 2000; Dillon et al., 2006; Kuo et al., 2018; Malone & Tranter, 2003; Martin, 2003; Rea & Waite, 2009; Rickinson, 2001; Waite, 2011). In the content areas of math, English Language Arts (ELA) and science, students show increased scores when outdoor learning is included in the curricula (Bentsen et al., 2013; Lieberman & Hoody, 1998; Lopez, Campbell, & Jennings, 2008; Martin, 2003; Waite, 2011). Classroom science investigations that include outdoor learning are shown to motivate students to generate more investigations (Blair, 2009; Carrier, Tugurian, & Thomson, 2013; Dymment, 2005; Waite, 2007). Research demonstrates that when students generate their own questions and research topics, they are motivated to develop research protocols to answer those questions and to investigate independently, increasing student engagement and knowledge retention (Becker, Lauterbach, Spengler, Dettweiler, & Mess, 2017).

Several studies have shown positive social and affective responses to outdoor learning in schools that incorporate outdoor teaching on a regular basis in their curricula, such as in the Forest School approach (Mygind, 2009; O'Brien, 2009; Roe & Aspinall, 2011). Outdoor learning can increase social equity and level social capital (Dymment & Bell, 2008). Engaging with the outdoor environment has been shown to increase social inclusion and development of identity, which can lead to the nurturing of a democratic approach to consideration of the rights of others (Aasen, Grindheim, & Waters, 2009; Bell & Dymment, 2008; Maynard, Waters, & Clement, 2013).

In Chawla's sweeping review of research into the benefits of nature for children (2015), she discusses the sense of well-being associated with being in nature ranges from health benefits to participatory play to a sense of belonging in nature. Research into the effects of green schoolyards on resiliency and stress levels in schoolchildren (Chawla, Keena, Pevec, & Stanley, 2014) shows that children experience positive moods and reduced stress, anger, inattention and problem behavior.

Outdoor play and time in nature has been recommended for physical activity as a prescription for childhood obesity and associated health disorders, vitamin deficiencies and other issues (McCurdy, Winterbottom, Mehta, & Roberts, 2010, Mygind, 2007). Students with attention-deficit disorders have responded with increased attention spans to time spend outdoors (Faber Taylor & Kuo, 2009). Benefits to cognitive function and mental health are indicated in a range of studies researched in the review by Bratman, Hamilton, and Daily (2012), including the seminal work by Berman, Jonides, and Kaplan (2008).

An important reason to spend time outside beyond the health benefits to students is to create opportunities for students to develop a connection with nature (Schultz & Tabanico, 2007), which can ignite an interest in science (Tugurian & Carrier, 2016) and spark pro-environmental behavior (Braun & Dierkes, 2016). One of the consequences of students spending time outdoors is that they may feel kinship with the natural world (Schultz, Shriver, Tabanico, & Khazian, 2004), develop compassion for the other living beings sharing their world, and gain a sense of the importance of environmental integrity (Liefländer, Fröhlich, Bogner, & Schultz, 2013). A common adage in environmental

education is that ‘you won’t care about what you don’t know’; research by Schultz (2001) empirically indicates that familiarity and connection with the natural world positively correlates with concern for quality of the environment. E.O. Wilson (1984) coined the term ‘biophilia’ to express the human need to connect with and be in relationship with the environment. Through being in contact with nature, people develop an environmental identity (Clayton, 2003), that can lead to pro-environment behavior (Devine-Wright & Clayton, 2010). In the current age of pressing environmental issues, students developing a connection to nature may be the necessary steps to enact change in our culture and society .

To summarize, we all need to spend time in nature, especially children, for a wide range of benefits and reasons. In our current culture, children are spending less time outdoors, with the majority of their daytime hours in a classroom. If we are to address the pressing needs of children to be outdoors, teachers can be part of the solution to get them outside.

Theoretical Framework

Experiential learning and social constructivist principles form the overarching theoretical framework for this research. The experiential learning principles put forth by Dewey (2007) and Kolb (1984) noted that learning that takes place in local environments becomes personally relevant and meaningful to students, creating deeper engagement with the subject material and fostering problem-solving through critical thinking. Social constructivist principles state that students construct meaning of their reality through interactions with their environment and with each other (Hausfather,

1996; Kim, 2001; Schunk, 2012). When students engage with the places where they live, they develop place-consciousness for the environment and culture of the place in which they live (Greenwood, 2013).

Place-conscious education incorporates experiential learning with social constructivist principles to describe a pedagogy in which students develop deep connections with their local culture and environment, enabling them to construct meaning of their place and their role in the shared reality of their educational setting (Greenwood, 2013; Gruenewald, 2003b). School-based outdoor teaching provides opportunities for students to experience relevant school learning in relationship to the world around them (McKenzie, 2008).

Two research studies, conducted in England and Scotland, provide lenses to begin to understand teachers' incorporation of outdoor teaching in their pedagogy. In the first study, an example of emergent pedagogy developed by teachers is shown in Sue Waite's research study (2011) conducted in England. Waite's research consisted of a survey of teachers throughout England (n=334, return rate 19%), followed by 5 case studies of selected individuals from the surveyed group, with the intent to study teachers' 'alternate pedagogy' in teaching and learning outside the classroom. In Waite's research into teachers' pedagogy, she noted the tension between teachers' desires and mandates to create student-centered, place-responsive pedagogy, yet also meet state-imposed standards measured through narrow assessment criteria. The study results indicated that teachers developed 'alternate pedagogies' to incorporate outdoor experiences in their teaching practices.

Waite observed that the level and types of ‘alternate pedagogies’ teachers chose to use indicated the degree to which teachers opted to achieve their prescribed standards, rather than critically engage with the standards and possibly be perceived as conflicting with policy. In the study, teachers who chose outdoor learning opportunities developed ‘alternate pedagogies’ out of passion for the potential for enjoyment and enrichment for their students, while contending with the barriers they felt were imposed by edicts such as National Curriculum requirements. Waite speculates that more adherence to a values-based pedagogy in place of a standards-based pedagogy may be fundamental to a wider incorporation of outdoor learning in classrooms.

The second study that informs this research is Mannion, Fenwick and Lynch’s (2013) analysis of an action research project involving 18 teachers in 4 teams, teaching at 4 different outdoor areas local to the teachers’ schools in Scotland. Mannion et al. (2013) described teachers’ incorporation of outdoor teaching in their practices as they collaboratively developed curriculum designed to offer students opportunities to interact with the environment during nature-based excursions. Teachers developed emergent pedagogy based on their experiences creating place-specific curriculum, both in response to their own personal reflections of their time spent at the outdoor sites, and students’ responses, questions, and interactions before, during and after the excursions. The teachers in the study by Mannion, et al. (2013), ranging from experienced to novice, found themselves orienting to and developing relationships with the places they took their students; they became responsive to their students’ experiences of place and to events experienced at the place they visited, such as wildlife sightings. The teachers

universally valued experiences that were student-directed and enjoyable. The theory of place-responsive pedagogy, in which teaching and curriculum explicitly use the environment to develop human-environment relationships, was proposed from the findings of the study .

Both studies illustrate some of the methods and motivations teachers operationalize when incorporating outdoor teaching in their pedagogy. The common themes of valuing student experiences and enjoyment, and recognizing and valuing developing relationships with place, provide a focus to begin to understand why and how teachers have proceeded in developing pedagogy around outdoor teaching by creating outdoor learning events for their students.

In this research study, Mannion et al. (2013)'s proposed theory, place-responsive pedagogy, is used as a framework to interpret the actions and motivations of the participating teachers. At the core of the theory, "place-responsive pedagogy involves explicitly teaching by-means-of-an-environment with the aim of understanding and improving human-environment relations." (p. 803). In place-responsive pedagogy, place-responsive educational events are framed as emergent teaching and learning opportunities as teachers and students respond to experiences from interactive relationships between themselves and the environment. 'Place', with all its inherent and specific attributes, holds a key role in those interactive relationships. The authors locate place-responsive pedagogy theory in "a larger process of curriculum-making that is derived from the conjunction of teachers' and learners' own experiences and

dispositions to place, and the experiences and events inherent to the place itself, including the activities of other living things” (Mannion et al., 2013, p. 803).

Place-responsive pedagogy is described as a ‘starting point’ for an emerging view of nature and culture in an ontology that is characterized by an awareness that people, places and activities exist in interconnected processes. Curriculum within place-responsive pedagogy can have an ‘element of becoming’, since it opens up teaching and learning to unexpected outcomes, experiences, and connections that may lead to new ways of thinking, learning and living within culture and nature.

The theory of place-responsive pedagogy in this research study may characterize and interpret the study teachers’ incorporation of outdoor teaching in their pedagogies. Place-responsive pedagogy may enable teachers to develop a more critical relationship to the curricula and pedagogy in use in their school contexts, and strengthen teachers’ endeavors to understand the biases of those curricula and pedagogy (Greenwood, 2013; McInerney, Smyth, & Down, 2011). The new understandings can lead to an evaluation of biases that may exist in relationships to land and the environment, seen in the pervasive impacts of settler colonialism and addressed in the move toward reinhabitation and land education (Tuck, McKenzie, & McCoy, 2014). That ideological lens may serve as one of the paths to interpreting study teachers’ motivations in including outdoor teaching in their curricula.

See Figure 1 for a diagram of the theoretical framework and conceptual focus of this research study.

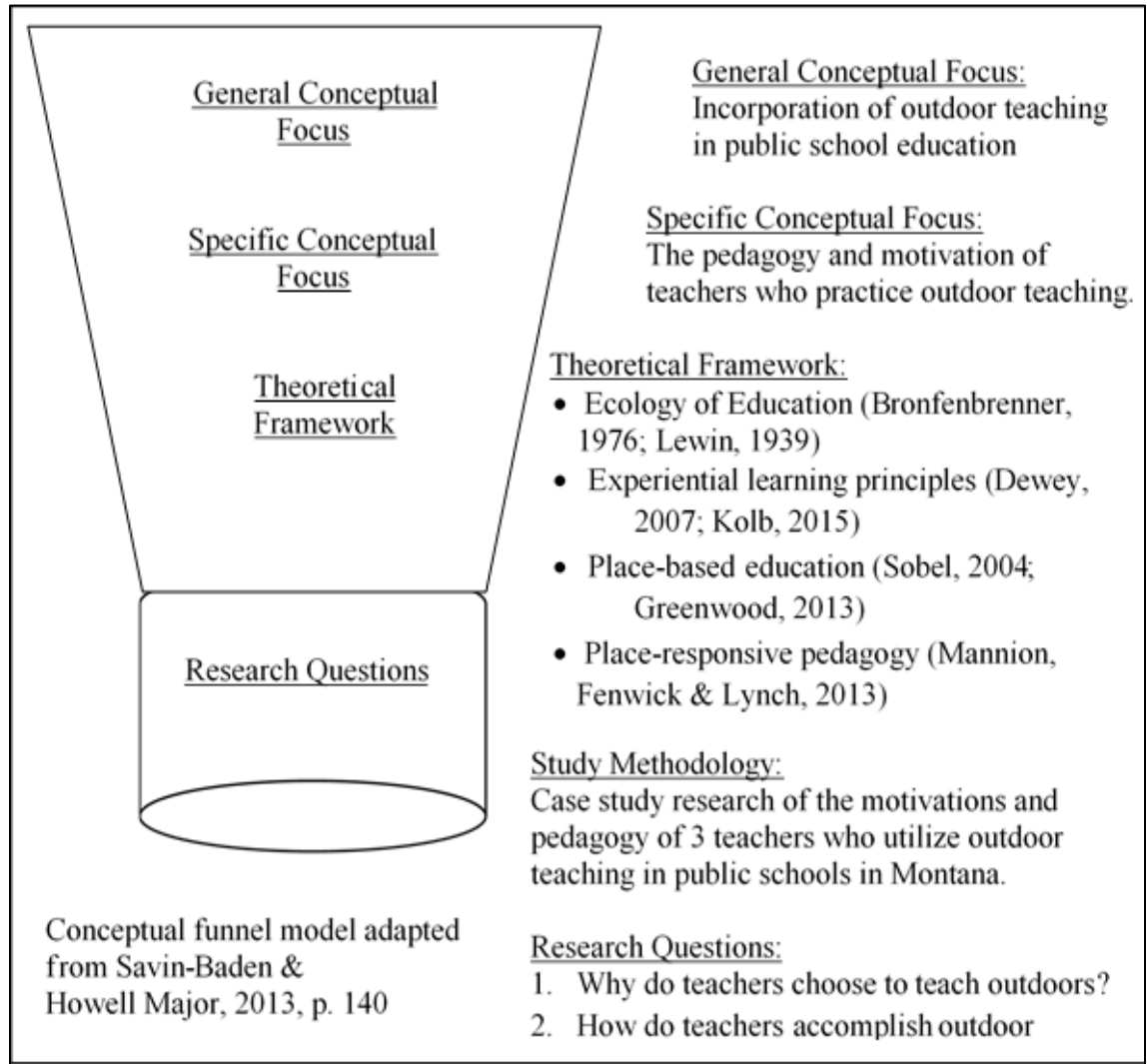


Figure 1. Research study graphic organizer

Personal Motivations for Research

My reasons for studying this issue stem from my own personal experiences spending time outdoors, as well as my experiences as a science teacher who incorporated outdoor teaching as much as I could in my career. My story is similar in many respects to the stories of the teachers in my research study, in that the deep and lasting value of my own outdoor experiences informs my current work. When I think of my connection to

learning and being outdoors, some of my earliest memories come to mind, chasing fireflies, watching the stars, and pulling carrots from my older brother's garden. Favorite family events often took place at the forest preserves and riverside parks near my home town in the Midwest. My refuge during high school was a picnic table in the woods with friends in some nearby natural area. I moved to Montana deliberately to spend time in wild landscapes where people were visitors, not residents. Through my love of the mountains and rivers of Montana, with their relatively intact ecosystems, I contrived to spend as much time outdoors as possible recreationally and in my various work positions, including as a geologist. I chose to eventually return to school for a science teaching degree after realizing, while running summer camps in Prague, that what I wanted to do was create opportunities for children to learn about the science of and develop connections to the natural world that were so important to me. In my experience, those connections have led not only to my health and well-being, but also to a strong commitment to environmental stewardship. I have noticed the same results in others as well.

In my professional capacity as a science teacher working in many public-school classrooms, and my work in after-school and summer science programs, I took students outside to learn about the natural world authentically, and personally saw their enthusiasm, curiosity and care for the environment blossom in outdoor settings. At the same time, I noticed that while teachers appreciated and approved of their students' time spend learning outdoors, most did not take students outside themselves. Observations of the constraints teachers face, counterbalanced with my own experiences of outdoor teaching, led to my wondering about those public school teachers who are successful in

taking students outdoors. Research into how successful teachers accomplish outdoor teaching was not extensive, and so I resolved to explore the issue in the hopes of providing insight and understanding that could benefit other teachers.

Statement of the Problem

The problem I am addressing in this research is why and how teachers successfully accomplish school-based outdoor teaching. The barriers to teachers' outdoor teaching are recognized and documented (Dillon, 2013; Ernst, 2007; Waite, 2009); what is not well known is how teachers who successfully incorporate outdoor teaching in their pedagogy achieve that accomplishment. What actions do exemplary teachers take to incorporate outdoor teaching in their pedagogy, and what are their motivations to take those actions to teach outdoors with their students?

For me, the compelling reason to understand the motivations and actions of successful teachers is that if students are to experience the benefits of learning outdoors, it is teachers in public school classrooms who determine whether their students will have opportunities to do so (Carrier et al., 2013; Ernst, 2007; Rea & Waite, 2009; Waite, 2011). The benefits to learning outdoors are well-documented ((Becker et al., 2017; Chawla, 2015; Dillon et al., 2006; Ernst & Monroe, 2004; Rickinson, 2001), as is the need to get children moving outdoors (McCurdy et al., 2010) and connected to nature (Chawla, 2015). It is my intention that understanding why and how successful teachers teach outdoors may make it possible to help other teachers understand what constitutes and enables outdoor teaching. If teachers are willing to do the work to teach outdoors,

there is a greater possibility that more children will benefit from time spent learning and being outdoors.

Background of the Problem

In general, I consider two elements to constitute the background of the problem this research addresses. First, teachers' options to teach outdoors have become increasingly limited in recent years (Waite, 2010). Second, children are spending much less time outdoors than they have in the recent past (McCurdy et al., 2010). In my estimation, these two elements combine so that students are increasingly isolated from connection with the natural world and opportunities to learn about science that are relevant, authentic, and interesting.

Factors that have led to teachers' limited options can act as the barriers that teachers feel they face when considering teaching outdoors (Dillon, 2013; Dymont, 2005; Rickinson, 2001). A major factor limiting teachers is the pressure for student achievement in general and on high-stakes tests specifically (Valli & Buese, 2007). The enactment of the No Child Left Behind (NCLB) (2001) policy established the need for annual year progress (AYP), to be measured by standardized tests, for students at certain grade levels in all public schools. While NCLB was replaced with the Every Student Succeeds Act (ESSA) (2015), state-administered standardized test scores are still the benchmark for measuring student success in public schools. For elementary school teachers, who take a generalist approach in teaching all subjects, the focus is on pedagogy and curricula in English Language Arts (ELA) and math, with less time devoted to other content areas such as science, social studies, art and more (Ernst, 2009;

Marx & Harris, 2006; Tanner, 2008). The tight focus on math and ELA in the highly structured schedules in elementary school classrooms can leave elementary teachers feeling that there is little time to explore options such as teaching outdoors (Carrier et al., 2013; Gruenewald, 2005; Smith, 2007). Middle school and high school science can feel the time limitations due to curriculum pressures (Ernst, 2009).

A related factor is that elementary teachers with experience teaching under the NCLB high-stakes testing focus on ELA and math may not have taught science, and may not have a strong sense of science-teaching self-efficacy (Lumpe, Czerniak, Haney, & Beltyukova, 2012). Also, both elementary and upper grade teachers in middle school and high school are seldom taught how to incorporate outdoor teaching, which is often associated with environmental education, in their pedagogy in training programs (Ashmann & Franzen, 2017; Ernst, 2009; Ernst & Tornabene, 2012; McKeown-Ice, 2000). For those teachers, incorporating outdoor teaching in their pedagogy requires them to teach in a way they did not experience themselves as students (Hug, 2010).

In my discussions with all grade-level teachers contemplating outdoor science teaching, and also noted in a number of studies, student behavior and safety is another factor in limiting teachers' options to teach outdoors. This can manifest in several ways. Teachers without outdoor teaching training or experience can feel that they will lose control of their students, resulting in lack of manageable, safe behavior by students (Dillon, 2013; Dymont, 2005; Ernst, 2007; Simmons, 1998). Teachers may also feel that students will encounter biting insects or other potential natural hazards in the outdoors (Dillon, 2013; Hug, 2010). Liability issues related to student safety are elements in both

teachers' and administrators decisions to create outdoor teaching events (Rickinson, 2001). In general, if teachers do not have a connection to nature and the environment, and they have not experienced it as students themselves, and they did not receive training as student teachers, they can feel at a loss about how to begin to establish or conduct outdoor teaching events with their classes.

For students, spending time outdoors has decreased in recent years, both in schools and at home (Carrier et al., 2013; Malone, 2008; Malone & Tranter, 2003). The fact that children are spending less time outdoors is related to several key changes in our 21st century culture: increased use of electronic devices for recreation and increased fear of exposure to hazards in the outdoors (McCurdy et al., 2010).

The effects of less time spent outdoors have been noted in students' conditions in many areas. One documented physical effect from lack of exposure to green spaces is the correlation to myopia increases across the world in urban areas (French, Ashby, Morgan, & Rose, 2013). A global study of comparing the physical activity of children in 15 countries indicated that it is commonly believed that children are experiencing lower rates of activity, particularly 'active play': defined as freely chosen, spontaneous, historically outdoor, fun activity, and there has been a rise in obesity globally (Biddle, Gorely, & Stensel, 2004). Sedentary behavior as a result of children spending increasingly more time indoors, often engaged with electronic media, is linked to rising rates in the chronic health issues of asthma, attention-deficit/hyperactivity disorder (ADHD) and vitamin deficiencies (McCurdy et al., 2010). Academic effects include declining interest in science in classrooms, as shown in studies across the globe

(Osborne, Simon, & Collins, 2003; Potvin & Hasni, 2014). Scientific literacy in the United States is suggested to be lower than some European and Asian nations (Carrier, Thomson, Tugurian, & Stevenson, 2014), creating the potential for U.S. citizens that are less capable of making informed decisions on public policy about the environment (Committee, 2010; Stapp, 1969).

Purpose of the Study

My purpose in conducting this research study is to develop an understanding of the motivations and actions of exemplary teachers who consistently and academically incorporate school-based outdoor science teaching in their pedagogy.

Research Questions

My research questions for this study are:

1. Why do exemplary teachers choose to teach outdoors?
2. How do exemplary teachers accomplish outdoor teaching?

Significance of the Study

A wide range of studies document that students of all grades benefit from the inclusion of outdoor learning in their curricula (Dillon et al., 2006; Malone, 2008; Rickinson, 2001). It has also been shown that teachers face real and perceived barriers to incorporating outdoor teaching into their pedagogy (Carrier et al., 2013; Ernst, 2007; Waite, 2009). What has not been well documented are the motivations and actions of those teachers who have accomplished outdoor science teaching in a regular and academic way. The significance of this study is that the in-depth record of the

accomplishments of exemplary teachers may enable an analysis that reveals the situational complexity of outdoor teaching. The deeply descriptive narratives also may increase transferability, allowing other teachers to learn from the motivations and methodologies of these three teachers. Training in successful methodologies of school-based outdoor science teaching may enable teachers to teach outdoors at their schools.

Definition of Terms

1. *Exemplary teachers*: the study teachers are considered exemplary due to their acknowledged success in outdoor teaching by their administrations and parents, as shown by the length of time they have been teaching outdoors in their schools and the benefits they perceive their students receive from learning in the outdoors. Their peer teachers also recommended the study teachers as exemplars of teachers who practice outdoor science teaching.
2. *Motivation*: anything that ‘energizes, directs and sustains’ action. (J. Downey, direct communication). Han and Yin (2016) define motivation as having two differentiated aspects: initiating motivations, which are the reasons for taking action, and sustaining motivations, the effort and reason to persist in doing that action. Motivation theories that apply to this research are intrinsic/extrinsic motivations, achievement goal theory and expectancy-value theory, as explained by Eccles and Wigfield (2002).
3. *Outdoor spaces on school grounds*: these areas may include purpose-built school gardens, green spaces such as lawns, natural or constructed areas adjacent to or included on school grounds, and the use of school campuses in their regularly-maintained conditions.

4. *Pedagogy*: 1) the art and science of teaching, including instructional, management, and curricular design strategies (Marzano, 2007); 2) the integrated relationships of the elements of teaching and learning- including the teacher, the classroom, content, and views on learning (Mortimore, 1999).
5. *Pedagogical ecology*: the contextual, curricular, and personal factors and their interrelationships in teachers' situations (Bronfenbrenner, 1976).
6. *Pedagogical ecology of outdoor teaching (PEOT) model*: a graphic organizer of the motivations, contextual factors and teacher-operational factors and their interrelationships, developed by the author, that illustrates the findings of this research study.
7. *Place-based education*: place-based education situates at least part of student learning in local social and natural environments, (Sobel, 2004). Place-based education is frequently associated with service learning, civic education, and project-based learning (Smith, 2007; Sobel, 2004).
8. *Place-responsive pedagogy*: explicit efforts to develop and use pedagogy specifically based on, and inspired by, local social and natural environments, with the aim of understanding and improving human-environment relations (Mannion et al., 2013).
9. *Positive student outcomes*: Increased cognitive, affective, social, behavioral and physical impacts in students from outdoor teaching.
10. *School-based Outdoor Learning*: School-based learning that takes place outside the classroom, in nearby natural or cultural areas, or on school grounds. This type of outdoor education is not adventure-based (Fagerstam, 2014; Thorburn & Allison, 2017).

Limitations and Delimitations

Limitations of this study are that the study participants are limited to those teachers that meet the inclusion criteria and are available and willing to participate in the study. Also, study participants are encouraged to be candid about their motivations and actions, but the veracity and depth of respondents' answers and contributions are subject only to participants' choices. A further limitation is that the participant teachers determine when and where they conduct outdoor teaching, placing those decisions out of the control of the researcher. The participant teachers also determine the pedagogy that they employ when they are teaching outdoors.

A delimitation of this study is that the chosen participants are experienced teachers who have their own personal motivations to teach outdoors and have developed situational pedagogies to enable successful outdoor learning experiences for their students.

Conclusion

The advantages students gain from outdoor learning is confirmed by numerous research studies and research reviews. Studies have also outlined the common barriers that teachers encounter when attempting to incorporate outdoor teaching in their pedagogy. In practice, there are teachers who successfully include outdoor teaching in their pedagogy consistently and academically. This study reveals why and how three exemplary teachers incorporate school-based outdoor teaching in their students' educational experiences.

CHAPTER TWO: LITERATURE REVIEW

I begin the literature review for this research by discussing the philosophical perspectives that I believe form the basis for understanding outdoor science teaching. I introduce the theory of place-responsive pedagogy proposed by Mannion et al. (2013), and the concept of the ecology of education, as in the work of Bronfenbrenner (1976, 1977), and in field theory, by Lewin (1989), as a means to interpret the role and interactions of pedagogy, context and motivation in outdoor teaching. I then discuss the philosophical perspectives of social constructivism and experiential learning as proposed by Dewey (Cahan, 1992) and Kolb (1984), and place-based and place-conscious education as described by Gruenewald (2003a), Greenwood (2013), and McInerney et al. (2011). The next topic I review are the barriers to outdoor teaching implementation that teachers experience and manage, as described in the research of Rickinson (2001), Dymont (2005), Waite (2009) and Carrier et al. (2013). I then review research into teachers' motivations to implement outdoor teaching in their pedagogy through the work of Fagerstam (2014), Berman et al. (2008), Rea and Waite (2009), and Dymont (2005). See Figure 2 for a graphic presentation of the literature.

Theoretical Perspectives

The specific conceptual focus for this research is that teachers develop their outdoor teaching pedagogy in response to their own motivations and environment, or 'place', as in the place-responsive pedagogy proposed by Mannion et al. (2013). A larger proposed conceptual framework for this study is that teachers' incorporation of

outdoor teaching in public school education may be described as their pedagogical ecology of outdoor teaching model which takes into account teachers' context, curriculum, and personal experiences in an interrelational paradigm.

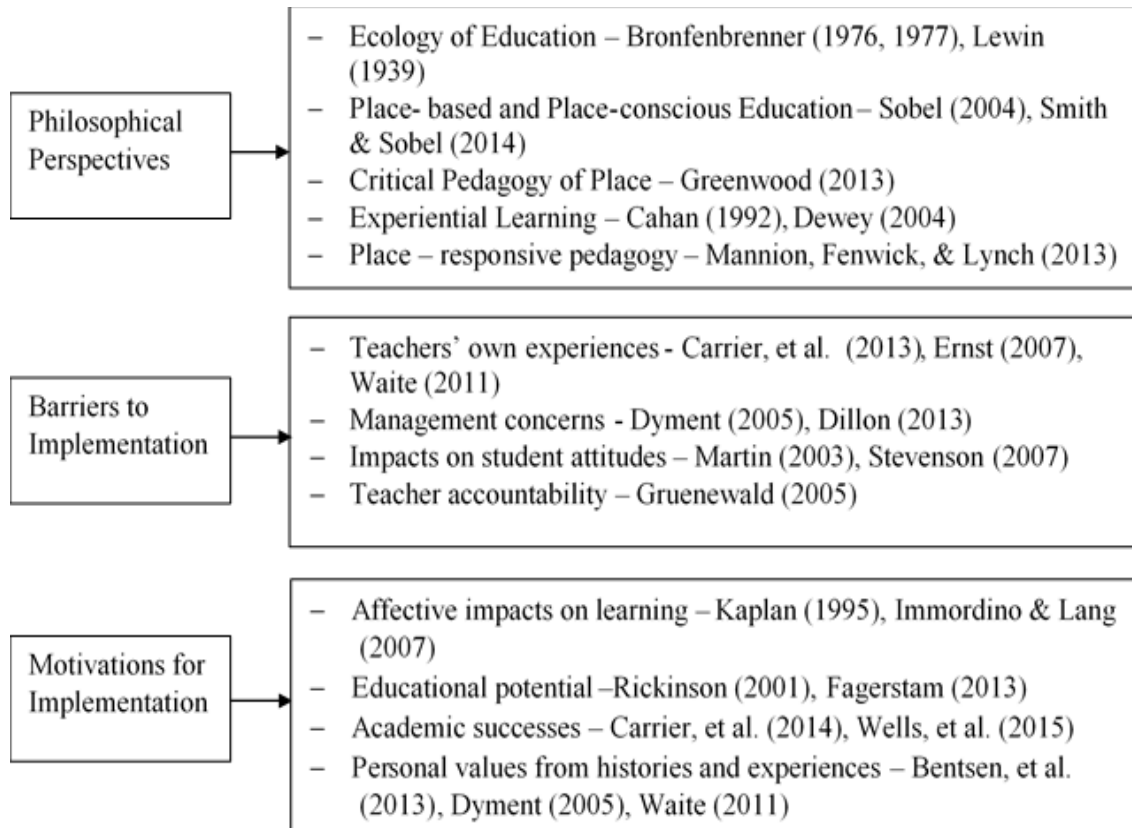


Figure 2. Literature review graphic organizer

Ecology of Education

The model of interrelationship of factors in a teaching situation, called pedagogical ecology in this research, aligns with the ecology of education and the ecology of human development models developed by Bronfenbrenner (1976, 1977). In Bronfenbrenner (1976)'s ecology of education model, he describes conducting

ecological research on education from the perspective of discovery of “the identification of those systems-properties and processes that affect, and are affected by, the behavior and development of the learner” (p. 6). This is similar to the idea of ‘field theory’ (Lewin, 1939), in which behavior is described as a function of the interaction of the person and their environment. Bronfenbrenner (1977) defines the ecological model of human development as the accommodations between growing human beings and their changing immediate environment, which is affected by the dynamic relationship of that environment with the larger social settings in which it is embedded. The ecological paradigm that indicates that the interaction of the individual with their environment determines behavior provides a perspective to support the conceptual framework of place-responsive pedagogy and the proposed pedagogical ecology of outdoor teaching model.

Place-based, experiential learning can be considered an example of educational ecology, where the teachers and students are situated within and interacting with their contextual environment. The social constructivist paradigm, in which individuals construct their own meanings of situations and experiences in relationship to the people and places they interact with to understand the world they live, is exemplified in place-based education as students inquire into local natural and social concerns, often using problem-solving techniques with student-centered learning activities, to construct their own knowledge (Smith & Sobel, 2010; Sobel, 2004). In place-based education, teachers may work as guides, facilitators and collaborators in researching and creating knowledge.

Place-based Education

Place-based education is teaching and learning based in local natural and cultural environments (Sobel, 2004). Place-based education has been referred to as community-oriented schooling, ecological education, and bioregional education (Woodhouse & Knapp, 2000). As stated in Woodhouse and Knapp (2000), place-based education connects place with self and community:

It emerges from the particular attributes of a place. The content is specific to the geography, ecology, sociology, politics, and other dynamics of that place. This fundamental characteristic establishes the foundation of the concept. Because of the ecological lens through which place-based curricula are envisioned, these connections are pervasive. These curricula include multigenerational and multicultural dimensions as they interface with community resources. (para. 9).

Sobel (2004) concurs by stating “the pedagogy of place-based education is the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science and other subjects across the curriculum” (p. 11). Gruenewald (2003) goes on to say that place-based education “aims to enlist teachers and students in the firsthand experience of local life and in the political process of understanding and shaping what happens there” (p. 620). Smith (2007) examines student engagement in local life in citizen science programs such as at Greater Egleston Community High School and Kualapu’u School, Moloka’i, Hawai’i, with fifth and sixth graders, that engaged students directly in the environmental implications of economics of their towns. Sobel’s (2004) description of programs in schools in Louisiana and New Hampshire illustrate how increased student engagement in learning

combined with concern for their local environment can follow immersion in place-based education.

Teachers' implementation of place-based education and outdoor science teaching in which connections are created to nature and the local environment can be an important piece in students' learning and growth. In a study by Brkich (2014), fifth grade students in an urban area in Chicago used participant-driven photo elicitations that showed their personal connections to their local environment while learning earth science concepts in a place-based educational framework. A narrative ethnography study of students and educators in the Bronx (Russ, Peters, Krasny, & Stedman, 2015) revealed similar connections and understanding of local ecology following engagement in local environmental education programs.

Using the outdoor spaces of school campuses as educational environments has been called outdoor education, environmental education, and place-based education, depending on its focus and use. Gruenewald (2003b) speaks of five dimensions of place-consciousness as a way to define and deepen the concept of place-based education, and uses the term 'place' to primarily mean the local cultural and ecological environments of human communities. Place-conscious education is concerned with the past, present and future of these local environments and communities, as well as the interrelationship with other communities, human and non-human (Gruenewald, 2005, p. 263).

Experiential Learning

John Dewey was an early advocate of the importance of connecting children to nature through experiential learning. In 'John Dewey and Human Development', Cahan

(1992) quotes Dewey as proposing that the ideals of a democratic society are made possible through rational scientific thinking that is based on experiential inquiry. Dewey states that “thinking is synonymous with inquiry...an operation of drawing inferences...of basing conclusions upon evidence... of reaching belief indirectly.” (as cited by Cahan, 1992, p. 208). Experiential learning and place-based learning, are considered fundamental elements of environmental education (Woodhouse & Knapp, 2000). William Stapp (1969), in his editorial for the first volume of the *Journal of Environmental Education*, noted that the increasing urbanization of the United States removed people from the daily contact with the natural world they experienced in rural settings. The lack of contact caused people to begin to disassociate from basic resources that ensure their survival. Stapp (1969) made the point that natural resource education creates an informed citizenry that can make decisions protecting and conserving necessary resources for all life to continue to exist and thrive on Earth. Dewey’s insights that science education through inquiry is crucial for developing thinking, socially responsible citizens, and Stapp’s observations about the detrimental effects resulting from our lack of contact with the natural world, are at the heart of environmental education and outdoor science education.

The field of environmental education has joined with, and differentiated into, a wide range of fields of practice and research, such as place-based education, experiential learning, outdoor education, ecological education, and more (Gruenewald, 2003a; Smith & Sobel, 2010; Sobel, 1996). Environmental education aims to develop ecological literacy, which unites science knowledge with ecosystem stewardship and sustainability,

and engendering a ‘sense of wonder’ of the natural world, called ‘biophilia’ by E. O. Wilson (Wilson, 1984). One of the goals of outdoor science education on school campuses is to begin to instill the ‘sense of wonder’ E.O. Wilson eloquently describes. The convergence of science education and environmental education shows promise for developing citizens who feel connected to the natural world, scientifically literate, and motivated to take responsibility and action to protect and conserve the natural systems that sustain us (Wals, Brody, Dillon, & Stevenson, 2014).

Barriers to Implementation of Outdoor Teaching

The barriers for teachers seeking to include outdoor teaching in their pedagogy are plentiful (Carrier et al., 2013; Dillon, 2013; Dymont, 2005; Rickinson, 2001). Rickinson’s (2001) research review of over 100 articles examining outdoor education indicated that barriers may include low teacher self-efficacy, low comfort levels, and lack of content knowledge to effectively use an outdoor space; little or no support from their principals or other teachers; the pressing need to cover specific amounts and content areas of curriculum within a prescribed timeline to comply with district and state standards and to prepare students for standardized tests; a lack of appropriate and interesting outdoor spaces for teaching; and safety and liability issues, including student learning and behavior management outdoors. Dymont (2005) compares results with Rickinson’s (2001) review through a mixed methods study involving an extensive survey of teachers and administrators from schools engaged in green school programs, followed by case study research of five schools among the survey respondents. Barriers in Dymont’s (2005) study remained similar to Rickinson, with the addition of the impact

of wider changes within the education sector such as labor disputes, resistance to green school educational reform, and the overwhelming number of roles teachers feel are required of them. The Canadian climate was also considered a barrier for some teachers. Results from Carrier et al.'s (2013) mixed methods study of two fifth grades comparing a school with an outdoor science culture to one without showed that teachers in neither school used the outdoor areas at their school to much degree due to emphasis on preparation for high-stakes testing. In Dillon's (2013) review of the House of Commons Education and Skills Committee's report on Learning Outside the Classroom (LOtC), barriers in the research of schools engaging in LOtC also included lack of integration into school curriculum and logistics and effective allocation of funds.

Teachers' Personal Experiences

In order to fully use an outdoor space on a school campus, teachers need to feel capable and comfortable to effectively teach outdoors. Teachers' low confidence levels and lack of content knowledge and their negative impacts on how much their students study outside has been well documented by educational researchers (Carrier et al., 2013; Dillon, 2013; Dymont, 2005). A further factor is teachers' own affinity and experience with the natural world, or lack of affinity, which plays a strong role in teachers' choices in their classrooms (Ernst, 2007; Waite, 2011). Ernst's (2007) results from an exploratory survey of 287 teachers seeking responses to their own use of outdoor-based and environmental educational approach indicated that teachers' environmental sensitivity and literacy strongly influenced their choices to teach outdoors. Waite (2011) surveyed teachers working with pre-school and primary grade students in England who

expressed their desires to offer similar positive sensory experiences and freedom to explore the outdoors for their students that they experienced in the outdoors themselves. This corresponds with similar research by Carrier et al. (2013) and Chawla (1998) indicating that those teachers with personal experience and appreciation for being in and learning about the outdoors are much more likely to value and utilize the outdoors in their own pedagogy. Research into changing teachers' beliefs about their abilities (Haney, Lumpe, Czerniak, & Egan, 2002; Lumpe et al., 2012), shows that given time and a strong commitment to professional development, positive and lasting changes can be made in teachers' beliefs and pedagogies.

Management Concerns

The press for time in standard classroom schedules, the need to cover a certain amount of curriculum in a specified period, and the pressure to perform on standardized tests all conspire to frustrate teachers willing to do outdoor teaching, and defeats those teachers who are not comfortable or enthusiastic about outdoor education (Carrier et al., 2013; Dillon, 2013; Ernst, 2007; Waite, 2011). In some schools, even with support from principals and parent involvement in creating and maintaining outdoor spaces, teachers still feel compelled to teach in traditional methods (Carrier et al., 2013; Dymont, 2005; Stevenson, 2007). Changes in standards, such as Next Generation Science Standards (NGSS) and Common Core English Language Arts (ELA) and math standards, may point the way to student-centered, experiential education that encourages teachers to take on the challenge of teaching outdoors (Barakos, Lujan, & Strang, 2012).

Another barrier to teaching outdoors on school campuses is the design, installation, and maintenance of green spaces used for classes. Teachers may feel that there is no appropriate or interesting place to take their students outside on school campuses; outdoor space designs can be out of contact with how teachers can effectively use them. In the nation-wide survey by Bentsen et al. (2013) of 216 Danish teachers who practice outdoor teaching, their preferences for outdoor areas such as forests and water features are frequently far beyond what is available for many teachers. School vegetable gardens are a fast-growing area of outdoor learning sites, often proposed, designed, built and maintained by teacher-parent collaborations or parent groups (Blair, 2009; Skelly & Bradley, 2007). Teachers encounter barriers to using school gardens when they face a lack of time to manage garden instruction, lack of comfort with and knowledge of the content area, and mixed messages from administrations of the importance of using gardens for instruction (Passy, 2012). In a report of a multiple case study research project by Passy (2012) in the United Kingdom, a divide between the teachers was reported of those teachers that favored and actively used school gardens for outdoor teaching, and those teachers that were not responsive to the idea. Those that were not responsive to using the garden offered the opinion that ‘it was not the norm’ , in terms of school policy, to use the garden for teaching, (p. 35).

Safety issues related to being outdoors, such as fear of insects and animals, often generated from a lack of familiarity by both teachers and students, has become increasingly paramount as students and teachers spent much less time outdoors (Dillon, 2013; Dymont, 2005; Waite, 2010). Safety concerns are also a concern for principals,

parents and school districts (Ernst, 2012). The rise in safety issues concerning children in the outdoors has helped contribute to children's lack of contact with nature (Dyment, 2005).

Student Impacts

A further barrier to outdoor learning lies with students, due to the nature of the inquiry-based, experiential forms of instruction that demand critical thinking, decision-making, and the work of researching student-chosen topics. Through content analysis research, Stevenson (2007) proposes a rhetoric-reality gap between inquiry-based, experiential pedagogy and curriculum and traditional pedagogical and curricular practices. The intellectual demand, the potential for uncertainty, and the frustration with themselves and the process can be difficult to cope with and lead to dis-engagement for students (Stevenson, 2007). Because outdoor learning can be challenging for students, it can require teachers to develop different methods of instruction and differentiation for struggling students, which can put a further burden on teachers.

Teacher Accountability

_____An overarching barrier for teachers when attempting to teach outdoors are teacher accountability and societal expectations. These can act as forces to institutionalize student experiences in school classrooms (Gruenewald, 2005). Because the typical workings of the classroom are taken for granted, and because the mechanisms of teacher accountability lack a vocabulary for outdoor teaching, or place-based education altogether, outdoor, place-based education can easily be seen, even by its practitioners and potential practitioners, as transgressive or tacitly forbidden. Teachers

who practice it may feel they need to be prepared for increased observations and to be able to demonstrate the value of outdoor teaching and learning in ways that are not necessary for teachers using traditional classroom-based pedagogy (p.272).

Motivations for Implementation

Affective Domain of Learning

Kaplan (1995) and Berman, Jonides and Kaplan (2008) propose a theory called Attention Restoration Theory (ART), which states that being in nature offers the opportunity for people to experience a ‘soft’ fascination, which provides relief from the ‘directed attention fatigue’ generated by the continuous focus needed to be effective in today’s world. After an interaction in nature, people are able to perform better on tasks that depend on directed-attention abilities. Faber Taylor and Kuo (2009) have proposed that attention-deficit disorder effects are diminished after exposure to natural areas. Increased attention spans in students after time spent outdoors has also been found in a quantitative study by Kuo et al. (2018) Keniger et al. (2013) offer evidence from a literature review of studies of outdoor interactions of students and adults in a wide range of settings, such as classrooms, hospitals, etc. in countries around the world. They describe the effects of 3 types of interactions with nature in six different typologies. Their findings indicated “an enormous range of benefits...spanning physical health and cognitive benefits to spiritual benefits to the tangible outcomes associated with food production and wealth.” (p. 917). Brody (2005) offers a theory of meaningful learning in nature that alludes to an interweaving of impacts from spending time outdoors. According to Brody, “learning in nature is a result of direct experience(s) over time in

which personal and social knowledge and value systems are created through complex cognitive and affective processes.” (p. 610-611).

There has been shown to be a profound connection between emotion, social functioning, and decision-making revealed in recent studies in neuroscience by Immordino-Yang and Damasio (2007). Emotional thought is their term for how emotional processes affect and supersede learning, attention, memory, decision-making and social functioning. The benefits of inclusion of outdoor learning in curriculum may be linked to this research outcome. Students’ positive emotional reactions to learning outdoors has been noted in a number of research studies, such as Fagerstam’s (2014) one year case study of teachers and their students in a Swedish junior high school and the research review report by Malone (2008) of learning outside the classroom (LOtC) in the United Kingdom. Teachers have expressed their observations that students are more engaged, and show greater enjoyment when participating in outdoor learning (Rea & Waite, 2009; Waite, 2011). In Waite’s (2011) discussion of the alternate pedagogies that teachers developed, student enjoyment was a key motivating factor in teachers’ commitment to developing their pedagogies.

Positive Student Outcomes

Academic improvement, greater applied critical thinking skills, and deeper engagement and attention have been correlated to outdoor learning events (Bogner, 1998; Dillon et al., 2006; Ernst, 2007). In the Rickinson (2001) landmark review of over 100 research studies of students’ responses to environmental education, the study indicated positive impacts of outdoor educational events for students in the areas of

cognition, affect, social/interpersonal interactions, and the physical/behavioral arena. Further positive outcomes were determined from the meta-analysis review commissioned by Farming and Countryside Education for the UK Department of Children, School and Families (Malone, 2008). The research included in the review was conducted at many diverse sites throughout the world that practiced Learning Outside the Classroom (LOtC). The sites were grouped into 11 types, one of which was school campuses. The compiled results indicate positive responses to LOtC in all 5 identified areas: cognitive, physical, social, emotional, and personal.

Teachers' Personal Values

Teachers who teach outdoors at their schools tend to be enthusiastic supporters of the practice. Dymont (2005) in a report on a schoolyard greening initiative in Canada, reported enthusiasm by teachers who watched students excitedly examine ladybugs with magnifying glasses. In a study by Carrier, Turgurian and Thomson (2013), in the United States, teachers and their principal expressed a strong commitment to teaching outdoors and utilizing the numerous outdoor spaces around the school. In Denmark, outdoor school programming, called Udeskole, is practiced in at least 14% of schools, with teachers reporting that they use green spaces at schools several times a week for ages 6-16 (Bentsen et al., 2013); teachers indicated they use the spaces “all year round” and that “The best thing is that all the possibilities are right outside our door!” (p. 569). Dillon, (2013) suggests that teachers bring innovative teaching strategies, and increased ownership and leadership in their school from learning in a natural environment (p. 159). Waite (2011) reports that teachers at a survey of 334 settings in SW England

ascribed the values of freedom, excitement, authenticity and generally a positive affect to outdoor learning opportunities, and that “their passion ...and enthusiasm were underpinned by a firm conviction in the value of outdoor learning.”(p. 78).

Conclusion

Teaching science outdoors can be considered place-based, experiential education (Sobel, 2004). Teachers who successfully accomplish it have dealt with a wide range of barriers (Dillon, 2013; Rickinson, 2001). However, those teachers that do teach outdoors are motivated to meet standards with interesting options, deeper engagement with the content, more relevancy, improved student interest and attention, interdisciplinary teaching opportunities, improved social equity, and ease of use with little or no costs (Chawla, 2015; Keniger et al., 2013; Rickinson, 2001; Waite, 2009). Teachers choose to teach outdoors because they believe that the benefits to students, to themselves, to communities and to the processes of teaching and learning are worth the effort. In doing so they may be holding themselves accountable to standards beyond those mandated by federal, state and local policy. (Gruenewald, 2005, p. 272).

CHAPTER THREE: METHODOLOGY

My purpose for this qualitative, multiple case study research is to explore and document the motivations and methods of exemplary teachers who include school-based outdoor teaching on a regular basis in their pedagogy. This chapter addresses the research design, research questions, role of the researcher, participant selection, data collection and analysis, and validity and trustworthiness concerns.

Research Questions

The research questions for this study are:

1. Why do exemplary teachers choose to teach outdoors?
2. How do exemplary teachers accomplish outdoor teaching?

Rationale

I have worked with several teachers who take their students outside to learn, and met many more teachers who would like to take students outside but are fearful, or do not know where to begin. Because I value outdoor science learning, I am motivated to add to the knowledge of why and how teachers teach outdoors. My goals for researching teachers' inclusion of outdoor teaching in their pedagogy are to document successful science teachers' motivations and methodology, and to seek commonalities of teacher practices that, if more widely known and used, could lead to greater use of outdoor teaching and learning in public schools.

Research Design: Multiple Case Study

The research design for this study is a multiple case study of three teachers who teach in public schools in the Greater Yellowstone Region of southwestern Montana. The research methodology is the case study approach as described by Creswell (2012), Savin-Baden and Major (2013), Stake (1995), and Yin (2014). In this research, I have followed the description of case study research given by Savin-Baden and Major (2013). In their description, case study research is holistic, meaning it seeks to describe the parts of a case and their relationships, including the context of the case, and it focuses on a particular aspect of a case by providing concrete descriptions of that aspect. In my research of the three study teachers, my goal was to learn about the various factors of their outdoor teaching: their motivations, their planning and their managing of outdoor teaching events in regard to science, and the interrelationships of those factors within their context of schools, communities, and the surrounding natural environment. In this study, each of the three teachers constitutes a separate case study, and the cases are ‘bounded’ by the focus on each teachers’ outdoor teaching as science teachers in their particular school and community (Creswell, 2012; Yin, 2017). The cross-case analysis of the three case studies followed Yin (2017) in that the multiple, replicative cases were synthesized holistically, using a case-based approach (pg. 196).

This research used an instrumental, descriptive case study methodology, characterized by data that provided the opportunity to look closely and thoughtfully at each case separately and all three cases collectively. Yin (2008) describes four applications of a descriptive case study: First, the method can explain complex causal

links in real-life decisions. Second, a case study can describe the real-life context in which decisions occur. Third, it can describe the decisions themselves. Finally, descriptive case studies can explore those situations in which the decisions being evaluated have no clear set of outcomes. In this research, the decisions being described are the teachers' choices to include outdoor teaching in their pedagogy.

Epistemologically, social constructivist theory (Hausfather, 1996; Kim, 2001; Schunk, 2012; Vygotsky, 1978) informs this study, as this research seeks to understand how each teacher constructs their outdoor teaching pedagogy in their own context; information that is made available by closely examining each teacher's motivations and teaching practices through the case study research approach. Critical realism, a bricolage approach of combining ontological realism and epistemological constructivism, as described by Maxwell (2013, p. 43) describes my paradigmatic assumptions that underlie this research. Teachers' development of their own place-specific pedagogy supports the place-responsive pedagogy theory put forth by Mannion, et al. (2013). The case study research approach is necessary not only to examine and record teachers' actions and thoughts, but to locate them in the context in which they teach, and to characterize the relationships between these key elements.

The multiple case study research design of this research is a literal replication design, as described by Yin (2014), in which each case study is a replication of the situation or phenomenon under examination. This differs from the 'sampling' approach, in that the selected cases are not meant to statistically represent a larger population, but to closely examine specific instances of a particular phenomenon. Replication logic in

the multiple case study approach enables a cross-case analysis that looks for ‘convergent evidence’ (Yin, 2017, p. 59) when comparing the individual case studies within the study. Analysis for common factors, or ‘convergent evidence’ increases transferability (Savin-Baden & Major, 2013; Yin, 2017), as it may reveal consistent pedagogical methods that can be generalized to assist teachers to overcome barriers and effectively utilize outdoor spaces on and near school grounds.

Researcher Positionality

Denzin and Lincoln, (2018) define qualitative research as ‘a situated activity that locates the observer in the world’, consisting of ‘a set of interpretive, material practices that make the world visible’ (pg. 45). In this qualitative research, I was the observer (Creswell, 2012) making ‘direct observations’ (Yin, 2017) of the study teachers and their context, during field observations and in interviews. My role during the data collection was largely as a nonparticipant. I am also the interpreter of my observations (Stake, 1995), bringing my interpretations to light in my analyses of the three study teachers’ motivations and actions. I bring to my roles of observer and interpreter my own history, values, judgement and bias. My ability to understand and interpret the worlds of the study teachers stems from my own experiences as a science teacher. I taught for 12 years as a ‘science teacher in residence’ in a wide range of grades in elementary and middle schools throughout SW Montana. I also taught informal science in museums, outdoor summer camps and afterschool programs. I conducted numerous teacher development offerings in science education, environmental education and

outdoor teaching for formal and informal educators alike. I have been a certified science teacher in Montana since 2004.

My professional experiences are largely in school-based outdoor science education, so I am knowledgeable in many areas of the public school environment. However, I have not had my own classroom in a public school, so in some profound ways, I have not had the same experiences as the teachers in my study. I did not have school year-long relationships with my students, and often I was not a member of the school and community in which I was teaching. But I do have first-hand knowledge of the challenges and rewards of teaching outdoors in public schools. In this research I used my experience to help understand the many aspects of the study teachers' situations so I could ask appropriate questions, and perhaps more importantly, begin to understand their responses and pick up the nuances of each teacher's situation. I believe my own personal experiences aided me in having a rapport with the study teachers, and in that way may have helped in gathering thoughtful and in-depth responses in our interviews, though otherwise I strove to remain a non-participant.

My involvement in the data is clearly evident in my analysis and interpretation of the study teachers' narratives. My reflexivity is most evident in this research in my development of the pedagogical ecology of outdoor teaching (PEOT) model, where I bring my knowledge and experience of public school settings and the work involved in outdoor teaching to help create a synthesis model of the study teachers' outdoor teaching pedagogy. By acknowledging what elements I bring to this research, I have worked to

maintain transparency in order to establish authenticity of the study teachers' voices in this research.

Data Collection Procedures

Participants

Each teacher chosen in this study is an example of someone who exemplifies place-based outdoor teaching, and the individual cases were chosen for their replication of the case selection criteria. A purposeful selection process was used to identify and recruit participants who met the criteria listed in Table 1.

Table 1. Study teacher selection criteria

Individual study participant selection criteria:

-
1. Currently teaching in public schools - participants are working within the public school system, and so share common experiences of many teachers.
 2. Academic use of the outdoors – participants weave outdoor experiences into their class curricula.
 3. Experienced in outdoor teaching – participants have included outdoor teaching in their curricula for more than a year, so that outdoor teaching is established in their pedagogy.
 4. Regular use of outdoor teaching – participants teach in outdoor areas near their schools, multiple times in the school year, so experiences teaching in the outdoors are part of the fabric of the school year.
-

Criteria for collective group of participants:

-
5. Participants teach in a range of socio-economic communities - so that a variety of opportunities and situations for incorporating outdoor teaching can be explored.
 6. Participants teach in a variety of grade levels, including elementary, middle school and high school – to provide evidence of how and why teachers overcome barriers and incorporate outdoor spaces throughout the K-12 teaching experience.
-

Participants in this study are public school teachers who teach at elementary, middle school, and high school levels. All three teachers teach in public schools in SW Montana; teaching within similar geographic locations provides some commonality within the group and increases the replication factor for the study.

Teachers were identified as potential participants through my professional association in area schools, and through chain or snowball effects, in which teachers who use teach outdoors were identified by other teachers or school administrators in the area. Teachers were selected who work in schools from a range of socioeconomic areas to provide realistic variation within the literal replication case study model. A study group of 3-4 teachers is considered sufficient by Creswell, (2012) to illustrate the various uses of outdoor spaces and also provide enough data to analyze for themes and conduct cross-theme analysis, while Yin (2014) describes a replication group of 2-3 case studies as a means of providing literal replications that provide more robust, stronger evidence. Teacher interviews and field observations were conducted prior to selection. Three out of the six teachers interviewed and observed were selected for this research. Information about the three selected teachers is shown in Table 2.

Confidentiality The confidentiality of participant identity was kept through coding names and locations of participants, though the study teachers indicated that they would feel comfortable having their identities revealed in case other teachers wanted to contact them for information. There was also a consideration that it would honor the study teachers' hard work and vision to acknowledge them publicly. In the final

decision, I chose to keep the study teachers' participation confidential for the sake of their students.

Table 2. Demographic data of the three study teachers.

Teachers*	Content	Location**	Years teaching	# of classes/ # of students
Henry David (Henry) 4 th Grade	All subjects, general science is a primary interest	Small rural town, pop. under 3000, one grade school, two 4 th grade classes	18 total	Self-contained classroom/ from 8-32, students, currently under 20
Bruce Wilson, (Bruce) 7 th grade	Life science	Small town, pop. under 8000, one middle school	20 in current position, 46 total	5 periods/30-35 students per period
Anna Leopold (DL) High School - sophomores, juniors and seniors	Biology, wildlife biology, algebra	Large town, pop. under 50,000, two high schools	24 in current position, 30 total	5 periods/ 20-30 students per period
*pseudonyms				
**Within a 100-mile radius of Bozeman – in the Greater Yellowstone Ecosystem				

The study teachers were given the option of choosing an alias, and all three chose people they respected in our culture. As little personal information as possible that could lead to participant identification was disclosed in transcriptions and in subsequent written or spoken communications. All participation was voluntary. Participants were treated equitably and respectfully; the teachers made the choices of when interviews and observations would take place. The teachers determined access during outdoor events

and in classrooms, with the knowledge and permission of their principals. No ethical issues were identified.

Data Sources and Collection Methods

Data collection in case study research is characterized by obtaining evidence from multiple sources, with the goal of reaching an in-depth understanding of the phenomenon being studied (Creswell, 2012; Ritchie, Lewis, Nicholls, & Ormston, 2013; Savin-Baden & Major, 2013; Yin, 2014). To achieve that goal in this research study, I collected data from the participating study teachers in multiple forms. Those forms were: interviews using a semi-structured protocol; field observations of outdoor teaching events, with field notes and photo and video documentation; video-recall interviews (Meade & McMeniman, 1992; Nguyen, McFadden, Tangen, & Beutel, 2013) recorded while viewing the photo and video documentation; samples of curricula of outdoor teaching events; and short questionnaires for the collection of demographic information. See Appendix B for the demographic questionnaire.

Multiple sources of data and in-depth interviews allowed me to develop a thick description of the study teachers, and enabled me to triangulate my data, two practices that contributed to the validity of the research. As a further validity check, the teacher narratives were member-checked by the study teachers.

Semi-structured Interviews

Data collection occurred during the winter and spring of the 2018 school year. The interviews were semi-structured, with questions and topics prepared beforehand pertaining to the research questions and the research literature, yet with the potential to

explore other areas as they arose. In order to complete the topics on the interview protocol, I conducted 2 interviews each with the three teachers over a period of 4 months, beginning in February 2018. Interviews took place in the teachers' classrooms in most cases, and once in one teacher's home. The interview locations were the teachers' choices. The interviews were recorded and transcribed verbatim. Field observations of outdoor teaching events occurred later in the spring of 2018. Photos and videos were taken during field observations, along with field notes of the events. Teacher artifacts, i.e. syllabi, curriculum materials, were collected before, during and after field observations.

_____ There were two areas of interest for the interview questions in response to the research questions for this study: 1) why do exemplary teachers choose to teach outdoors? and 2) how do exemplary teachers accomplish outdoor teaching?

Interview questions were generated from the research literature about what is known about motivations for teachers to teach outdoors and about barriers to implementation of outdoor teaching.

In the area of the teachers' motivations to teach outdoors, interview questions centered around learning about the teachers' history and background in spending time outdoors, their training and professional development related to teaching outdoors, and how much the benefits to students' learning, engagement, and/or dispositions related to being outdoors factored into their decisions to teach outdoors. In the area of how teachers accomplished outdoor teaching, questions dealt with how the teachers overcame the recognized barriers to taking students outdoors, how the teachers managed

the governance of outdoor teaching, such as enlisting school, parent, and community support, and how teachers developed class management and participation expectations.

Information about situational specifics for each teacher, such as the logistics of their outdoor teaching events, was also collected, along with contextual information pertaining to the school and community setting and administrative and parent support. The goal of the interview questions was to gain a clear picture of each teacher's motivations and context. See Table 3 for the table of specifications for the semi-structured interview questions.

Table 3. Table of specifications for interview questions.

Research Questions		Corresponding Interview Question Categories
1. Why do exemplary teachers choose to teach outdoors?		1. Teachers' motivation
2. How do exemplary teachers accomplish outdoor teaching?		2. Pragmatic issues of planning and management
Sub-Questions	a. What methods do teachers use to teach outdoors?	a. Class and administration management a. Pedagogy
	b. How do teachers overcome barriers to outdoor teaching?	b. Barriers to implementation

See Appendix C for the semi-structured interview protocol.

Video-recall Interviews

The video-recall interviews were conducted on separate days after the outdoor events to fit the teachers' schedules and to reduce impacts on the teachers' time and energy. Later scheduling of the video-recall interviews had the added benefit of enabling our discussions to be generalized to the teacher's practice and not specific only to the observed outdoor event. To conduct the video-recall interviews, I met with the teachers at a time and place convenient for them, typically in their classrooms, but also in their homes. For all three teachers, those interviews occurred after school had ended for the year, either in June or July 2018. The video-recall interviews were lengthy, typically lasting 2+ hours. The teachers were prompted just before viewing the photos and videos to describe their thoughts, feelings and actions that occurred during the recorded events and also as they watched the photos and videos. Those prompts were used so that teachers could think, feel and reflect holistically about the events they were watching.

Data Analysis

The initial data analysis entailed the use of NVivo CADQAS software. Interview transcripts were coded in NVivo into first cycle, a priori themes derived from the research literature in response to the research questions, and into emergent themes that I detected in my readings of interview transcripts (Miles, Huberman, & Saldana, 2013; Saldana, 2015; Savin-Baden & Major, 2013). The individual case studies were then written into a narrative form, organized by the a priori and emergent themes in the first-cycle coding. The second cycle coding process then analyzed each of the narratives for

patterns within the narrative (Miles et al., 2013; Savin-Baden & Major, 2013). Each teacher's narrative data was abstracted into graphic organizers that represented their pedagogical ecology – the personalized elements and interactions within their pedagogy, history and contexts. Each teachers' pedagogical ecology graphic organizer can be found in Chapter 4, Section One, within their individual narrative analysis.

After analysis of the individual case studies, the collective case studies were considered for cross-case analysis. Cross-case analysis consisted of an examination for patterns of variables that were present throughout the cases (Miles, et al., 2013). In the matrix developed to aid in the comparative analyses of the three narratives, a strong correlation was clearly evident between all three teachers in motivations, planning and methods of why and how each teacher taught outdoors. The cross-case comparison patterns were synthesized into the proposed model called the 'pedagogical ecology of outdoor teaching' (PEOT).

Validity and Trustworthiness

In qualitative research, validity can be considered a measure of the 'quality of the process' of the research, or rigor and trustworthiness of the research methods and researcher integrity (Merriam, 2009; Savin-Baden & Major, 2013). The quality of the research can be evaluated through examining how the various threats to validity are recognized and addressed in the research design (Savin-Baden & Major, 2013; Yin, 2017). In this research study, the strategies I chose to use to ensure the validity and trustworthiness of the research findings include triangulation of data, rich thick descriptions, member checking of individual case study narratives and graphic

organizers, peer review and audit trails (Creswell, 2012). Data was triangulated through semi-structured interviews and video-recall interviews, curriculum artifacts, demographic questionnaires, and researcher observations and field notes of outdoor teaching events. Thick and rich descriptions consisted of the compilation of both types of interview responses and outdoor event observations into a comprehensive narrative of each study teacher's responses and actions, along with the thick descriptions of the of teachers' contexts and outdoor teaching events. Member checks by the teachers of interview narratives and graphic organizers were used to maintain the accuracy of transcriptions and to check for fidelity in the interpretation of their interview responses in the research findings. The study teachers also reviewed the cross-case analysis and pedagogical ecology of outdoor teaching model description and graphic organizer. Peer review was used in coding interrater reliability, with an interrater agreement rate of approximately 70%. The table of commonality of findings on pg. 153 can be considered an audit trail of the interview analyses of the study teachers, along with the records of the research proceedings.

A further threat to validity and trustworthiness can occur due to researcher bias. In this research, my researcher bias was recognized and acknowledged through critical self-reflection and reflexivity (Savin-Baden & Major, 2013). As I feel I am strongly positioned in this work since by own teaching experiences align closely with those of the study teachers, I worked to have my critical self-reflection became a habit as I listened and observed the study teachers. I paid particular attention to adhere to researcher ethics, described as conducting research in an ethical manner that demonstrates the integrity

and professionalism of the researcher (Merriam, 2009; Yin, 2017). To me, that meant listening and observing in an open, non-judgmental way while exhibiting my respect for the teachers, their students, and their situation.

Methodology Conclusion

The rationale for this research is to observe and record exemplary teachers' successful use of outdoor teaching to determine if there are commonalties among those teachers that could be shared with the greater teaching community. Research into teachers' successful use of school-based outdoor teaching has been limited, with much more information known about barriers to outdoor teaching, and about student successes when learning in the outdoors. This research study seeks to provide data and analysis to help fill that informational deficit.

The research design for this qualitative study was a multiple case study of three teacher participants, following Yin (2014), Creswell (2013) and Savin-Baden and Major (2013). The study teachers were chosen for their remarkable outdoor science teaching histories, their match to the selection criteria and their willingness to participate. Data collection involved semi-structured interviews with the teachers, field observations with photo and video documentation of outdoor teaching events, video recall interviews with the teachers of the photo and video documentation, a short questionnaire to gather demographic information, and curricula artifacts. The interview data was transcribed; the transcriptions, field notes and demographic questionnaires were analyzed for themes within each case study, and narratives of each teacher were written following the identified themes. Class artifacts were used in triangulation verification only. The

thematic narratives were analyzed for cross-case themes, comparisons, and patterns among all three case studies. Cross-case themes and patterns were synthesized into the pedagogical ecology of outdoor teaching (PEOT) model. Trustworthiness of the data was verified and maintained through triangulation of the multiple data sources, thick, rich description collected during observations and interviews, and member checking of the descriptive narratives and graphic organizers; validity threats are recognized as researcher bias and reflexivity.

CHAPTER FOUR: INDIVIDUAL AND CROSS-CASE ANALYSES

Introduction

This study seeks to gather information to inform the research questions of 1) why do exemplary teachers choose to teach outdoors? and 2) how do exemplary teachers accomplish outdoor teaching? Three exemplary teachers were studied, using case study methodology as described by Savin-Baden and Major (2013), Stake (2010), and Yin (2014). Data for each of the three teachers was collected in the forms of semi-structured interviews, stimulated video recall interviews of recorded field observations, researcher notes of field observations, and demographic information questionnaires. Data for each teacher was coded in categories using qualitative analysis software, and then analyzed for themes within each category. Themes that emerged during analysis are described here in narrative form. Included in the narrative as evidence are quotes and conversations from the transcribed interviews.

Data informing the first research question of why teachers choose to teach outdoor is categorized into two forms of motivation: types of personal motivations and types of motivations based on perceived positive student impacts of learning outdoors. Though types of motivations are categorized separately in this analysis, in practice, motivations are not always clearly delineated into specific forms and types.

Data informing the second research question of how teachers accomplish outdoor teaching is divided into two types of factors, contextual factors pertaining to planning for outdoor teaching, and teacher actions in managing outdoor teaching. The division of factors expresses the sequential nature of the steps that teachers take to teach outdoors.

Planning actions are contextual factors that are initial steps taken to develop a context to enable outdoor teaching. Teacher actions to manage outdoor events take place after planning actions have enabled an outdoor teaching context, in direct association with the action of teaching outdoors. While expressed as sequential actions in this study, in actuality, these actions are iterative and may occur simultaneously.

Section one of this chapter examines the three individual case analyses, described individually in narrative form. Each narrative is structured to first give a personal sketch of each teacher, and then to provide the teachers' responses to the research questions of 1) why do exemplary teachers choose to teach outdoors? and 2) how do exemplary teachers accomplish outdoor teaching? In section two of this chapter, the cross-case analysis explores the commonalities and differences in each of the study teachers' motivations and actions in teaching outdoors. The commonalities and their relationships are expressed in a proposed 'pedagogical ecology of outdoor teaching' (PEOT) model. The PEOT model outlines the elements within a teaching situation that enable teachers to successfully develop and incorporate outdoor teaching in their pedagogy.

Section One

Case One: Analysis of Themes in Bruce Wilson Interviews

Bruce Wilson (his chosen pseudonym) is one of the three teachers who are the study participants of this multiple case research study. Bruce is a seventh-grade life science teacher who lives and teaches in a small city in southwestern Montana. The city

is located on the banks of the Yellowstone River within the Greater Yellowstone Ecosystem. Bruce teaches at Central Middle School (a pseudonym), abbreviated CMS. More specific details about the city and school are withheld to keep the teacher, students and school anonymous. The graphic organizer shown in Figure 3 provides a visual analysis of the elements and their relationships in Bruce's pedagogy.

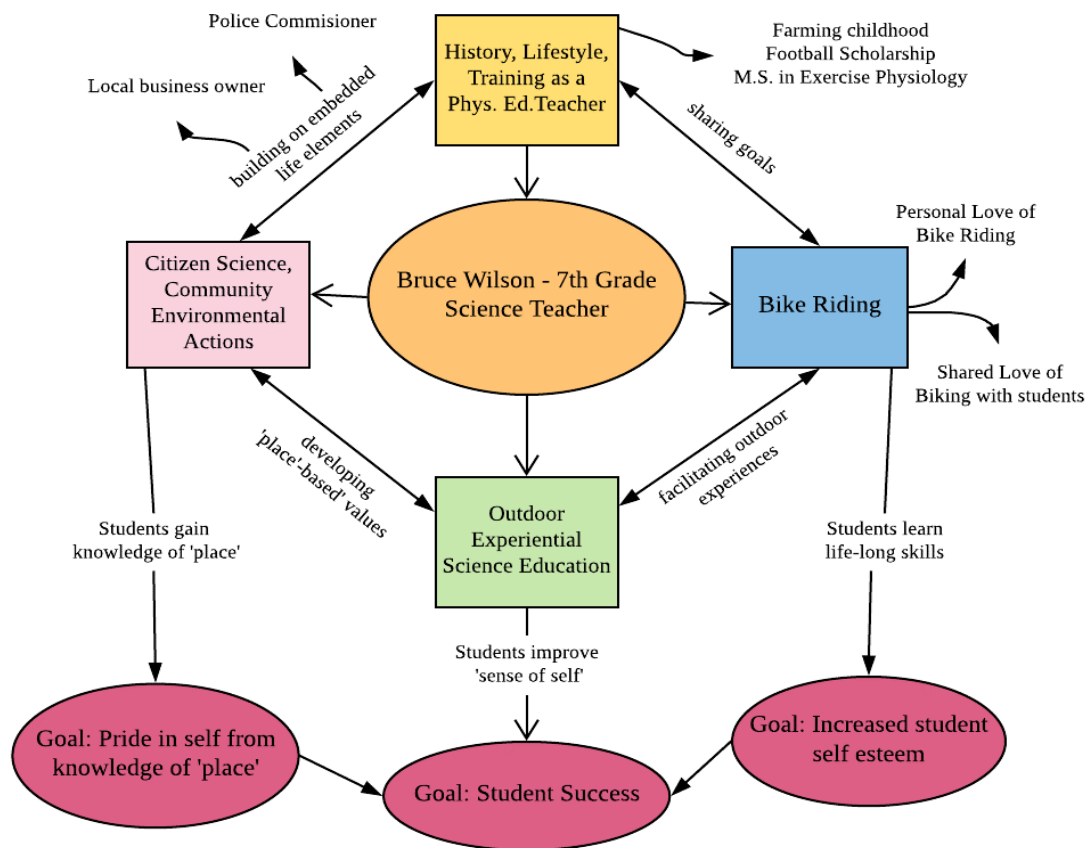


Figure 3. Contextual factors and their relationships in Bruce Wilson's pedagogical ecology of outdoor teaching

Personal Sketch of Bruce Wilson

Early Experiences in the Outdoors Research on educators' decisions to teach outdoors (Chawla, 1998) tends to show that various types of life experiences in the outdoors influence educators' motivation and sense of efficacy in teaching outdoors. In Bruce's responses about his early outdoor experiences, he described his early experiences outdoors as growing vegetables and raising livestock and playing sports in school. He related a story of walking in his fields in the summer, picking a ripe tomato off a plant and enjoying the pleasure of eating it outdoors in the sun. Bruce explained that he and his family had a big farm and raised all their own food in the small town in Ohio in which he grew up. His father worked in the steel mills, and he and his brother ran the farm. He described his early life as a kid, "I'd get up at 5 in the morning, go out and work. Chase cows down, milk them, get ready to go to school, then get home late at night and have to get that done before school work." He explained that he was good at sports, so he was busy year around doing something outside. In seventh grade he chose football over marching band and eventually went to college on a football scholarship.

Education. Bruce earned a Bachelor of Science, and was an academic All-American for 4 years, which allowed him to go to graduate school and earn a Master of Science in Exercise Physiology. He used his exercise physiology degree at Goddard Space Flight Center with aspiring astronauts, then earned a Master's in the science of teaching at American University. He taught Marine Biology and scuba diving on St. Croix U.S.V.I. In his 46 years as a teacher, Bruce explained that he has always had an outdoor component in his teaching.

Professional History Currently Bruce has 20 years in his position as a 7th grade science teacher. Before science, he taught physical education for 26 years. He has taught at 4 different schools in his teaching career. Biology and physical education are the subjects he has taught most often. Overall, he has taught six subjects (AP biology, bio-tech, advanced physical education, life science, and marine biology.) He considers biology and human anatomy/physiology his areas of deepest knowledge. Figure 3 shows Bruce's pedagogical elements, contextual factors and their relationships.

Professional Development

The opportunity to talk to other people at trainings and conferences, listen to and try their ideas is a motivator for Bruce. He has taken courses at Teton Science School (TSS). He explained that "I went there for three summers, two as a student and one as a teacher about how to teach water, the physical, chemical and biological aspects". He noted that he has received equipment through TTS for water science such as dip nets and chemistry sets." He has taken the whole 7th grade faculty to Teton Science School as well.

Bruce has taken courses at the Heritage Institute in Yellowstone National Park. He explains, "every summer we go down there for two weeks and we'd stay at the Buffalo Ranch. We've been in the wolf dens. We've had Dr. Halfpenny teach us about using GPSs and mapping and doing stuff at night with stars." He noted that,

We'd study the plants, study a little bit of water, study the wolves, study elk and things like that. We actually had an elk being chased by a pack of wolves and get caught in the Lamar River and killed like from here to the bus barn. So, we watched all week. Then the next day, grizzly bears came down and took it over. So, you see it in a succession and then all these birds and stuff.

Other trainings Bruce has incorporated in his classroom include one at Montana Tech in Butte. Bruce trained with other teachers from his school on water quality education. Together they wrote up a project regarding water quality in general and the creek restoration at the school in particular. Recently he applied to MSU for a grant to learn about and teach alternative energy. He explained that if he receives the grant, he will be working with his students to do a study of the downtown area to analyze it for alternative transportation possibilities, possibly creating a one-way downtown street.

As an aide to incorporating bike riding in his classrooms, Bruce has gone to trainings given by the big biking community in Missoula. The trainings were about bike safety and how to work with groups on bikes. He has taken a fellow faculty PE teacher and her husband with him to train and become certified on how to teach various aspects of biking.

Research Question 1. Why Does Bruce Choose to Teach Outdoors?

Motivations: Teaching and Personal

In Bruce's interviews, he explained that much of his motivations to teach outdoors stems from the perceived benefits to his students when outdoor teaching is an integral element in their science education. In his opinion, his students benefit in a number of ways. They benefit academically through an increased understanding of the relevancy of science content and in increased interest and engagement in learning. He feels his students experience an affective impact from outdoor teaching in a range of areas such as a greater appreciation of their local environment, which can lead to

increased sense of citizenship. He notices that his students tend to experience a rise in self-esteem through an increased sense of self-efficacy brought about by greater academic achievements. Furthermore, he has noticed a trend in enhanced interpersonal relationships in outdoor learning situations.

Student Academic Benefits

Direct Indications of Science Relevancy Bruce has found that outdoor phenomenon creates multiple opportunities to reinforce in-class lessons with real-life examples, often without being planned. For instance, one class watched swallows build mud nest on the eaves of the school, which corresponded to the videos he had shown in class several weeks previously about swallows in an African country. Another time a deer gave birth in front of the class, after discussing placental mammals in the classroom.

Bruce noted that students tell him that they appreciate being able to make connections between what they have learned in the classroom and the real thing outdoors. Students have said they “could see what he was talking about, it’s real”. Bruce has found that students remember outdoor field trips years later and that they will describe incidents, like seeing a moose in the city park on a field trip there, years after it occurred.

Increased Engagement in Learning In Bruce’s experience, students are motivated to learn through a variety of outdoor learning opportunities. He appreciates that students become excited to see natural phenomenon in the outdoors. As he put it, “it ‘hooks’

them”, and they are excited to learn more and be engaged in science and the natural world around them.

Student attention and engagement is critical for Bruce for teaching and learning; when he is teaching outdoors he said that he is always scanning the students’ faces for engagement. Bruce noted that outdoor learning can accommodate a wide range of learning abilities – science learned outdoors can play to the strengths of students with strong observational and questioning skills but limited reading, writing, and math skills, as he has seen in his two class periods that contain students with a wide range of learning disabilities.

Desire to Explore the Natural World Bruce explained that going outside sparks students’ curiosity and desire to learn. He observed that in the outdoors students get to explore and discover for themselves, which gets them interested and willing to investigate. Students begin to ask questions about the phenomena they see outdoors and come to Bruce for answers. He generally tells them to research and write a small report, for which he gives them extra credit.

Experiential Learning Bruce noted that outdoor phenomenon helps students develop observational skills, hunter/gatherer skills, and sensory awareness – the softness of a leaf, the worm inside a gall, aphids on a tree, owl pellets. He feels they are ‘thinking without thinking’ – experiencing, feeling, taking in the environment. Bruce is motivated to get students outdoors for their own sakes, “because they are young and growing...kids need to explore, need to see all the little things that are out there...it tunes up students’ observational skills”.

When asked what he thinks it feels like for students to be learning outdoors vs. learning in the classroom, Bruce replies, “I think there, they get the experience of it. They’re experiencing the cold wind, the wind blowing. One day I took them out and the kids came back and said, ‘that was a wind from hell. We suffered. I’m so glad to be inside.’”

Student Affective Impacts

Appreciation of the Natural Resources of the Area One of Bruce’s motivations to teach outdoors is to expose his students to what he considers the amazing and outstanding outdoor learning opportunities around his school. Available at the school where he teaches is the river across the field and the creek behind the school, abundant wildlife like eagles, deer, owls, snakes, moose, and lots of wildlife sign; plus, a variety of plant habitats: riparian, cottonwoods, and urban forest. During outdoor field trips, Bruce points out how their community is situated in the natural world, so that as students learn about the natural environment of their community, they can become aware of the interrelationship of their community with their natural environment. They can begin to discern impacts to their natural and urban environments and become aware of the resources available in their surrounding environments.

Developing Citizenship Actions and Values Community-based service learning projects have been an on-going part of Bruce’s curriculum. A significant way that students have benefitted from outdoor teaching has been through the projects that his classes have done over the years.

Community, civic responsibility and the values associated with good social behaviors have been an underlying foundation of Bruce's commitment to teaching. He works to instill civic-mindedness in his students, to create good citizens and community members. Bruce considers teaching manners part of his curriculum, and because of his business and community connections, he hears feedback about how the young people working in businesses in town have behaved. Bruce noted that he is proud of his students and pleased when he hears reports of polite manners and respectful behavior by his students in the community.

Bruce's students have impacted their community in other ways besides service learning projects. Due to the bike riding in Bruce's class, the local paper has featured them several times. One time the paper featured a group of riders from California who had worked with Bruce to stay in the community. Their bikes were stored at the school and they ate at the business that Bruce owns. The group contained people in the LGBTQ communities, which Bruce and his students supported.

His long-term relationships in the community mean that community members have called on him to help deal with and manage students who are 'screwing around'. His influence on students in the community extends past their time in his classroom – he mentioned that six years later previous students are still concerned if he sees them not wearing helmets when riding their bikes.

Rise in Self-Esteem A goal of Bruce's has been to increase students' self-esteem and self-respect, along with increasing their respectful interactions and leaderships skills with other students and in their community. He stated that his students gain self-esteem

by experiencing success when displaying what they have learned about local natural history when fishing or gathering usable plants. He also described that they have learned respect and leadership behavior with their peer groups doing service learning projects in their community. The spontaneity and creativity in student-designed science projects and students-generated investigations, sparked by their interest from outdoor observations, have also created opportunities for increased self-respect.

Enhanced Interpersonal Relationships Bruce noted that students have different interactions out in the field than in the classroom. When asked why he thinks that happens, he says, “It’s not as controlled, we don’t have walls, seats you have to sit in, we can go out and we can move.” While watching segments of class videos, Bruce mentioned “Now you’ll notice, there’s respect there too. When I’m talking, they’re looking. Now, they might not be thinking.” I’ve said, “Even pretend. I don’t care if you are listening to me or not, even pretend that you are. Just look at me. You might get something out of it.” He went on to say that, “if they have something to talk about, we’ll expect everybody else to listen to them, too. And if we’re not talking about science, they can talk about other things. Usually, I don’t know what they are talking about, who knows? Hopefully it’s appropriate.”

Bruce explains one of the differences he notices about student interactions in the outdoors as opposed to school classroom or hallway interactions:

Here’s what I’ve never seen happen, though. I’ve never had people come back in and say, ‘Jimmy called me a ---- and I’ve going down to talk to the guidance counselor.’ You see, that stuff doesn’t happen when we’re outside, whereas, inside in the hallways, exchanging classes and stuff, the kids say they feel very uncomfortable when there are no teachers in the hall, because that’s when people make these... ‘they bully us, they make

these different comments'. So, on these trips, knock on wood, I hope it never happens, but that stuff just doesn't happen, for some reason. I think they appreciate being outside.

Personal Motivations

Personal motivations can stem from the teachers' own desires to spend time outdoors. For Bruce, one personal reason he has chosen to teach outdoors arises from his love of bike-riding, and his desire to share that skill and passion with his students. Another reason he has chosen to teach outdoors is his joy of teaching and the perceived positive impacts learning outdoors has had on his students. His perception of the benefits to students of learning and being outdoors motivates him to continue to do 'the hard work' of outdoor teaching.

Desire to Bike with Students One of Bruce's motivations to teaching outdoors that he spoke about is that it allows him to get outside with his students, both on bikes and walking, to "breathe fresh air, see the seasons, feel the wind, and get their bodies moving". Bruce mentioned that one of the reasons he thinks students are motivated by outdoor teaching is because they often get to ride bikes. Bruce described students who want to come to school even if they are sick at home, because they want to ride bikes and they don't want to miss out.

Joy of Teaching Joy of teaching has been a motivation for Bruce. He said that he "enjoys the students, the work and the job". Interest and concern for his students, and finding ways to reach each student, came through clearly in many of Bruce's comments. He mentioned that he likes to learn "the skill of getting some knowledge to a kid. I like

it when their face lights up,” when they are learning and discovering new ideas and skills. He enjoys learning from his kids and finds ways to relate with each unique student and to help them be good students. Bruce said he feels like he has “the best job. I laugh when I go to school, I laugh when I go home, and I enjoy being here, I enjoy the kids. It’s pretty cool.”

Not only does Bruce learn from his students, but he is always educating himself, through classes, from other teachers, in programs, and by experimenting. He said, “I’m like a sponge, always picking up stuff. Stealing ideas, trying them out to see if they work. I experiment in class with new ideas.” As a science teacher, he has felt able to “try things out over and over again until students get it.” He makes a point of learning new skills and teaching innovative ideas learned from other teachers and institutions and applying them in his classroom. Bruce says he’s always learning, from whatever source is available – his student teachers, his students, other teachers, technology. He says “When I’m teaching them they’re also teaching me also so it’s kinda cool. I think it’s just developing a relationship with kids and have them be curious, you know.” Bruce was quick to say that, even with all the hard work, it is definitely worth it to take his students outdoors. Bruce noted that “it can be so exhausting to take kids outdoors, and you say to yourself, ‘why did I do all that?’ and then after a while, it’s like, ‘Wow.’” “Looking back on stuff I’ve done, I think, it was hard, but it was worth it.”

Research Question 2. How Does Bruce Accomplish Outdoor Teaching?

In the following analysis of Bruce's narrative, his responses to the research question of how he succeeds in outdoor teaching can be divided into two categories: how he plans for outdoor teaching, and how he manages outdoor teaching. Planning for outdoor teaching describes how Bruce develops the contextual factors that support his outdoor teaching events. The contextual factors include setting up protocols with his administration; enlisting community values and aid; taking advantage of inspiring outdoor teaching sites around his school; and meeting science standards by choosing to teach place-based curricula.

How Bruce manages outdoor teaching events can be categorized into four areas. The first is working with students to set behavior expectations and managing consequences. The second is class management while teaching outdoors, including class procedures and timing. In the third, Bruce does due diligence in managing his outdoor teaching, including the safety factors of working with his students with disabilities and riding bikes. Fourth, he works to develop place-based curricula to include natural phenomena encountered while teaching outdoors.

Planning for Outdoor Teaching

Bruce describes the preparation process for outdoor teaching as a series of progressive training steps, and through the process he starts to get a sense of who his students are. As Bruce explains it, the process begins in the beginning of the school year in the classroom by discussing appropriate behavior on field trips, and then the class will

alternate foot and bike trips, each time going out further, working on field trip behavior. Bruce makes it clear that he has a different attitude with his students outdoors than he does in the classroom. He points out that being outdoors with students is “a huge responsibility, and you have to understand that. You can’t just say, oh, I’m one of the kids. You’re not””.

Getting Students Out on Bikes Riding bikes allows Bruce’s classes to cover much more distance in a much shorter amount of time. Bruce states that “you get more time to teach and more time to learn. Riding bikes to the outdoor teaching areas gets students there twice as fast as walking, which gives the students more time in the field, and is much less exhausting,” particularly for the teachers who do it multiple times a day.

Taking students out on bikes can present a range of issues that Bruce has carefully resolved. When Bruce began planning to take his classes out on bikes, not all the students had bikes to ride. As a police commissioner, he was able to bring in lost and found bikes and donated bikes to school and fit them to students each period. At one point, Bruce received a grant from Montana Department of Transportation for 15 coaster bikes and a bike trailer. The bikes are numbered, but students don’t necessarily use the same bike each time they go out. Since all 15 bikes are the same now, he can get everyone adjusted in 4 minutes, using a hex wrench for the seats. He has done the routine so often now that he knows how long it will take to adjust seats and handlebars on the bikes each period before taking off.

He trains his students how to ride a bike if they don't know, and how to be safe on bicycles. Some students come to school not knowing how to ride. The year this research took place, three students did not know how to ride a bike when they came to school in the fall. He teaches group riding rules as well. As Bruce says, "Riding in a group is different than riding by yourself, but riding in a class is "totally different, 'because I expect you to learn something here'". He shows them how to ride in a group, how to talk in a group, and then has them do a bike jamboree to practice. The classes take a break from riding during winter, and in the spring, Bruce reviews everything with students to get everyone on the same page. The classes also do a week of bike/train safety with Montana Rail Link (MRL) in the spring. Bruce tells students that they represent the school when they are out riding bikes in the community, and he reminds students about appropriate behavior and re-teaches every time they go out.

Administration

Bruce worked with his school administration in a number of areas to help organize the context of his outdoor teaching. Those areas included the range he could go to outdoor teaching sites, permission form protocols, support for place-based curriculum, financial support and grants, and the inclusion of other faculty in professional development opportunities.

Outdoor Teaching Sites In consultation with his administration, it was determined that Bruce would have a three-mile radius around the school in which to take his students, either walking or on bikes. Available sites within the three-mile radius are a stretch of private land that Bruce has gained access to that includes the river bank in

front of the school, a large city park with a lagoon, a fishing access point on the river downstream from the school, the creek behind the school, and his classes can ride out to a large island in the river that has road access.

The field trips that Bruce takes his classes on around the school are supplemented by a full day field trip to Yellowstone Park. Another field trip beyond the three-mile radius around the school is the annual all-day, 8-mile, bike ride to one of the bridges on the river. At that site, students have been known to fish with a baited line on a Coke can, and one time a girl caught a big trout, which they cooked and ate.

Permission Forms For parental permission, Bruce created a blanket permission form that he sends out in the beginning of the school year that covers all the field trips he might take within the 3-mile radius around his school, and it gives students permission to ride bikes as part of science class. For longer, specific field trips, Bruce sends out a separate permission form for each field trip.

Place-Based Curriculum Support Bruce has worked with the administration and curriculum director to develop curriculum to include outdoor science. His administration supports him in choosing when in the school year he teaches the various life science topics that he is required to teach. That flexibility allows him to match the topic to the seasons of the year - doing indoor content during the winter (cells and cell biology) and outdoor topics in the spring and fall. (water in the fall, plants and birds in the spring).

Grants and Financial Support While his administration completely supports his efforts at outdoor teaching, Bruce does not ask them for money for his science classes

and projects. Instead, he has participated in fun runs and written grants to various organizations. His administration writes letters of support for the grants. The grants support his class, and he explains that he typically does not write his outdoor teaching expenses into the school budget. Over the years that Bruce has been teaching, field trips costs have been covered by grants from the local newspaper, Dept. of Environmental Quality (DEQ), National Science Teachers Assoc.(NSTA), MT State University (MSU) (when Bruce takes courses with them), and SMART (Saving **M**oney and **R**esources **T**oday) Schools grants, from MT DEQ, among others. An example of a grant that Bruce obtained was the Montana Department of Transportation (MT DOT) grant for \$6000 that enabled him to buy bikes for classes to use. In order to pay for the buses for the Yellowstone Park field trip, Bruce and his classes participate in a local run, which brings in around \$500. As of these interviews with Bruce, this will be the fourth year they've supported the competition.

Faculty Support In general, faculty in Bruce's school are aware of and support his outdoor teaching activities. He has partnered with the math teachers and language arts teachers to create an integrated curriculum for the Yellowstone Park field trips and other trips and worked with the P.E. teacher on the bike jamboree each year. However, past principals have indicated that they have dealt with a few negative comments from other teachers, though that has not affected his outdoor teaching. Bruce has helped to bring some of his fellow teachers to places like Teton Science School and Yellowstone Park to get training in outdoor science so his team works together to support and utilize the outdoor teaching opportunities in the area and at the school.

Community

Throughout his discussion of his outdoor teaching practice, Bruce mentions his connections with the community he teaches and works in. People in his community know that he takes a hands-on, active approach to teaching science, which they support by providing learning opportunities when they become available. Community members have called him when there are items worthy of bringing his students to see - a black bear that's been hit by a car, or calf birthing. They have offered to help with field trips and safety education. Various business owners have provided bike riding support and taught bike safety, train safety awareness, and tobacco awareness. Bruce has connections with the police department so that if there are any concerns about taking kids out, he is notified with updates on his phone, which can affect where and when he takes his students outdoors. He has received 6 calls in 15 years for things like a bear in the area, a moose in the area, and an alert about a suspect individual. He keeps parents informed of what's happening with phone calls and letters, by inviting them on trips, and by making his classes inclusive for them. The community is aware that he bikes with his classes and support it. Some parents have let him know that it's one of the best things they want for their kid when they call to express their appreciation.

A further community connection Bruce has made is with local landowners whose properties are near the school. He's developed ongoing relationships that benefit his students because they are allowed on sites that offer science experiences in local environments. Recently, Bruce and his students gave a plaque to a local landowner

who's allowed access on their property for many years and allowed Bruce to set up an outdoor classroom with a trailer of equipment that stays in place all year.

Community Involvement in Classes Student service learning projects that have been developed and managed in conjunction with the community have been a part of Bruce's classes for years. Projects that his classes have either instigated or taken a part in are: painting chevrons on streets for bike safety; painting storm water drain warnings; getting involved in the restoration project for a local creek; developing a roundabout for the city; and having the bike path extended. Bruce has enlisted community involvement by inviting the local newspaper to come and learn about what the class is doing. His students become excited to have the paper come take pictures and Bruce posts the newspaper photos and articles on his door for everyone to see. He also brings in guest speakers to his classes from the community.

Some of his students have done independent projects that have benefitted the community and county. One of his students did a project on the city compost project. A group of his students put together a presentation for the city commission on a project to improve the city for bike safety, which the city used to raise money to make the improvements. Current plans are to have students help create an alternative traffic flow pattern to improve traffic safety for alternative forms of transportation like bikes and walking.

Community Values for Students Because Bruce is active in his community, he hears about it when tourists compliment the community's young people on their manners and politeness and he states that he feels proud and responsible that he helps

develop the values and actions of the young people of his town. He's also informed about student behavior issues related to bike safety that come up in the community. He is sometimes asked to talk to students about their behavior. When he does, he stresses that 'with privileges comes responsibility', and that they need to be aware that they could cost other students opportunities who want to bike in his class.

When his classes are using the local landowner's property between the school and the river, he has students help clean up the property, and he uses the opportunity to teach about respect, responsibility and honoring the privilege of using the land. To enable his classes to use the property, he promised the landowner: "When you have deadfall and such, let us pile it up for you. Let us do some of these things to help out. Let us pull the invasive species, please." Bruce says that he told the landowner, "We'll respect your land, we won't do anything, bring any trash." Bruce makes a point of telling his students "it's a privilege that we get to go on the property."

Personal Community Involvement Bruce's involvement in the community goes back for years – he's well acquainted with the members of the police force and serves on the police commission. Bruce takes advantage of his ownership of a deli in the community by taking kids for ice cream cones occasionally. He feels that as a teacher at the local school, his situation is unique. He says, "It's just unique here. You know, three blocks away, we walk down and have a free ice cream once in a while. I mean, we ride our bikes down and stop and have an ice cream. I say, how cool is this?"

Bruce makes a point of knowing about his students' personal lives and about their families. Watching the class videos, we hear him congratulate one student had just

broken a school record for running, a record that his father had set in the past. He teases another boy about his doctor's appointment and a girl about her boyfriend. Bruce explains, "See, when you are teaching, you've got to know everything, besides what you are teaching. It makes a kid, at this age, feel good, you know?"

Managing Outdoor Teaching

In talking about teaching outdoors, Bruce stated that "if a teacher has the desire to take students outdoors to learn, it's a lot of hard work and it takes time to develop the protocols and strategies." He made the point that "you need to have a plan in place, and have time limits and goals, or you lose the kids". He goes on to say that "it takes time to be ready to go outside, you have to have your kids ready, you can't just go out sometime". Bruce explained that:

It's work training the students, it's physical work, being out with the kids, checking the area beforehand, having equipment and materials ready, and it is mental work as well, thinking of all the things that are going on, being aware of liability, deciding what to do if you can't go where you planned. It's also emotionally demanding, dealing with all the needs of the students, all the issues of the situation.

People who hear about how he takes his students outdoors say to him "you must have a blast." Bruce says he doesn't, because he 'is always worried about what he may be missing, what he's not seeing, and what could happen with his students'. Bruce stresses that he is always paying attention to his students outdoors. He tells a story of another teacher who tended to not watch his students very closely as an illustration of what not to do when teaching outdoors. He says, "I can't do that stuff, I don't want the program to fail because students have gone missing or are injured while outdoors."

Behavior Expectations and Consequences

According to Bruce, appropriate student behavior is critical to successful outdoor teaching. From the beginning, Bruce educates his students about appropriate behavior and the consequences of misbehaving. He indicates that poor student behavior, disrespect, etc. acts as a limit to taking students outside. He lets students know that outdoor learning is a privilege that can be taken away if students behave poorly. Bruce makes sure students are paying attention and listening respectfully. He sets clear expectations and enforces those expectations, and he will bring in the parents if necessary to change poor behavior.

Expectations Since he began to teach outdoors, Bruce has had two rules in the field: no touching and no throwing. He explains why to his students, and tells parents too, so that if something happens, they are aware of the expectations and consequences. Even at the end of the school year, he still repeats the rules every day they go outside. Bruce also insists that students pay attention, just like in a classroom – ‘no talking while I’m talking, or anyone else’. While watching the video from one of his class periods, Bruce points out how all the students are paying attention and seem interested. He states that he would have been upset if he had seen anyone not doing that and he had let it go.

Encountering natural phenomenon occurs frequently on Bruce’s field trips, something Bruce makes a point of looking for and including in his lessons for the day. He feels that one of his responsibilities is to emphasize to his students the outstanding natural phenomenon that they encounter on their field trips. As he puts it “We’ll go out and we’ll see two eagles sitting there, I’ll say, ‘you guys, this is phenomenal! And

they'll go, 'we see this every day.,' and I'll say, not like this!" One of the phenomenon that the classes encountered on a field observation day was a nest of garter snakes. In the videos recorded that day, many students are holding garter snakes. When asked about that, Bruce says they are doing just what he asked, "I think they're doing fine, they are all doing just fine. Nobody is harming the snake, they're just gently holding them. They aren't scaring anybody with them, they aren't doing stupid stuff."

Consequences At the start of the school year, Bruce explains the rules and reinforces them on field trips until students are well aware of behavior expectations.

Bruce is firm about what is allowed and what is not allowed. He states that:

students know what the line is, and that if they cross it, they will be in trouble, but not big trouble. If students cross the line, they do the consequences – like sit-ups, or staying after class, or losing bike privileges. When it's over, they are back on the right side of the line and the infraction is dealt with and over.

Consequences for misbehavior start with letting students know that he is disappointed in them, and then could include restricting their options of going on field trips next time but letting them know that it would make him sad to not have them on the field trip. He will also call parents to let them know what happened and that the behavior is unacceptable. He noted that typically, students come back afterwards and apologize for their misbehavior. When students are disrespectful, outdoor opportunities are eliminated or cut back. Sometimes he will use peer pressure to motivate students to adjust their behavior, by letting them know that they 'can keep acting like that, but the class will not go on any trips.'

Bruce often assigned push-ups as a consequence to misbehavior. In one of the videos, Bruce asked students to whisper, and one of the boys didn't whisper quietly enough, so Bruce told him to do push-ups. As the boy started to do the push-ups, Bruce turned to walk away, and the class began to follow. The boy noticed that there was bird scat right where he was laying down to do the push-ups, and that the class was walking away, so he didn't do the push-ups, got up, and joined the class. When asked about the push-ups, Bruce said that students can choose not to do them, but the alternative is to stay after school 2 hours for 3 weeks. He had cleared those consequences with his principal when he started teaching science. Bruce stated that "some of his students do a lot of push-ups, and some don't do any at all".

Doing Due Diligence: Schedules, Safety, Riding Bikes

When discussing how he manages his field trips, Bruce spoke about how "managing bike riding, and taking students on field trips in general, means doing your 'due diligence', and having very specific rules and guidelines, including letting your administration know that you know the areas you are going, you have checked them out and they are safe". On a field trip day during the first period, Bruce keeps an eye out on how things are laid out for any obstacles or hazards they might encounter, and for any learning opportunities that might be present along their path to the site they are going that period.

One of the field trip sites that Bruce uses often is the strip of private land along the river that is just in front of the school. On the field observation days when the videos were recorded, most of the classes went to this private property. The property has tall

cottonwoods with grasses underneath, a few shrubs, and along the river bank there is a levee with a flat top, like a road, that is easy to walk on. Willow and alder shrubs grow along the river bank, and the water that field trip day was just below the top of the levee. The levee bank is steep, and at that time of year the river was moving fast and near flood stage with snow run-off. Bruce noted that he can't have them out there messing around, that would be unsafe, that some fool would push another one into the water. To access or leave the property, Bruce has the option of having the class climb through the fence or straddle the fence anchor posts above the river.

Typical Daily Class Schedules A typical day for Bruce is 5 class periods and 2 prep periods. The year this research study took place, he had classes for first through fourth periods, with lunch between 3rd and 4th period. Fifth and sixth periods were prep periods, and 7th period was his last class period. He goes outdoors with the students each class period, though he may not take each class to the same location during the day. Second period students will get out on bikes or walking, but they may not go as far or cover the same material. In the fall and spring, Bruce goes outside three or four times a week and sometimes only once a week. Bruce explained that how often he goes out depends on 'if the class is caught up, what they are doing, what they've seen, what they've learned, and the safety of the situation'.

The timing of an outdoor class is carefully controlled. Bruce plans the class schedule to leave the outdoor teaching area and head back to the classroom with plenty of time to spare in case something should happen. If something did happen, like a flat tire, there is time to deal with it and still make it back for the next class period. Bruce

constantly checks his watch. Out of the 55-minute class period, when students are on their bikes or walking, they have about 40 minutes in the field. In the 40 minutes, he'll 'plan a little lesson somewhere'. While Bruce is out with his class, though he is very conscious of the time, he does not hurry them or make them feel they must speed up what they are doing. It creates an atmosphere in which the class is focused on their surroundings and what he is explaining, and not trying to rush through the field trip.

Bruce starts class periods with bellwork, which is work students are expected to start on when they initially enter the classroom. The bellwork typically relates to the field trip the class is going on that period. For field trips, students either have a hand-out or they write in field notebooks. Field notes are modeled after Lewis and Clark's journals, as Bruce describes them, so students are journaling like scientists and writers.

For the field observation day, the bellwork was the beginning of the field notes for the field trip. On the white board was a list of vocabulary words relating to the science content the field trip will explore: canopy, understory, niche, riparian. As students walked in the classroom and went to their seats, they read the board, went up to the front and picked up a clipboard and a handout for the period, went back to their seats and started filling out the handout. As the class began, Bruce looked up the outside temperature, wind speed, and visibility, and had students record that data, along with the date and time.

In a video taken at the end of a class period, students were back in the classroom and talking about what they experienced. Bruce stated that he felt the discussion went well, that kids were listening and talking and seemed to like the experience. Bruce noted

that he tries to have time at the end of class for students to debrief and/or write up a lab report about what they saw and did, and that typically, students do a daily write-up of the outdoor field trips after they come back inside.

2nd Period and 7th Period Bruce teaches two class periods with students with special education services or disabilities. Several of his second period students deal with issues around walking, and so Bruce provides 3-wheel bikes for those students. The trike bikes allow those students who aren't capable of balancing on a two-wheeler to get out and ride with the rest of the class. During the video recall interview, Bruce mentioned that one of the girls would fall off her trike often as a result of seizures and falling asleep, but that they were doing fine that period.

Field observations were made on two separate days of the 2nd class period. On the first day, the group had eleven people, counting Bruce and the paraprofessional teacher, or 'para', assigned to the class. The class biked to the local park to check on baby goslings. On the second day, the group had nine people, with the two teachers, and they walked over to the high school to check out the greenhouse. Bruce stated that his goal for this class (2nd period) is to get them out exploring, looking at colors and talking about different elements of outdoor science that might come up.

The last period of the day is 7th period. Students in this class have education plans, such as 504s or IEPs. A para is assigned to this class every day. There was much less joking around with the students in this class, and much more emphasis on consequences of behavior. At one point, the whole class was doing push-ups for not paying attention. Bruce called on girls to do push-ups in this class, something not

observed in other classes. He noted that this class meets at the end of the day, which may account for some of the different behavior challenges with this group.

Bruce mentioned that while he is teaching, he is “constantly scanning this group for attention issues and for spontaneous behavior that could lead to someone getting hurt”. He mentioned that he is also ‘more protective of this group’. He said that “this group has the poor readers, the poor math guys, the poor self-esteem kids”, and that he needs to ‘make sure the rules are very set for them’, that the rules are constantly reiterated and reinforced, so that students can feel successful by not making as many mistakes. In the video from the end of this period, his students are simply sitting quietly, not doing a write-up as the other classes did at the end of their periods. When asked about his choice to not do write-ups and to have the class sit quietly, Bruce stated “that’s because you wouldn’t get one (a write-up) from this group. I had them just sit and be quiet. That’s hard for that group.”

Safety Equipment and Procedures Considering safety concerns, Bruce said, “in the classroom, everything is safe, up to a point, and I can teach and sit back down. Outdoors, I have to be careful, teach, and still get back to the school on time”. When considering medical situations, Bruce said “You’ve got to know your kids.” He has dealt with diabetes and allergies, among other issues. Bruce brings basic items for medical emergencies, such as band-aids, glucose tablets and an EpiPen, in a backpack, fanny pack, or small pack on his bike. He always carries a whistle for safety reasons, to get students’ attention outdoors quickly, and he carries a little extra gear just to be prepared. He has his cell phone with him during class to have the school office in reach.

He considers it his lifeline to the school ‘for all kinds of stuff’. He’s connected to the Nextel (information channels for the police) for warnings, animal sightings, and what’s happening in the community, so he can plan his class trips in response.

Managing Bike Riding Bruce rides his bike with every class for 5 periods, with 2nd period being the special needs group, so they don’t go as far or do the same things. As we watch one of the field observation videos, Bruce goes over the rules for acting safely while riding in a group on the roads (calling out ‘up’ and ‘back’ to alert riders about cars), using hand gestures, being safe around cars. He reminds students about not getting your shoelaces caught in the chain, or not touching your bike tire to another tire while riding or watching that a sweater around the waist doesn’t get caught in the spokes or chain.

All students wear helmets all the time when they are riding bikes in class. He has a stack of helmets in the back of the classroom. If they don’t wear their helmet while on a bike, they lose the privilege of riding a bike. As an example. Bruce indicates a boy in the video who is walking and makes the point that he is not riding a bike because he wasn’t wearing his helmet the last time they went out and this is his consequence. Bruce said he reminds them of the rules each time they go out on bikes, and he still receives calls from motorists about inappropriate actions that students have done on their bikes

In general, students do not carry any clip-boards or anything with them on their bikes. If any equipment is needed, Bruce drives it down in his truck and leaves it parked where it is needed for the day. When the class heads out, Bruce takes a small tool bag with him and carries a small CO2 cartridge to fix flats in a hurry. He has a tool box and

a tire pump in the classroom that students know how to use so they can fix their bikes before they go out. Bruce inspects the bikes periodically, each day sometimes, to check for damage or repair needs, and oils the chains.

In videos and photos of his third period class, students are discussing where they should go on their bikes that period. Bruce says that he is letting them be part of the process of thinking what they are going to do, even though he already knows what his plan is. He explains that if the class decides to go on bikes, all the students must be on bikes. Bruce mentioned that there really weren't that many different places they could go on their bikes within the three-mile radius limitation.

Place-based Curriculum: Standards and Development

Curricula Goals Bruce has a number of science curricular goals he has worked to achieve in his outdoor teaching. Those goals include reaching his students through multiple modes of experience, providing opportunities for students to learn observation skills and explore natural phenomenon, and creating interesting and fun classes to increase student engagement and learning.

Multi-Modal Teaching To reach his goal of 'multi-modal' experiences for his students, he provides opportunities for students to engage in science content in a variety of ways, including writing, drawing, building projects, observation, and discussion. Field trips on bikes or by foot are a multi-modal experience for students that often reinforces the science content that they are studying in class. The field trips are

correlated to his curriculum, with few restrictions from administration except safety considerations.

Observation Skills A goal of his is to develop students' ability to observe, to 'really see the little things that are going on around them'. He puts it in this way, "it's taking the opportunity to see a unique event, like bats learning to fly, rather than sticking with the planned curriculum. I use it as a 'teaching opportunity', which I approach in different ways, depending on what happens." He explains "it's like something will make it click. So when I see a mayfly, I can talk about gleaning. Whatever I see out there, we talk about. It's like a little naturalist talk."

Exploration and Student Engagement A goal during field trips is for his students to explore. As Bruce explains it,

they might come across a number of things. So that's what science, I think, is, where we are exploring. So I have them explore.... I don't know what they're going to find, I just give them some ideas of what they may find. I can't point out everything. Once in a while, a kid will point something out to me. So it's like have 30 sets of eyes, 60 eyes out there besides mine.

Another goal is to create interesting and fun classes so that 'students really learn and want to be there'. Bruce goes on to say that one of the advantages to teaching outdoors is the opportunities that might come up to engage students in interesting natural events. When asked if teaching outdoors is one of the ways he has found to make class more interesting and fun, Bruce replies "Absolutely, yup, and not just outdoors. I think that includes field trips, and project-based, hands-on activity, whether it's outside or in your classroom." Bruce was encouraged by a previous science teacher, who is now the curriculum director, to use the outdoors as a learning opportunity. Bruce stated that the

teacher told him, “when you live in a place where the outside is available, why keep ‘em inside and learn it from a book when you can go outside and actually see it?”. He ‘hit the nail on the head’, according to Bruce. The types of activities Bruce does now in science, and his outdoor field trip calendar, have evolved since he has built on the things that he began doing 15 years ago, noting that ‘he teaches totally differently now’

In keeping with his goal of making science interesting, Bruce’s room is filled with many different elements pertaining to what he teaches, such as student work, mounted animals and fish, skulls and bones and pelts, equipment and supplies, bikes, plus cupboards and desks for 30 students. He has most of the wall and ceiling surfaces covered with items. Looking at the videos and photos of his room, Bruce commented that “So there is a lot of action in my room.” In the set-up of his classroom, the desks face the whiteboard at the front of the room, and Bruce’s computer and stool are off to the side of a tall, wide desk that stands in front of the whiteboard. When he sits at his computer, he can turn to the left to see his students or turn to the right to see the whiteboard.

Humor as a Teaching Strategy Bruce uses humor to relate to his students, for fun, and to make learning memorable. One example was while they were outdoors examining deer scat, he went through the motions of tasting the scat to help determine what kind of animal left it. He offered a taste to students as well, in such a natural way that it seemed like a plausible test to make. In another example, while outdoors with his third period class, it was evident that this class wouldn’t find any asparagus since the previous two classes finished it off, so Bruce discussed the plant called houndstongue

with them and made up a story about how he's going to start manufacturing toilet paper from it.

In one of the videos, a student rubs her arm with the houndstongue to feel how soft it is. Bruce pointed out that she is now learning about the plant by feeling it, using her senses. In discussing the video, Bruce laughed about the funny idea to make toilet paper out of houndstongue and explained that the asparagus and houndstongue discussions were a way to have students think about what grows in the forest from a hunter/gatherer point of view. He noted that the multiple interactions with the plants give students a greater chance of remembering them and their characteristics.

Whole-Group Vs. Individual Instruction Bruce made a point about outdoor teaching that he felt was particularly important with his classes with special needs, that when his classes are outdoors, the students are not able to receive the individual attention that they can get while in a classroom. He explained,

When you are in the classroom, it's easier to do it [give individual attention] than out here. Have you noticed that? Out here, you've got to go with the group, and if anyone is farting around, you can't address that one person. Inside it's more individual than you can manage outside. When we are as a group, we're looking at canopy, understory; see, we're doing everything in a group. When they're inside, you want individual things, because what am I going to learn most, when I'm in a group or by myself - doing it by myself.

Since outdoor teaching for Bruce tends to be group learning, he keeps the limitations in mind when planning his lessons and uses outdoor group teaching in conjunction with individual learning opportunities in the classroom.

Affective Teaching Goals. Teaching manners, respect, being a learner, being a leader, is as much of what Bruce teaches as science content. In discussing what he emphasizes in his classroom, he said “We talk about that all the time. You’re being respectful, being a learner, you know, being responsible... being a leader and a learner. We talk about those things all the time, and everyone has to be reminded of those things.”

Asked if he thinks his students have a different attitude when they are outdoors, he says,

Nah, they’re just kids. They like different things, sometimes. You’ll always have the kids that are kids, and you’ll have the other kids that are the learners and the leaders and take things really seriously, and you’ll have the guy that wants to be with his buddy and just talk about whatever they did at the baseball game last night and stuff like that. Those kids won’t be paying much attention and will answer with ‘oh, yeah, that looks nice’ to me,’ when I point something out.

That’s when he calls their attention to an item or event the class has come across in their exploration by saying “Looks nice? Get over here and look at it!”

Science Curriculum

The science curriculum that Bruce teaches is based on state and school district standards, which at the time of this research are based on NGSS standards. For science topics in general, before heading outdoors to teach Bruce covers the basics in his classroom first, and then as the science units progress, he incorporates outdoor experiences into the curriculum. As he put it, “as they know more and more, they can take that knowledge outdoors”.

Seasonal Science Pedagogy The sequence and timing of the science topics Bruce teaches are determined seasonally, by what areas and what types of natural phenomenon are available to him when he teaches outdoors.

In the fall we start off with water science because the water levels are much safer in the fall than in the spring. We are in the Missouri watershed, we'll start off with the watersheds first and then we'll study macroinvertebrates because this is a fishing community and we'll learn how to tie flies. We'll learn how to identify insects, so, we'll actually go into invertebrates, and study that for a quite a while. Along with that we're doing water quality, so we'll do the physical 'how do we measure the stream'. We'll look at turbidity, how fast the water's going, how deep is it, what's the water temperature, things like that on the physical side. And then what's the shape of the river, does it have deep bits or whatever, and then we'll do the biological - that's when we go into all the macroinvertebrates and what have you, and how does that determine water quality. The stoneflies' the king so we'll look for stoneflies, mayflies, caddisflies. The students are hands-on with identifying the macroinvertebrates.

In the fall, students collect aquatic macroinvertebrates out of the river in front of the school and identify them in the outdoor lab that Bruce has created in a trailer that he keeps parked on the private property near where students collect insects. In explaining his water science curriculum, Bruce says, "So, it's like trying to keep every kid engaged. They all have a job and they're all using dichotomous keys to figure these little bugs out, what they have there." Because of the geographical location of Bruce's school building, he has two diverse types of water resources available to him and his students. He explains how he uses the two resources,

I'm very fortunate that we have the Yellowstone River, that's 200 yards, but we also have the creek out behind the school, and they just redid it. So, when the weather is not safe for bikes, raining and what have you, we'll go out and hike along the creek and stop and look at different systems and niches and ecosystems: what's going on here, what's this little part of the river like compared to the river? We can actually compare a slow-moving,

manmade waterway that's being taken over by nature, how's it developing compared to the Yellowstone River.

In the winter when the weather is too challenging to spend much time outdoors, his classes study topics appropriate to indoor work, such as cell biology and DNA, and they work on science fair presentations. Outdoor science topics that Bruce may teach in winter are snow chemistry and snow characteristics, such as pH, temps at tops and bottoms of the pack.

In the spring the classes study plants and birds. The plant kingdom unit includes projects such as seed germination in the aquaponic system, greenhouse and outdoor gardens adjacent to his classroom. He also incorporates an Indian Education for All (IEFA) component through questions such as: how did the Indians cure headaches using plant properties? When the weather improves enough for bike-riding, the plant kingdom unit is reinforced with bike rides to different areas around the school to look at nonvascular plants and vascular plants. During the field observations for this research, Bruce was teaching about types of vegetation in riparian areas: canopy, understory, shrubs vs. trees, sedges, rushes, niche, scat, biotic vs. abiotic factors in an ecosystem, herbaceous, and woody plants. Bruce explains his bird unit choice for spring:

The great thing is, right here, we're in a flyway, so the birds will start coming in as soon as the snow is gone. When it gets about forty degrees, we start seeing all kinds of birds coming in here, so we'll go out to the local park. The park is great because it has all kinds of water on it, so birds will come in and build nests and hide and what have you. We'll see wood ducks, we'll see mallards, we'll see Canada geese, we'll see all different barnacle geese, we'll see sometimes snow geese and swans, trumpeter swans. And the osprey come in and the eagles come in, so we're looking at all those different things, you know. We'll talk about how the male mallard is really looking sharp, bright, bright colors and the females kinda drab, and once in a while we'll catch em mating and the kids will all go crazy"

Regardless of the science topic of the day, Bruce emphasizes that specific curriculum content may change as the day progresses when teaching outdoors, since new science content opportunities may present themselves while other content areas may not be present. He noted that the overall content of his classes is consistent each period for that day.

Assessment The forms of assessment in Bruce's classes range from daily write-ups of field trips to projects that students design for units such as the plant kingdom, the animal kingdom, and cells. On the days his students go out on field trips, they usually complete a write-up of what they've learned that day. He describes how he explains the write-ups to students, "Then they have to give me, at the end of the day, a little write-up of what we did that day and that's what they get graded on."

Standardized Testing In Montana, standardized tests are not part of the curriculum for students in seventh grade. In response to questions about standardized testing, Bruce said that he's glad his grade doesn't do standardized testing because it gives him more flexibility of what and how he teaches. He explains that he can go over a subject a number of times until students get it. He points out that he does keep standardized testing in mind, however, because even though his grade level does not do standardized testing, he is aware of what students need to know for the tests they will be taking. That means that there are certain science topics he makes sure to cover very well, like the organization of cells.

When asked about his opinion about outdoor teaching and standardized tests, he says that outdoor teaching does not ‘get in the way of standardized testing’ because he sees the look on their faces when they are having a good time and they want to learn more. His students bring him books and things to show him what they are learning. In his experience, outdoor learning reinforces concepts learned in the classroom, because they see the phenomenon in real life.

Bruce’s grading philosophy is to allow lots of extra credit, and to give kids lots of motivation by making assignments worth quite a lot of points, which are part of his philosophy of looking for their strengths so they can succeed. His students ‘knock the standards out of the park here’, so he feels he is doing pretty well with that.

Bruce’s outdoor science teaching is worked into his yearly curriculum, weather-dependent and safety dependent. He pays attention to what he and his class encounter in the outdoors, so that if something interesting is happening or appears, they can take advantage of it. In that case, Bruce will modify his plan and change focus, as he says, ‘it would be a waste to ignore it’. Bruce makes it clear that an advantages of teaching outdoors is that there are unplanned opportunities for excellent science learning. As an example, he explains “You know when they say, ‘oh, we found some snakes, can we hold one?’ Well, why wouldn’t you, unless it’s a rattlesnake? Please don’t do that.”

Summary of Bruce’s Pedagogical Ecology

The research questions that this study seeks to answer are 1) why do exemplary teachers choose to teach outdoors? and 2) how do exemplary teachers accomplish outdoor teaching? In the narrative for this case study of Bruce’s outdoor teaching

pedagogy, there are key elements in that describe why he is motivated to teach outdoors and how he accomplishes outdoor science teaching.

In answering the question of why he teaches outdoor science, Bruce explains his motivation by saying that he sees an increase in students' sense of self-respect, self-worth and citizenship through the sense of accomplishment they feel from various aspects of outdoor learning. Those aspects include mastering the life-long skill of bike riding; gaining appreciation and concern for their 'place' through personal, experiential knowledge; and taking action in their communities through outdoor-based service learning projects. Bruce states that when learning outdoors, students develop a greater sense of engagement in and excitement for learning, qualities that lead them to learn and retain science content knowledge more deeply and consequently earn higher grades in class, another factor that increases student's self-respect. The wealth of opportunities for students to observe outstanding natural phenomenon right in their own community is a motivator for Bruce to get his students outdoors to observe, learn about, and ultimately appreciate all that their own local environment has to offer.

How Bruce accomplishes outdoor teaching can be understood by considering how he plans for outdoor teaching, and how he manages his classes while teaching outdoors. There are several key elements in how he plans and manages outdoor teaching.

When Bruce first initiated his outdoor science teaching program, he gained support from his administration, local landowners and his community. He maintains that support through his adherence to 'doing the right thing', by faithfully practicing due diligence

and following safety protocols. As each school year begins, he teaches appropriate student behavior during field trips and on bicycles and maintains student behavior through clear expectations and consequences.

He has closely tied his science curriculum to local outdoor teaching opportunities available to him throughout the school year. Two examples in his curriculum are that he teaches water science during the fall, when water levels in the nearby river and creek are much lower and safer for students to work in; and plant science in the spring, when students can plant in the greenhouse and observe growing plants outdoors. Over the years that he has developed the outdoor science teaching opportunities in his curriculum, he has determined which outdoor areas to take his students to observe natural phenomenon that they can connect to class science topics. He has succeeded in adapting his curriculum and pedagogy to differentiate for the wide range of student abilities in his five class periods, so that each student experiences success and real-life connections to the science they are learning in their classrooms.

This narrative picture describes Bruce's creation of relevant and engaging learning experiences for his students, accomplishments that he has achieved through vision, hard work and perseverance. Bruce's choice to teach science outdoors is reinforced by the perceived beneficial impacts he sees on students' learning and self-worth. Bruce may be unique in his profession in being able to get his students out on bikes to experience outdoor science phenomena. In the analysis of Bruce's actions and motivations for teaching outdoors, it is evident that the synergy of the natural attributes of his school's location, his desire to teach science experientially, his extensive

experience in physical education, and his strong school and community ties, have led to Bruce's approach to teaching science outdoors. His outdoor teaching approach is a model that works for him and his students in the setting of his school and town.

Case Two: Analysis of Themes in Henry David Interviews

Henry David (his chosen pseudonym) is the second study participant in this multiple case study research. At the time of this research, Henry was a fourth-grade teacher in a small rural school in southwestern Montana. The narrative analysis begins with a sketch of Henry's personal and professional history. In response to the research questions of this study, the narrative continues with a discussion of Henry's motives for teaching outdoors, and then describes Henry's planning and management of outdoor teaching events. For the past few years, Henry has co-taught with the other 4th grade teacher in his school, who is referred to in this narrative as B. Figure 4 shows the nested factors within Henry's pedagogical ecology that motivated and enabled him to teach outdoors.

Personal Sketch of Henry David

Early Years: Childhood and Education Henry David grew up in a small town in western New Jersey, situated on the banks of the Delaware River. He describes the area as farm lands and deciduous forests, with meandering creeks and muddy-bottomed ponds filled with bass. Henry notes that his family were very outdoorsy, and one grandfather, after school and on weekends, would take him out to fish, trap, and "sometimes just walk through the woods, pointing out things that I had never seen

before.” Henry explains that “I always had this connection to nature.” During his adolescence, Henry chose to do “mostly sports and outdoor geeky stuff like hiking, playing in dirt, wandering through streams, checking trap lines with my grandfather.” Around the family home he recalls “weeding the garden, mowing lawns,” and a childhood with “live music, picnics, walking through the woods identifying plants, animal tracks, building things in my father’s woodshop, riding dirt bikes, riding road bikes, soccer, lacrosse.”

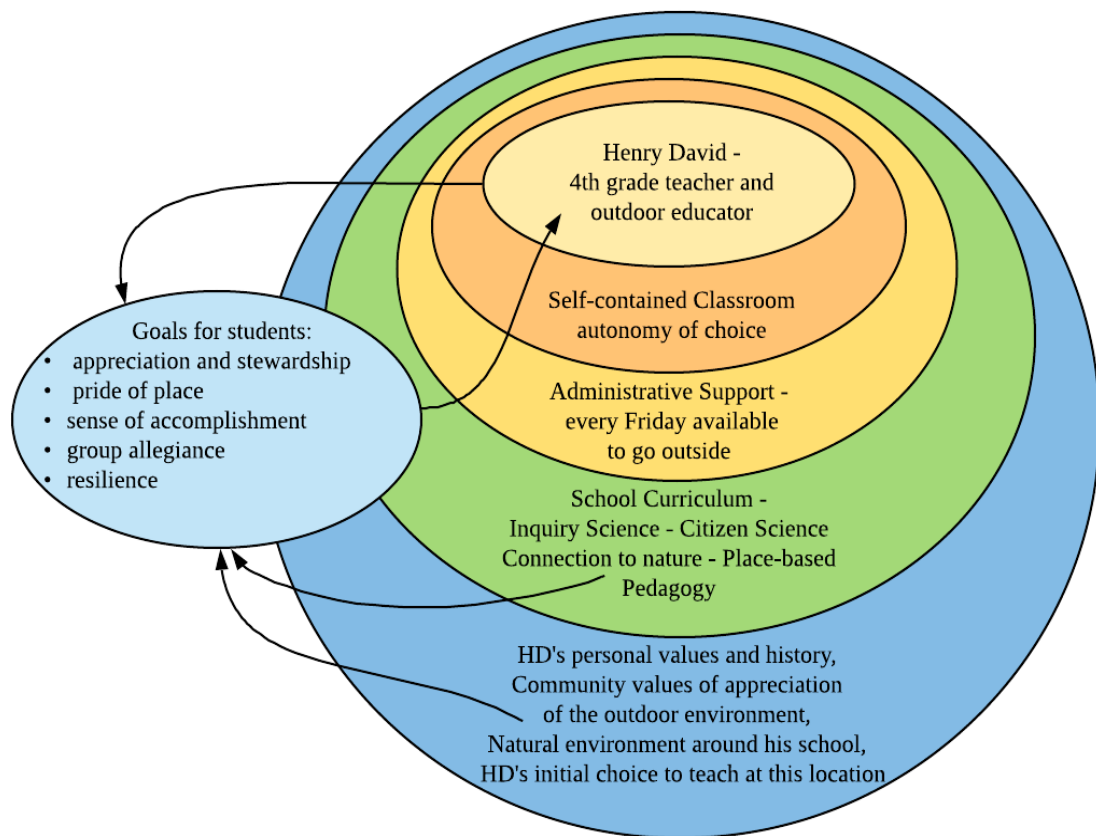


Figure 4. Henry David's pedagogical ecology showing contextual factors and their relationships enabling his outdoor teaching

In describing his education, Henry explains that he “attended a Quaker boarding school outside of Philadelphia, which sat on a beautifully lawned and heavily treed campus, which encouraged us to explore the outdoors.” He attended a small liberal arts college in Ohio where he double majored in Religion and Psychology. He began studying education when he attended a university in San Francisco. After graduating with a teaching degree, he took the job he has held for eighteen years at South Elementary School. Henry has worked in other areas besides education, including tech education consulting, bartending, outdoor camp, restaurant and service industry, and painting houses and mowing lawns as a younger man.

Professional History Henry David took the position of the 4th grade teacher at South Elementary in 2000, and has taught primarily that grade, along with 2 years of 4th grade combined. Henry teaches in a self-contained classroom and is responsible for all content areas except Spanish, PE, Music, and Library science. He considers science his specialty and has earned a M. Ed. in science education. He has ‘a personal interest and love of the world of science.’ He describes his interest in teaching science by saying, “science was always my thing as a kid, I always got it more than other classes... so it’s just made sense that that’s [what I teach].”

When Henry was hired, the school was a K-8 school with an emphasis on outdoor learning and service learning. The South Elementary school district has since added a high school and built a larger elementary school to accommodate the growing population of students. Over the years he has taught there, he has had from 8 to 32 students in his classes. Currently there are two 4th grade classrooms, and lately he has

had under 20 students in his class. He frequently team-teaches with the other 4th grade teacher and class. At one point he was offered the opportunity to teach just middle school science, but he realized that he liked bringing all the other topics, like math, ELA and writing skills, and life skills, into his teaching.

Henry considers himself a life-long learner who tries to stay fresh with innovative ideas. At the end of the 2017-2018 school year, Henry accepted a different position within the school district. Beginning the following school year, he will transition to teaching 6th-12th grade design technology, a content area he has been exploring in his 4th grade classes. Henry explains that currently the design technology class does not allow time for outdoor education, “which is the one caveat I have to explore, but I am very excited to try something new and, in my wheelhouse, but outside my comfort zone- which is where we learn most.”

Early Years of Outdoor Teaching Henry describes his earliest experience with outdoor teaching, which occurred during his student teaching, when he took his students to a beach in San Francisco to participate in a sand-castle building contest. After graduation he began looking for teaching positions in towns and schools that offered opportunities to recreate and spend time in the mountains. He applied to South Elementary because he was aware of their outdoor emphasis. South Elementary was working as a Journeys School and had an already established service learning program.

On the day of his interview, he took a bath in the river beside his campsite and went into the interview shivering, with a wet head. He recalls hearing himself say in his interview, when he was asked what he would do that was different if he was hired, that

he would teach outdoors and continue with service learning projects such as counting elk numbers and dealing with noxious weeds. He also offered to teach river ecology and stream science. Once hired, he realized he could actually do this (teach outdoors) and began adding it to his curriculum, in a limited amount at first and with more committed time through the years. For him, river ecology and outdoor teaching really clicked and have become continuing elements in his pedagogy.

When asked about why he began to incorporate outdoor teaching in his pedagogy, Henry explains that,

I pretty much started out using outdoor ed as a way to reach students who didn't normally or typically do well in a traditional classroom setting. Also, I just like to be outside and thought 4th graders would benefit, as would I, from being outdoors 1 day a week. So, from the start I pretty much started incorporating it into the curriculum.

Henry credits his first administrator's encouragement with his development as an outdoor teacher. He recalls that the administrator let him know that "I think this good for kids, it's going to really fit in." Part of his program development included keeping the administration informed of the science and other topics he was teaching outdoors, along with ensuring students' safety. As Henry consistently included outdoor teaching in his classroom pedagogy, he became known as the guy who did that:

I created my own persona with that, like fourth grade that's what you do. Somehow in fairly short time...I'm talking about two or three years... I was the guy that that's what you did when you got to fourth grade, that's what you got to do, and no matter how many years, which is all eighteen of them, I've tried to get others to do it... taking other classes out or whatever... with us. I was still the guy.

Professional Development

Range of Opportunities Throughout his time as a science educator, Henry has taken part in a range of professional development opportunities that have been available to him regionally, locally, and on-line. Regionally, Henry has attended outdoor science workshops at Teton Science School, in Jackson, WY, and has considered Ravenwood School, near Flathead Lake in western Montana, one of his mentor programs.

Locally, Henry found support and training within his school and community, in particular with the Big Sky Institute (BSI). In the years that BSI was operating, Henry took part in their professional development summer programs in science education, While BSI was active, there was a BSI educator in his school who he considered a mentor and resource person to help him develop his outdoor teaching skills and service learning projects. As Henry puts it, “she was my science person go to.” At one time, BSI offered fellowships to science resource people within Henry’s community, and a BSI fellow was placed in his classroom. After that experience, Henry “felt comfortable then to continue doing what I was doing, I was doing the right thing.” Through personal contacts in his community, Henry learned about stream ecology and water quality. He has since incorporated stream ecology into his classroom as both a science topic and through service learning projects in water quality and aquatic macroinvertebrate populations and species.

After the BSI fellowship experience, Henry enrolled in the Master of Science in Science Education (MSSE) online program based at Montana State University in Bozeman, MT. Through the MSSE program, he traveled throughout Montana looking at

topics like climate change and sharing teaching and learning opportunities with teachers from around the country. Since earning his master's degree, Henry has been involved in science and social studies curriculum development for his school district.

Additionally, Henry keeps current in CPR, which he needs as a teacher, and wilderness first aid, a certification that requires taking refresher courses every two years. He has done a swift water rescue course and trains with wilderness schools when they work with the summer camp program he runs. Henry says that he is always reading books about 'classroom stuff' which can be taken outside as well.

Research Question 1. Why Does Henry Choose to Teach Outdoors?

Motivation

Personal and Teaching Motivations Henry traces his motivation to spend time outdoors, both personally and with his students, to his time spent outdoors with his family in the eastern seaboard state where he spent his childhood. In particular, he cites the time he spent with his grandfather walking in the woods after school and fishing and trapping on the weekends. Henry explains that "I always had this connection to the outdoors through him...and then my parents are very outdoorsy, and it just followed through as a family thing." He states that now he feels that he, personally, needs to get outside, and that since he teaches in a community that values outdoor time, his use of outdoor teaching in his curriculum is a good match. Henry describes how he's the kind of person, when he is out hiking and exploring with his family, he will find new areas

and ideas of how to apply them and share with his students during their Friday expeditions.

In Henry's opinion, his childhood experiences have shaped his appreciation of being outdoors. He explains that, as a teacher, he's offering those same experiences for his students, saying, "let's see if we can have them appreciate this stuff so when they're my age they want to do the same thing..." He notes that "I want them to experience that too, as well as... that there's a lot of magic out there... you know?" Henry explains that he values the outdoors and feels that if students appreciate the outdoors, they will care about it and act to protect it. In his words,

I want kids to appreciate it and if they appreciate it they're going to take care of it hopefully... so... it's that whole idea, if you love something you take care of it. If you're outdoors once a week as much as you can and learning stuff... you're going to love it, which means hopefully you'll take care of it.

When asked if he has seen that happen with his students, he explains that now that he's been teaching for quite a bit of time, he does have students who come back to him and say, 'I'm studying to be a park ranger or I'm working in environmental law... or... I'm looking to be a game warden,'; but whether his 4th grade class was the defining influence, he can't say. They do tell him that he made them appreciate the outdoors more than they did before, even given where they grew up. He points out that he doesn't have many of those stories, but that also, he has never really asked or taken the time to find out what his students are now doing after they graduate. Henry tells about receiving letters from students who have moved away after 4th grade who tell him how much the trip with EY to Yellowstone Park and the weekly expeditions meant for them; that after

they moved they didn't get that in their new school and it's what they missed the most. He mentions that he hears that from local kids as well, that after 4th grade they don't go outdoors in their classes anymore. He explains that he has noticed that:

Kids really miss it, it's crazy, whenever they're doing a graduation speech, in 8th grade or 12th grade, they might skip 2nd and 3rd grade reflections, and then goes to 4th. It's always EY, or hikes. That's it, that's what they remember. And even conversations after they graduate and they come back for the summer, that's the thing they remember.

Student Impacts

In discussing impacts on students of his outdoor teaching, he explains that he doesn't have any empirical evidence or research data to determine if being outdoors builds more knowledge. He does state that he thinks it makes a better person, and possible a better student, since students need to use their time wisely and finish their work before the class will go outside on the Friday expeditions. Henry mentions that he also sees affective and behavioral changes in students. When they come back into the school from their Friday expeditions, his students are "walking in the hallway... it's so weird, when they come back on Fridays, they literally look good and [other] people are hunched over physically and look like they're a wreck emotionally, we're all like, hop to our step." He notes that he can tell that his students are engaged and responsive after being outdoors. He describes how "the kids come back with this whole different energy about them", and he feels that "alright, Johnny, who was ding-donging around in class all week, is now crushing it, he's got kids listening to him and he's reading about this little bug that he found."

Student Changes in Perception In his teaching, Henry makes a point of asking students to share what they are observing and the connections they are making. During the video and photo viewing, Henry notes that students are sharing what they are observing more deeply than at the beginning of the year, and that their shares are qualitatively different. He explains that it is a goal of his and B.'s teaching, that students make deeper, different connections and shares. In describing the differences he sees in his students, he says, "instead of 'the grass is green', by the end of the year, it is 'yellows and browns, and shades of greens, and there's critters living on them, or underneath them,' type of thing." Henry explains his teaching philosophy,

It's always nice to ask everyone about what they've seen, because they're seeing it, they're not recording it on paper but they're processing it, so sometimes kids need to let it go, share it. So, we try to give them opportunities to share, as much as they can.

While continuing to watch the students in the videos and photos, Henry points out that "and now they're all looking down for things, so even just that conversation might have prompted a couple of them to, 'oh, now I'm going to look differently in this next part, I'm going to look for something.'" In the video, not all the students are talking about their observations. Henry notes that "'some of them just need to talk and be social, and that's fine', and that when we, as adults, go on hikes, we don't have a plan of learning, we just go, but in the end, we say, 'oh, that was cool. We saw that, and saw that', and conversation's different'." Henry explains that those are the changes he sees in his students' conversations, that the students increasingly share their observations of what they have noticed when they are outdoors. As Henry observes his students in the videos and photos, he points out that "it looks like they are thinking, that they are not

being prompted to look, but are just being natural.” He notes that it’s the same with every expedition, “that it takes them awhile to get there, and there is a lot of prompting along the way, but by the end of the year, they are there, they nailed it, they all get it by the end.” Henry describes their developing sense of connection:

It’s more about that they’re starting to figure out how they connect to everything, even a tree, a bridge, a backpack, whatever, a flower, they’re connected to it, and now they’re able to roll with it. It comes to identity, like they’re opening. They’re very literal, at 7, 8, 9, they are so literal, if it’s not exactly green, we’re going to hear it. Now, at the end of the school year, they’re like, oh yeah, I get it. And it’s not the students, I think, it’s really just the age that does that.

Individual Student Responses Henry notes that there are students who excel in the outdoor teaching format and others that excel in the indoor classroom. Henry explains that the earlier you get students outside to learn, the earlier you see the true identity or personality or the persona of your students. He notes that “you see the ones that are a little timid out there but in class they’re the ones who are crushing the test and super confident. But then you get them out there and not so much,” For him as a teacher, he feels that for those students who are timid outdoor, you realize that “there’s a place where I can... build on that student”.

Henry describes how some students who are not feeling comfortable in a classroom, blossom into ‘super knowledgeable, amazing’ students who ‘find finite details of the outdoors and then bigger picture connections.’ He describes how students who are adept at reading articles indoors, who understand the details of everything the author said, might not see the big picture of the idea that “we need to take care of this or all living and nonliving things work together in an ecosystem”, but that,

those kids who might not have been able to read that article as well and pull out the actual details the author said... in turn when they're outdoors they see that bigger picture... much differently.... soooo... is it every student like that? No. Many of my struggling students over the years, academically struggling students... when we are on those Friday expeditions or that week in the park are completely in their element, out of the classroom element, and become the leaders of those expeditions. Other students I've seen are...and have made comments... that they are blown away by the knowledge they have.... that's kind of cool to watch.

He has found that much as he'd like to continue to foster those students' engagement and success, "as a teacher, how can I bring that back in... but you can only assign so many like hunting books to read, wildlife ecology stuff or geology stuff." He has had the 5th grade teachers ask how he has connected with some of these students, and he tells them to take them outside, or to give them curricular materials about the outdoors. Henry speculates that it may not be the topic as much as it is the setting, and that those students may have had personal experiences with the outdoors as he did, or possibly not, but he has not done research on that point.

When considering if there is a long-term or ongoing improvement in their academic achievements for those students who excel in outdoor science but not necessarily in the classroom, after they experience success during outdoor experiences, Henry speaks about how their abilities as students may overshadow their successes in outdoor learning:

I think that comes to the point of probably something's going on within them that's not clicking. Something like a reading thing or a mathematical concept or a writing task or skill they're lacking. Of course, over the eighteen years I've seen a few students who took that experience and came back and really took over a leadership role where they weren't before. Up until then they were probably looked down upon as the kid who couldn't quite get everything and struggled with school. Then... with enough of these experiences with them leading it... they came back, and kids looked

at them differently but most importantly, they, I think they, looked at themselves differently. They were like wow, I can actually, I can kick butt on that and I can... I know this stuff if I apply it and look at it.

Henry describes how parents and teachers in his community have always been supportive of the outdoor teaching he has done over the years. He feels it is, in part, because of the changes they have observed in their children. Henry tells of how parents have told him that they ‘just loved it’ because their kids felt so good about themselves. Those parents often note that when ‘in the following years, their children did not go outdoors to learn, they slipped back into feelings of challenge and the ‘school’s not for me type of thing’ but they always remember their year in his class because he helped them connect to the outdoors.’

Student-Led Innovations When teaching outdoors, Henry takes the opportunity to allow science topics to be more open and flexible and student-led, which he feels is important. When students are outdoors, he finds that they are inspired by what they observe outdoors. They ask questions about what they observe that can lead to topics to explore and research. As a 4th grade teacher, Henry is responsible for teaching all the subjects, including science. He explains that he uses outdoor science to teach, or ‘slide in’ other subjects, like math inquiry, ELA, and life skills. He notes that students may not be aware that they are learning in multiple areas at once. Henry notes that he very seldom brings technology into the field and uses the time outdoors to put away the technology. He states that they use technology “fairly heavily all week, which is another reason why Fridays are a great day to put it away, clean the screens, clean the computers, log out of everything.” Occasionally he will bring electronic tools into the

field, such as laser thermometers, or his camera on his phone, but that otherwise, no technology in the field. He points out that when students want to learn more about what they have observed outdoors, they use technology to explore those topics when they are back in the classroom.

Henry explains that, as a teacher, trying new things and learning about new areas can make you a role model for your students:

You know, sometimes teachers get stuck in our ways and like to do things that make us feel comfortable, because it makes us feel like we're teaching something, but... none of that's true... it's the opposite of that. When you get out of our zone... you learn you're teaching better because...you give off that 'I'm learning, right or wrong, I'm learning something I don't know about' idea. What kind of bird is it? Let's figure it out. Come on, let's get a guide, let's figure it out...'

Student 'Personal Ecology' Henry points out that 4th graders are gaining more independence from their families and becoming more of an individual, so that when it comes to spending time outdoors, students in 4th grade are starting to get 'dialed in' with the gear and the responsibility of taking care of themselves outdoors. Henry explains that students are beginning to develop "'personal ecology', a balance of the physicality, the emotional part, and the academic part," of spending time outdoors in class. Henry describes 'personal ecology' as:

Can you take care of yourself... still knowing that you're affecting other people's decisions, that your decision affects it... affects them? Can you adapt, and can you change to the situation? And whether it's temperature, you gotta take a layer off, or whoa, 'I'm really tired and I gotta write a poem now'....

Henry explains that he doesn't see 'personal ecology' develop in the classroom setting, because students can 'escape' from the classroom, from dealing with the other

students on a constant basis. He points out that, in his classroom, students can “leave for the bathroom when you want. You can grab a snack when you want. You can sit down when you want to, you can stand when you want to if you’ve been sitting too long.” In those ways, students can make decisions that move them away from working with the group all the time, but in the outdoors, they do not have those options, they have to consider their actions in relation to the whole class.

During Friday expeditions, Henry mimics the experiences the class will have when they spend the week with EY in Yellowstone Park, when students’ actions are determined by the park ranger. He further describes classroom vs. outdoor class dynamics:

We travel in a group, we travel in our clans, we travel in that order. We travel... we circle up, we eat when we say we eat. You know you’re writing, and yes, you have to write, or yes, you’re drawing, sketching, whatever and that’s important, and we’re all doing it. In the classroom there’s less, here’s the irony ... there in the outdoors there’s no walls, you know, holding us in, but yet in the classroom there’s more places to personally escape emotionally, like... sit in the corner.

When I say, ‘go journal’, most kids go off and find a little rock or under a tree or in the wide open. There’s no corners to hide in. When you go to the bathroom you gotta go with someone. When you’re hungry you have to wait to eat in a group and then check to make sure you didn’t leave any scraps, whereas in a classroom you just sit at your desk and there’s crumbs everywhere.

Impacts of Expedition Yellowstone The Expedition Yellowstone week-long trip is a cumulative experience for Henry’s class; it is an event that students train for and look forward to for months prior to it happening. Henry notes that he sees tremendous changes in his students after the trip, and for years afterward. In his words, “They are a completely different person, human, learner; it’s unbelievable. This transformation

happens Thursday night usually if it's the Monday through Friday trip; if it's the Friday through Monday trip, its Sunday night, so the last night basically," He goes on to describe the transformation more thoroughly:

The last night they're there, most of them, most years, you see this... I think it's... 'okay I did this, I was really scared, really nervous, and if I didn't act like it I was, because I'm nine or ten, but I did this'. And then I think part of it is, they actually have created this connection to a place they've visited a hundred times before or two or three but never in the same way. They were intensively thrown in at it, full day, exhausted, eating things they're not used to, sleeping in a cabin- you put that whole experience together, that specific experience, and it's a big thing.

You walk down in the hallway and they walk past you and they're just standing a little taller, walking a little more prideful. The cool thing is the following years you can walk past them in a hallway, if they attended the trip, and they just... you've got that, you shared that thing and that was really important to them at that time, even when they're in high school. They'll walk by you and... they may not say, hey, Mr. David, a lot, or stop and talk to you, but they give you that look like, we did that together...

When asked if he thought the students themselves recognized how much they had changed, Henry stated that he thought they might know, because their actions show the change. He explains that:

I think they might, cause by this time, they're like, 'I really think I've changed. I think ever since EY, Expedition Yellowstone, I've changed'. And to be quite honest, that's the pinnacle of our year, I feel. That they, most of them, have become calmer, more aware, calmer in the sense like, they're comfortable with who they are. Everybody, after you spend 5 days in the park with each other, you know, showering and living with someone and eating every meal together, you're like, there's nothing left to hide, you know who they are, you know who everybody is. And that doesn't happen, usually, until we come back from that trip, and during that trip. Now everyone just comes back a little different. It's almost like they are little, crazy, wild kids, they still are, but then they have a sense of becoming someone, sort of create their own identity that week. Or they maybe not create it but realize it. They start realizing who they are.

Research Question 2. How Does Henry Accomplish Outdoor Teaching?

Planning for Outdoor Teaching

The considerations Henry takes into account when planning to teach outdoors are the environmental aspects of his outdoor teaching sites, and the people who are integral to Henry's teaching situation. For Henry, ongoing environmental concerns each year, and throughout the school year, are weather, water hazards and wildlife. The people who are integral to his teaching situation are his administration, the families of his students and his community, and his students as fourth-graders.

Concerns as Barriers When asked about any barriers he deals with in order to teach outdoors, Henry's initial response was that he didn't have any barriers. He explains that when he first started teaching outdoors, he didn't think he had ever looked at outdoor teaching as difficult, that it came easy for him, and he mentions that he thinks his initial administrative support helped him succeed in those first years. Throughout the interviews with Henry, as he describes how he manages teaching outdoors, it's evident that what are typically considered barriers by other teachers are not barriers to him because he has been able to manage them, or his teaching circumstances have not created those barriers. In the research literature, some of Henry's concerns are recognized as barriers for other teachers. Those recognized barriers are: student safety, lack of administrative support, difficulties in scheduling, curriculum connections, lack of funding, and lack of personal and professional efficacy in teaching outdoors (Dillon, 2013, Dymont, 2006, Rickinson, 2001).

Environmental Concerns of Outdoor Teaching Concerns that Henry manages stem from two general areas. One concern is the environmental characteristics, such as the potential for bear encounters, of the two outdoor areas that he takes his students to on a regular basis. The other concern is the weather that is typical of the geographic area in which his school is situated.

The two outdoor areas he walks to with his class each have their own hazards at certain times of the year. To reach one of the sites, the roadless area across from the school, his students cross a small wooden bridge over a river to access the trail. High water in the river from snowmelt in the spring threatens the bridge, so during runoff that site is not accessible to Henry and his students. The other site, located behind the school, is a meadow adjacent to a roadless wild area that is home to bears and other wildlife. In the fall and spring, as bears prepare for and emerge from hibernation, the bears' presence constitutes a risk factor in taking students to that site. During the field observation day in early June, as the class prepared to leave the meadow, Henry had them wait until he could get to the front of the class on the trail, saying, "let me go first, in case there are any grizzlies in here."

Being prepared for the weather that students encounter when out on expeditions is another environmental concern. It is Henry's practice to take students outdoors throughout the school year; and he and B. plan the EY Yellowstone Park trip for April, a month that can bring a wide range of weather. Henry follows the motto that 'there is no bad weather, just bad gear', and expects his students to be ready to handle the range of weather they might encounter on the weekly expeditions. To that end, he explains that:

We do a lot of preparing... how you dress, you've got to wear layers, you've got to wear synthetics. That's a big conversation at the beginning of the year when it's still warm here, and when it cools down. So, how do you feel today? If you're cold, next week you need more layers; if you're hot, think about not wearing cotton, if you were wearing cotton, cotton kills. We have these little survival things in the beginning of the year to build up to how to not get yourself in a situation.

Henry explains that many of his students recreate outdoors on the weekends in winter, so he is confident that they are capable of spending four hours on a hike during the Friday expedition day.

Administration, Community and Student Concerns Two administrative concerns for Henry are the scheduling of specials classes for certain students, and the alignment of Henry's outdoor curriculum with school and district curricula. For scheduling, Henry points out that the staff have been very flexible and able to work with him so far, but he wonders if, as the school population grows, it will always be the case. As for curriculum alignment, Henry has been responsible for writing the revised curriculum to meet the recently adopted International Baccalaureate (IB) standards and Next Generation Science Standards (NGSS), ensuring that his outdoor teaching is relevant to the current standards.

Community concerns for outdoor teaching generally pertain to the week-long EY Yellowstone Park field trip that Henry and B. arrange in late winter/early spring. Parents have expressed concern that they will not be able to be in contact with their children, that their 4th graders may not be able to handle a trip of that length and rigor, or that there is danger from encountering a bear. Henry remarks he tells the parents that is it their choice, but that almost always the students end up going on the trip, and that in

seventeen years, only one family did not allow their child to go because they did not want their child to be away from home for that length of time. About the ability of fourth-graders to handle a long, rigorous, outdoor experience such as the EY field trip, Henry describes his experiences with fourth-graders on the EY field trip over the years:

Kids'll tend to complain less when they're not your kids, so when you put the backpacks on and, you know, during the school year we hardly ever get more than three miles, four in a day on our expeditions because we stop and do lots of other stuff... they don't, hardly, rarely would they complain. That's getting them fit for that week where we are walking around all day from eight to five in the park. So you give a little to them now and you tell them that 'oh what you just did, that's way harder than what you're going to do at Yellowstone.' Then when it happens, they say, 'oh yeah, that wasn't as hard as what we did', and you're thinking, 'it is harder but they didn't recognize it'.

Henry points out that in fourth grade, “you’re at that point of, ‘alright I’m getting a lot more independence from my family, and I’m becoming more of an individual, so I can do this probably, with assistance.’” Henry explains that he and B. dedicate a lot of time and effort through the school year, prior to the EY field trip, to training students to be safe and capable learners in the week-long outdoor conditions that students will experience.

Administration Support

Throughout the changing administrations in the eighteen years he has been teaching at South Elementary School, each administration has supported Henry in incorporating outdoor teaching in his pedagogy. The different administrations have worked with Henry to ensure his outdoor teaching supports the current school guidelines.

Curriculum Alignment Each administration has required proof that what Henry does outdoors with his students is aligned with the school's curriculum. With various changes in administration through the years, Henry has dealt with some that have questioned how his outdoor teaching connects to the school's curriculum. With those administrations, Henry has had to reaffirm the validity of his outdoor teaching.

Scheduling of Specials Classes The administration at South Elementary supports outdoor teaching by allowing Henry to schedule specials classes for certain students on Monday through Thursday and skipping Friday, giving him most of the day on Friday to devote to his expeditions.

Service Learning Another way Henry's administration supports his outdoor teaching is through an emphasis on service learning projects. Service learning projects that Henry has organized for his class include conducting tests for water quality to help provide data for the local watershed organization, road-side trash clean up outside the school, noxious weed removal in local areas, elk counts, and others. Service learning projects typically include a component of outdoor teaching.

Environmental Risks South Elementary School administration supports outdoor teaching for Henry by helping to monitor environmental risks in areas where Henry takes his class on expeditions. As Henry describes it, his administration 'provides some checks and balances' in determining expedition locations each week.

Community and Co-teacher Support

When asked about what his community thinks of his outdoor teaching, Henry notes that the whole town is ‘super supportive’ of it. He says that it’s well-known that in fourth grade, it’s ‘the thing you do.’ His co-fourth grade teacher is also supportive. As Henry puts it, “B. loves the outdoors, she loves going. She doesn’t like to be holed up in here more than four days a week.”

Henry explains that he feels fortunate that parents in his community support it by preparing their children with appropriate gear for the weather. His community has also supported his class outdoor expeditions by providing outdoor gear for the students and community to use. One community family donated forty backpacks that Henry offers to any students and their families to sign out for a week. Henry notes that he tries to make every effort to help families with outdoor gear.

Grants and Fundraising Aside from the week-long field trip to Yellowstone Park with EY, costs for weekly expeditions are minimal. In the majority of weekly outdoor expeditions, Henry, B. and their students walk to the areas they are studying, so there are no transportation costs. The school district has their own buses and drivers for bus-supported field trips.

For the EY Yellowstone Park week-long field trip, the school’s parent group covers the educational costs of the trip, while the school board pays for the board for the classes. Henry’s students raise money to cover their travel and food costs during the trip. He and his students have conducted various types of fundraising campaigns in the

school and community. Past fund-raisers have been readathons; the current fund-raising campaign is a ‘bowlathon’ called ‘bowling for bison’.

South Elementary School District is supported by a number of community foundations who are generous in providing funding for school district events and needs. The school district has low to no free and reduced lunch numbers. With the support of various community foundations, Henry has found that his school is not eligible to apply for some grants to support travel to Yellowstone Park.

Managing Outdoor Teaching

Expeditions Teaching outdoors in Henry’s class typically happens on Fridays, in events he calls expeditions. Henry arranges his schedule for the week to clear most of the day on Friday, giving his and his students a 4-hour window to spend outdoors. Henry and B. also plan a week-long field trip to Yellowstone Park in early spring. Expeditions and the Yellowstone field trip take place in all types of weather.

In the first weeks in school in the fall, Henry explains that he and his fellow 4th grade teacher, B. introduce outdoor expeditions early to take advantage of the warm fall weather and to break up the first long week. He points out that it’s usually hot, “we can do stuff in the river like look for macros or take big stream samples and stuff like that. It’s a good time to take advantage of things that you would normally teach in the spring, but you can’t do here safety-wise.”

Friday Expeditions: A Typical Day Henry outlines a typical Friday expedition day schedule: At the beginning of the day, B. and Henry will ask if “anybody’s got any

last-minute wrap ups of anything”. From nine to nine thirty, the classes spend time with their little buddies in kindergarten, and then at nine thirty, everyone begins to get ready to go outdoors. At that point, the classes may do some indoor activity first, such as what to pack in a backpack, look at graphs, or read a poem to see how they can reflect on it that day. The classes will spend no more than a half hour on that activity, and then they are out by 10 a.m. and on the trail.

Depending on where they go, it usually takes up to twenty minutes to get to where Henry and B. have decided to spend the day. The class may stop once or twice along the way to do an activity, and then when they get to the trailhead they will head to certain areas depending on the theme of the day. Typically, Henry and B. plan on doing two or three activities in the morning, the students have lunch together, and then do two activities in the afternoon. Everyone returns by two p.m. because the 4th graders get out early, at two thirty so instead of three thirty, on Fridays.

Altogether the class does from four to six activities through the whole day. Henry notes that there are times when the students have a working lunch. They may be doing something that’s teamwork-based that Henry and B. have planned for them to do, and the students don’t really know they’re doing a planned activity. Since both 4th grade classes go out together on Fridays, Henry and B. have developed a co-teaching model for their Friday expeditions. Henry describes it by saying “we’ll each do an activity. She’ll run an activity, then I’ll run one, then she’ll run the other, then I’ll run one. We’ll rotate through, instead of me doing everything or her doing everything.” He goes on to say that “we hardly ever get more than three miles, four in a day on our expeditions,

because we stop and do lots of other stuff.” One of the goals of the Friday expeditions is to prepare students for their week-long field trip with Expedition Yellowstone (EY) in Yellowstone Park.

The Field Observation Day At the beginning of the field observation day, Henry talks about order and non-order, human and natural organization. He later explains that he did not have a specific science content or concepts that he was planning on teaching that day, but that he was inspired when he spotted the coniferous tree that had been planted out in the middle of the sagebrush flats. When the class stops again further up the trail, he spies a line of ants walking across the pavement where the class has circled up and he continues with the order and non-order theme, using the ants as an example. Henry mentions that he had only intended for everyone to stop and take a water break, but seeing the ants inspired him to bring up the topic once again. In the video, while speaking to the class, he points out how we can walk in order, and have order in our lives. He talks about how to approach the outdoors in a mindset of randomness and disorder.

When the class arrives at the aspen grove, they set down their packs in a circle. Henry discusses the scavenger hunt, and students spread out in small groups or pairs to find the objects on the list. After the students come back, B and Henry use the scavenger hunt review to talk about natural science – water cycle, humidity, solar energy. One of the items on the list is finding a wheel. Students talk about the water cycle, the earth, a color wheel. Listening to the video conversation, Henry points out that by this time of the year, in 4th grade, students are not nearly as literal as they have been, they are able to

think more figuratively and abstractly. With the scavenger hunt list finished, Henry introduces the boat-design activity. Students become busy in the creek, braiding grasses, redesigning the creek bank, building boats and floating them. Henry notes that this is what he loves about this activity and being outdoors with his students, that he sees them find their identities and strengths in what they choose to do. He sees them using creativity, innovation, sustainability, team work. He feels that if he had structured the activity more, he would have lost some or all of those opportunities for students to express themselves. Henry notes that, “kids naturally design, I mean, that’s what they do, when they play, they design. They work on a task, they go back and redesign, they go through that whole questioning.”

When asked if this format for the day is similar to expedition days earlier in the year, Henry clarifies that earlier in the year he would have had more specific content and would require that all the students be engaged in the specified activities. Also, he would be using the outdoor activities as components of the science units he taught during the year. The difference for this day is that it is nearly the last day of the school year, so this day is much more geared toward exploration and enjoying the outdoors. He explains, “One of the things we did this week, the last week we were outdoors, was explore a little bit more. And see, they’re pretty calm, they’re just like taking it all in, it’s kinda cool. In the beginning of the year, it looks different.”

In the videos and photos, some students have begun to explore the area, create forts, and go on small walks together while talking. One group finds a downed aspen tree nearby. Henry walks over and discovers that the aspen tree is chewed up by elk. He

calls the class over on the way over to talk about how the aspen got chewed up. He points out that “this is one of the great things about being outside, that things like the aspen tree come up.”

The class moves on to the pond, and most of them wade out into the water and begin exploring. One student goes out further, and then another. Henry comments about the students’ actions, “it’s like a game of trust.” In the video, Henry and B. sit up on the bank and watch with some of the other students. Henry describes what he thinking as he watches the students:

Half the time, I like to just sit up there and watch, because kids, it’s truly them being a kid, there are no classroom walls, there are no textbooks, there are no instructions, no plan. It’s the way kids have been for thousands of years, till recently, you know, really just connecting to animalistic senses. And they don’t need fancy technology, or white boards, or Chromebooks, or any of this other tech.

Inspiration from the Land Henry points out that his students are at an age where they want to know the schedule of their days, but that he will occasionally want to wander with his class, that “it’s good for them and me to think, ‘we’re just going to wander and see where it goes.’” He explains that he doesn’t always have a theme for the day, that he approaches the expedition from “more of a bigger picture of ‘theoretically, let’s just see where we get’”, and that the class will go out and ‘get to something that’s interesting’ and that will become the day’s theme.

Curriculum

Curriculum Concepts and Science Content South Elementary has recently adopted the International Baccalaureate (IB) degree program. Henry has worked on tying the state standards for science, social studies, and Common Core standards to the IB. According to Henry, the IB is very concept-based, such as the concept of change. Henry was responsible for re-writing his school's K5 curriculum when the district decided to adopt IB. Henry describes how he incorporated the concept of change into the science content areas he has been teaching, "my basic thing is I'll take a standard or conceptual idea... now that we're in IB it's very concept-based, like change, how can we, if this unit we're working on is change, see what changes are happening with the earth?" Henry goes on to describe some of the science content areas he has chosen to address the concept of change, such as geology, beaver dams, the water cycle, and humans changing landscapes. Henry explains that he is inspired by teaching science outdoors because he sees that the concepts in the IB can be seen and applied when making observations in natural settings. He provides an example by saying:

I can just take something and go with it. I start with the basic concept: change, causation, form, function... those big concepts. That's everywhere. It's earthly...universal yet unique depending on where you live. And one cool thing with the IB is, you have to know about where you live but you also have to be able to take this unit that you're teaching, pick it up and put it in the Sahara Desert and teach it.

He goes on to explain "When I rewrote the curriculum last year for the K5 group for science and social studies, I've tried to throw in as much opportunity for field trips as I could, thinking, 'hey what about going here?'" He stated that he chose places that were not necessarily out on a trail, but out somewhere like a state park where students

could look at interactions of indigenous people and pioneers. He notes that, “I think I’m trying to squeeze it in to other classes as much as I can...”

Henry describes his thoughts about the curricula he uses and its relationship to outdoor science teaching:

There’s so much out there whether you’re in the big city or you have the National Forest next door and a pristine blue-ribbon trout fishing river, though they probably don’t get to see all the things that are out there that my students can see. Part of that is that you can take curricula and apply it out there just as easily, sometimes easier, than indoors, because it has true meaning. Sometimes it’s just lifting up a rock.... and they didn’t know that there were things underneath it. Which again you could do in the big city.

When asked if his expeditions are focused on specific content areas, Henry says that they used to be, that if they were studying geology that’s what they would be out doing, or ecosystems, they’d be doing ecosystems stuff. He goes on to point out that now with the IB curriculum, “we’re focused on the IB stuff that we’re learning, those units are based around a theme like how the world works and then some concepts like change, causation.” Besides science, art and literature, indigenous peoples have been a recurrent theme in Henry’s curriculum. He explains that he has “always brought in indigenous peoples because they’ve got so many great stories and then so many great contributions to our world that, you know, tools-wise and stuff.” With the change to IB, his curriculum is more based on IB themes and units.

Multidisciplinary Outdoor Teaching As a fourth-grade teacher, Henry teaches multiple subjects in his classes. He incorporates multidisciplinary activities in his outdoor teaching as well, using the natural world as inspiration for art, poetry and literature. He and his co-teacher choose authors renowned in emphasizing the natural

world, such as Henry David Thoreau, Robert Frost, and John Muir. He describes how students in his class will read a poem, or a piece of a poem, to each other when they are sitting back to back outdoors, or to themselves with their backs to a tree. He says that when you read a poem like that in a classroom, you can create a concept map of the symbolism on the board, but when students are reading it outdoors,

it's the component of just being outside and feeling the wind against your face... hearing different critters or whatever. If you're reading a poem about a tree and you get up to a tree and read it, then go look at it and modify it, maybe make your own little poem, that's different then... sitting in your chair reading it and trying to make connections.

Outdoor Science in the Classroom Henry plans his curriculum to have interconnections between what is taught and learned in the classroom and what students encounter outdoors or the data they collect outdoors. One example is in studying geology. In the classroom students learn rock types and formations, and then see that geology on field trips to different areas around the school. Another example is water science. In their classroom students raised trout and studied water quality, and then at the river they collected water quality data, such as aquatic macroinvertebrate counts, water chemistry and physical hydrology. They then created graphs back in their classroom to interpret the data.

One of Henry's goals in his science teaching is to provide students with foundational knowledge about ecology for their EY week-long experience in Yellowstone Park. He works to ensure that they are not 'bombarded with new concepts and vocabulary' but can build deeper connections with the knowledge they encounter in the park. Henry explains that too much information can be overwhelming; if students get

too much information, it's boring. He explains that there is a fine line between too much and not enough, and it's different for each student.

He achieves his goal of providing foundational ecological knowledge by setting an intention in the classroom each day for that expedition's focus. He describes how teaching outdoors is theoretically different than teaching in the classroom, because in the outdoors there is access to things that are not available in a classroom. As he says:

When you're outdoors, I think you might come across something and bam there's a teaching moment. Not that there's... there's still teaching moments inside the classroom, but if you come across some wolf tracks, and you didn't know they were going to be there, then that opens up a whole discussion of... you know... depends on what your theme is but... you can run with that. If the beavers build a new lodge, that's a whole new topic you can discuss even if you have something planned ... so beavers build dams and the dams still there and it's kind of boring, but look the lodge has moved well, why did it move? and that opens up a whole new thing....

He explains that it's the same in a very empirical way of opening a question and then going to try to discover the answers, which is similar to opening the day with a certain guiding question, whether it's math, or a poem, or a word, whatever it might be. Henry notes that "it's kind of what we do when we go outside... let's look for this... along the way we'll find things we didn't know were there."

Goals for Expedition Yellowstone Henry's outdoor expeditions include preparing physically, emotionally, and academically outside for the weeklong or multi-day trip to the park. Topics Henry emphasizes to make sure his students can handle a week-long trip, when they are outdoors in all weather, and still be learners, include how to take care of themselves during the week: do I know how to pack a backpack every morning for this trip? Do I know how to hang my socks up and to tell if they're done if

they were wet? Do I, or can I, remember to put my lunch in and a full water bottle? He also trains his students in outdoor observational skills, so they are aware of their surroundings and can answer questions like: When I get out there do I know which way I'm walking? Can I make some observations that are deeper than others? Academically, during the EY trip, students learn natural history and ecology of the park's ecosystems. A goal of the EY trip is to have his students be able to identify that they are in the same ecosystem as Yellowstone Park, even though they are not in the park, because an ecosystem doesn't have physical boundaries like a park boundary.

Creating Connection to Nature An overarching goal for Henry through the years he has been incorporating outdoor expeditions for his classes is for his students to make deeper connections with nature through 'playing around in nature' and 'writing about becoming closer to it, feeling connected to it'. He explains that he doesn't have evidence to prove that experiencing ecological principles in nature helps students make connections more easily, but that he 'wants to think so', that:

When you sit here and talk about it, write on the board, it's one thing, but when you go out and you see how these certain animals are using the rocks the macroinvertebrates live under and collect the food, and make sure the oxygen levels are increased where the rock, where the water flows under the rocks, and you see that as an example... then it's 'ok, I get what's going on'. This stuff on the board or even on YouTube or whatever is 'ok', but when you're actually there getting wet, getting cold... and probably little animals on you and... picking up rocks... it just builds a whole ecosystem.

When Henry is teaching outdoors, he explains that he would rather do three or four things in an outdoor adventure that students can get really deep and connected with,

where they begin to ask questions and make observations, than to try to squeeze in ten things in a day.

Change in Pedagogy over Time When asked how his pedagogy has developed, or if his pedagogy has changed over the years in response to his continued outdoor teaching, Henry commented that he feels he has become more open-minded, he allows his students to be more curious and ask questions and he is not as directive. He explains that:

If anything's changed it's probably that. I probably started off being very directive, like talking the whole time, feeding them information. Now I try and allow them to do that. That might be the only really logistical thing that has changed.

I look back.... I haven't changed my management. I haven't changed where we go, hardly... not that that matters but, haven't changed the journaling much or the reflection piece, making observations differently. Probably just me personally growing and allowing the kids to discover things on their own, not so much me feeding it to them, which out there it's easy, you just look around for a little bit....

Assessment

Standardized Tests When asked about how or if he thinks outdoor teaching impacts his students' test scores, Henry points out that traditionally, his classes have done quite well on the state's standardized tests that are administered in 4th grade. He notes that he's not sure if it's because of the amount of science he teaches, his enthusiasm for science, or students' outdoor expedition experiences. But that "hopefully they bring that in too." He has seen that, even as standards change, his goals have still been 'loosely jointed, or connected in some way' with the changing standards. He notes

that now that his school is transitioning into IB, they still have state standards “wrapped inside IB units of inquiry but they are also mixed up a little bit differently and traditionally.” He explains that with the IB, what had been traditionally a science class is now an inquiry class, and how that will be reflected in students’ state standardized test scores will be determined in the next couple of years.

Summative Projects In regard to how standardized testing impacts his teaching in general, he states that he hardly ever has any sort of standardized test in mind, but that he does keep the performance assessment of a unit, typically a project or problem, in mind the entire time. Often, as he is teaching, he will tell students to consider the resources and tools they will need for the project they will be creating at the end of a unit. For instance, as a summative assessment, they would work with a group to solve a problem in their streams or rivers or lakes, and the solution will have a focus on ecology and economy. In that way, his students are not surprised and know what they need to achieve at the end of a unit. He comments that he hasn’t written a multiple choice or short answer test in quite a while, and that he is moving away from those types of assessments in math as well, as he is not finding them very useful.

Summary of Henry David’s Pedagogical Ecology

In the analysis of the interviews with Henry and the field observation notes, main themes emerged in answer to the research questions of why Henry chooses to teach outdoors, and how he accomplishes outdoor teaching. Themes in Henry’s interviews that answer the research question of why Henry chooses to teach outdoors include personal

and teaching motivations, and perceived positive impacts and benefits for students. Henry's personal and teaching motivations intermingle, in that he is motivated to teach outdoors because he appreciates being outdoors and works to offer his students the opportunity to gain that appreciation as well, and because he sees benefits for his students in learning outdoors. Those benefits include increased engagement in learning and a greater understanding of the ecology of their local ecosystems by increasing their perceptions and appreciation of the natural world. Another benefit is the development of a sense of 'personal ecology', a greater awareness of themselves and the impacts of their actions in group situations. He also sees selected students who may not be as strong academically in the classroom see their own value and worth revealed in outdoor learning situations, enabling them to take on leadership roles they may not attempt in other circumstances. Henry's personal history of time spent outdoors with his family, and professional history and training as a natural science teacher, are also motivating factors for Henry to teach outdoors.

In answer to how Henry teaches outdoors, there are several key points of his school situation that allow him to teach outdoors on a regular basis. One of those points is that Henry has structured his weekly class schedule, with the cooperation of other faculty and administration, to allow him to leave his classroom from mid-morning until the end of the day on most Fridays throughout the school year. This gives him a 4-5-hour block of time to teach outdoors most weeks. Another key point in Henry's situation is that he has two natural areas, besides the school campus, within walking distance of his classroom that offer relatively easily accessible opportunities for activities based in

the natural world. A third point is that he is supported by his administration, community, school and community foundations, and fellow teachers, including the other 4th grade teacher with whom he co-teaches outdoors. Support includes funding, gear, time for curriculum development, and attitudes that embrace his outdoor teaching as worthwhile.

In his eighteen-year history as a 4th grade teacher at his school, Henry has been ‘the teacher who takes his students outdoors’. Every 4th grader in that span of time has encountered the impacts of Henry’s outdoor teaching while exploring the natural areas outside their classroom doors. According to Henry, the Friday expeditions and EY field trip to Yellowstone Park are experiences that stand out in students’ memories when they speak of their grade school years at Henry’s school.

Case Three: Analysis of Themes in Anna Leopold Interviews

Anna Leopold is the third teacher of the three study participants in this multiple case research study. She is currently a biology teacher at a mid-sized high school in south-central Montana, teaching primarily sophomore biology and the junior/senior course that she developed called wildlife ecology and management (WEM). She incorporates outdoor science teaching in the day-long field trips she arranges with small groups of WEM students, multiple times in the school year. She also practices school-based outdoor teaching with her sophomore biology class at the creek that flows past her classroom door. The pedagogical factor diagram in Figure 5 displays the contextual factors, their relationships, and motivations that comprise Anna Leopold’s pedagogical ecology of outdoor teaching.

Personal Sketch of Anna Leopold

Early Life Experiences Anna Leopold (her preferred pseudonym) has lived in Montana for much of her adult life. She spent her childhood in New Jersey with winter trips to Florida with her grandparents. In Florida she fished in the Gulf Stream with her grandfather, but otherwise did not spend time outdoors with her family as a child.

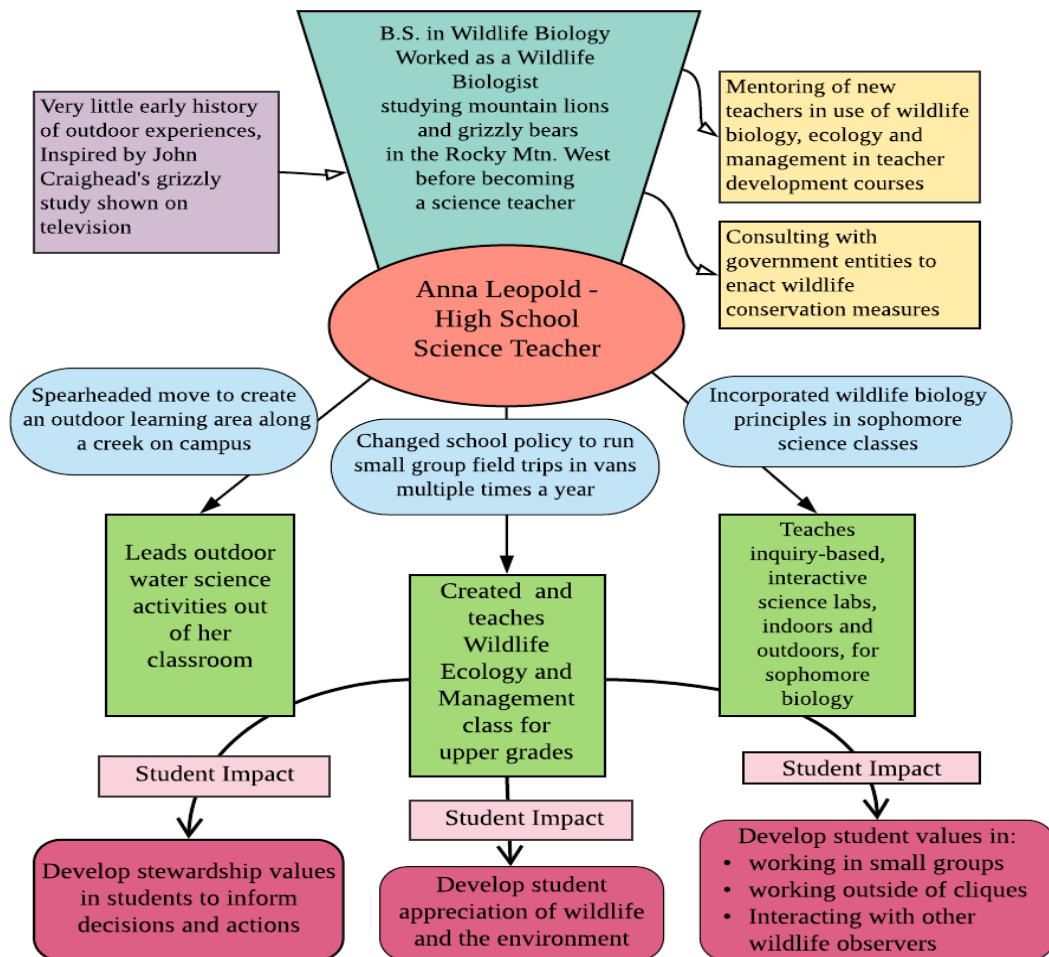


Figure 5. Contextual factors and their relationships in Anna Leopold's pedagogical ecology of outdoor teaching

In high school she recalls watching a program on television about Dr. John Craighead and his grizzly bear research in Montana. Learning about that type of research inspired her to search for colleges in the west where she could study wildlife biology, particularly large predators. Anna chose to attend the University of Montana, in Missoula, where Dr. Craighead was doing research. Anna tells a story of about going to the library in her town to look for pictures of Montana and not finding any, so when she stepped off the plane in September, she ‘really had no idea where I was going’ since the only pictures she had seen were the ones in the brochure the school had sent her.

Education in Wildlife Biology Anna started in the wildlife biology program at University of Montana. She worked with professors and graduate students at the Montana Cooperative Wildlife Research Unit on their research projects, and in her junior year began doing research on mountain lions by radio-collaring and tracking animals with a fellow undergraduate student. She recalls being one of the very few women in the wildlife biology department at the time, and that as a woman, she was initially barred from field research. Anna credits Dr. Craighead with establishing the fact that women during menstruation were not specifically an attractant to grizzly bears and insisting that she join the research teams. She notes that affirmative action measures initiated during that period began increasing the number of women in the department. Her earliest work in wildlife biology included working at a check station during hunting season when she had newly arrived in Montana; at that point she was still learning how to identify big game animals. She also worked on identifying calving areas for elk, and grizzly bear habitat components. Anna explained that she worked on mountain lion

research for three years, until her funding was cut for that project, and then continued with grizzly bear research. She recalled working with some of the original researchers in wildlife biology, such as Dr. Craighead, Dr. Les Pengelly, and Dr. Bart O’Gara.

Teaching as a Career Choice In her explanation of her decision to switch from wildlife biology research to science teacher, she described an event that occurred when she was researching grizzlies in a remote valley in Montana. She stopped by to visit and stay with a friend who was running a camp fire group for kids. She was invited to talk with the kids and found that she ‘just really loved it’ and felt that she was ‘kind of good at it.’ At that point she began to compare the impact of her work on mountain lions and the potential impact she could have as a teacher. As Anna puts it, “underlying why I left wildlife research and came into teaching is because I saw the reality that without human involvement, wildlife is destined to be eliminated from our continent, unless the next generation cares”. She also considered that the career path to continue her wildlife biology work would entail a master’s degree, a path she did not want to pursue at that time. Her proclivity for teaching induced her to change careers, and she studied for and received a teaching degree in secondary science education in biology and math. Her change in career choices was wholeheartedly supported by her mentor professor at her university, and in the end, rather than feel she had let him down switching to teaching, she realized that in her choice, she was honoring his life’s work as a teaching professor in wildlife biology. She remembers him saying,

‘I’m a teacher, Anna. You know, you could not honor me more than by becoming a teacher.’ And then, all the pieces filtered in, and I realized how much he and so many others had changed my life, and how I wanted to do

that. You know, that I was literally copying them, because they were all teachers, and that's what I wanted to do.

History of Teaching Career The school where Anna currently teaches is her fourth school in her teaching career. Her first placement was in a class C high school on one of the reservations in Montana. She then left to teach at a class B high school, and then a class A high school. She described the smaller schools as places where she had strong connections to the community, and people were aware of her role in teaching science.

Her current school is a bigger high school that she applied to with a plan to develop specific types of classes. She explained that in her initial interview with the school, she was very clear that she wanted to create a wildlife biology class. To develop the wildlife biology class, Anna approached her administration with the concept of field trips to Yellowstone National Park and other areas that provided opportunities to study wildlife biology, ecology, and wildlife management. She was aware that the school had resources and that there were parents and school officials, hunters of diverse types of game, who appreciated wildlife and could support her. The wildlife management and ecology (WEM) class she teaches now is the result. She has been teaching at her current school for 24 years and taking her students on field trips for her WEM class for 22 of those years.

Professional Development

Anna's training to teach wildlife biology outdoors includes her wildlife biology degree, professional work in the wildlife biology field, and the teaching certificate she

earned when she chose to work as a high school teacher. She has supplemented her core teacher training with workshops in Project Wild, Project WET and other environmental education curricula. She also attends, when possible, the Montana Chapter of the Wildlife Society's annual conference, and numerous presentations by local biologists, to keep current on issues in wildlife biology and management. Anna noted that she draws on her wildlife biology degree and professional experience to create curricula that she considers rigorous enough for high school-level classes, in particular the WEM class. Anna teaches several sections of sophomore biology as well as the WEM class. She explains that the sophomore biology curriculum is dense, with a lot of vocabulary, so with those classes she is limited in how much outdoor teaching and wildlife biology she can incorporate. Anna is currently working with fellow teachers who are new to the school who want to learn how to take advantage of outdoor teaching opportunities. She also teaches teacher workshops in wildlife biology curriculum implementation.

Research Question 1. Why Does Anna Choose to Teach Outdoors?

Motivation and Student Impact

Motivation to take on the work of incorporating outdoor teaching can come from a number of sources. For Anna as a teacher, the various kinds of impacts outdoor teaching have on her students are powerful external motivators to teach outdoors. Anna is also motivated by internal reasons to teach outdoors. Her personal motivations are to spend time outdoors herself; to engage in outdoor pursuits that are fulfilling for her, such as observing wildlife; and to gain a sense that she is contributing to the conservation of

wildlife species populations and the environments that support them. Anna's motivations are interwoven between external reasons derived from the impacts on students, and internal impetuses stemming from the value of immersion in outdoor spaces and the need to conserve important wildlife species.

Changing Student Attitudes Anna teaches four sophomore biology classes and one WEM class, which is an elective for juniors and seniors. When she speaks about teaching outdoors, she refers to all her classes, but primarily to the wildlife class, since it is that class that she takes on six or more field trips throughout the year. For her, teaching outdoors is 'going out in the field'. She takes her students out in the field to collect data, putting to use the science skills and knowledge they learn in the classroom throughout the year. In referring to her motivation to teach outdoors, she states, "Certainly, in my WEM class, what I see is, it's almost a requirement. I mean, I could teach the class without going out in the field, but what's the point?" She goes on to elaborate on her meaning:

And the point is to get kids outside to experience and see things they've never seen, even though everything has always been there. But if you don't have the knowledge, you don't see. And so just to take kids out and have them be better observers, and then to understand the adaptations and the complexity of managing wildlife populations in a science, data-based sampling strategy.

I mean, our populations are managed based on data collection. And to connect the science with wildlife populations, but also, point out and have them see the complexity of that and how it actually somewhat becomes an art than just science, and the human involvement and all the complexity. I mean, the positive thing about taking kids out in the field is that they see and witness and experience what you talk about.

Anna mentions her background and knowledge as a wildlife biologist conducting research on mountain lions and other wildlife as the basis for her desire to educate about

wildlife ecology and management. Her concern for wildlife population loss is a motivating factor in her choice to teach outdoors. She explains:

Underlying why I left wildlife research and came into teaching is because I saw the reality that without human involvement, wildlife is destined to be eliminated from our continent, unless the next generation cares. And that, historically, has been through hunting and fishing. And the average hunter is my age. Fishing has a higher percentage of our population, but hunting does not.

And so I try to expose kids from a different perspective, so that if they're hunting or not hunting, that they see the big picture, and they see how the risks of where wildlife is vulnerable, especially in a place like Southwest Montana, where human populations are increasing so dramatically. And it's so easy to incorporate biological principles that they've learned in sophomore biology, and then incorporate that and take it further.

So, there's a personal reason, just for my fear of the future and the overpopulation of humans and what impact that will have on other species' populations. And then there's the academic, the science, the data collection. So, both of those, for kids to see a thrill but also to know there's a lot behind that.

Anna describes a moment in Yellowstone Park when she, a National Geographic photographer, and her class were watching wolves interacting with a grizzly bear and cub. While two wolves were trying to grab the grizzly cub, her students exclaimed over the sighting of a bird that they had been studying in class:

It was the first yellow-rumped warbler they've ever seen. And of course, after the bird was tweeting around in the sagebrush, they came back to the grizzly and the wolves and all that. But it was just such a special moment for me, that some little tweety bird that they've never seen before, they reacted in such a way. It was one of those moments that it was just like, ah.

Having her students learn to see birds in the natural world illustrates what she works to accomplish in her classes. When she is outdoors with her students, she will ask them, "what do you see?" In her experience, "kids do not see birds. They hear them, but they don't hear them. They see them, but they don't see them. It's like a blur. It's just

like the forest, it's green. It's not until they learn the individual trees that all of a sudden, they start seeing the trees."

As she puts it, with "your typical high school kid, you don't know if you're making a difference, if they even hear you." Anna describes another time in Yellowstone Park when her students reacted similarly to the sighting of an American kestrel. Her students "burst out of the vehicle, screaming 'stop, stop the car!'. She explains that "these cool, we don't say anything, high school kids went chasing after and trying to sneak up on the falcon." Al notes that, "they would see the color, and they were in love. They didn't realize it, but they were in love with it all. And those are the moments."

For her, to have her students react positively to 'little critters' in the presence of the bigger animals like bison, wolves and elk shows her that her students have had a 'rounded exposure'. They have become accomplished observers, and have developed a sense of wonder, connection, and understanding of the natural world. As she puts it,

I can teach, but have they embraced it, do they care, do they see, do they wonder? And there's a lot of times, for high school kids, they talk but they're somewhat hidden versus little kids as far as what's happening, what they're thinking, what they're feeling.

And so when you get those glimpses of those moments, that's like a little peek inside of what they've accomplished and how they have changed. And, it keeps me going, totally, very much so. And it's just that connection to things that are real.

Anna points out that she feels that as students begin to learn about the natural world around them and can identify the wildlife that live in it, they develop connections to that world. With knowledge comes understanding, value, attachment and caring, and she believes that when the emotional connection is made, students will eventually take

actions and make decisions to conserve and protect wildlife and the wildlands they depend on for survival. She feels the same holds true for hunters, fishermen, and gatherers of berries and firewood, too; a sense of value and connection to the natural world is forged when it comes down to survival through obtaining your own heat and food, even though there is a grocery store around the corner and heat is supplied to your home without securing it personally. As she describes it, ‘it’s very primitive, ancient. It’s in our evolution, our 50,000-year-old DNA. And to hook up to that connection is life-changing.” She points out that the idea of encountering a grizzly bear creates the same ancient, primal feeling in a student. She begins to see those ancient connections reinvigorated when students come in and tell stories of birds in their neighborhoods that they’ve just begun to hear.

Changing Student Behaviors Changing student behavior and making students aware of their behavior are motivations for Anna to take students on field trips. Anna expects certain types of behaviors of students while in her class and on her field trips. To that end, she trains her students in the types of behaviors she wants them to choose. As we talk in the interview she states her expectations and her reasons why she asks them of students:

RV: So one of the things that also came to mind as you were describing the situation where students acted inappropriately, how for students and kids, part of the education experience is learning how to behave in this kind of thing. Is that a motivator for you for taking kids out in the field? Is that they learn how to be?

Anna: Oh, certainly. Changing that behavior or helping them be aware of, hey, we are in grizzly country. We have our pepper spray. We’ve talked about what to do. Nobody goes off in the bushes alone to go potty. You always have a second person. They have pepper spray. Those kind of things, I think, are just basic skills that are, over the decades, I’ve seen have

decreased, just that knowledge, just what do we do. I mean, they have a knowledge that bears and other things that could kill you, but it's not always real to them.

And so I have to really nail it and go, what are you going to do? Right there, there's a bear. What is your plan? And make sure because we have the practice canisters, and so we all go out and practice.

RV: And also, behavior of how to be in a group and how to be on a field trip safely and make the right choices?

Anna: Sharing data, everybody helping, yes, all of that. There's interactions, so that's why no electronics. I mean, you have to talk, you have to interact because that's decreasing also, just talking with each other, they text. So yes, very much.

Anna notes that she has been really pleased all these years that, even if students are outside of the van, when she says something, they all move to respond appropriately. She has seen it get to a point where the students are watching other people in the park later in the day and they say, 'can you believe that person there?' And they start modeling correct behavior around wildlife.

Changing Social Dynamics Anna explains that she is very proud of a situation that develops on her field trips, which is that the students come together on the trips who are not in the same social groups outside of the field trips. Typically, in a school setting these students would not share food or spend time around each other, but they do on the field trips. She sees the fact that there is a 'whole bunch of different kids in the vehicle' as an advantage of the field trips. In watching the videos of the field trip, Anna noted that one student was sitting by herself in the van at the time. Anna mentioned that this was the student's first field trip and the girl did not take the class with any friends or buddies, and that she was proud of the student for signing up. Anna explained that if students do sign up with a friend, she will try to 'mix up the seating' so that those students will interact with other people as well as their friends.

When asked if students begin to change their social behaviors in school once they are back from a field trip, she says, “it’s a kind of a mixture, sometimes, yes, but students this age have their ‘packs’, their groups they hang with.” Anna explains that:

It's actually biological. It's dispersing subadults. And we talk about this in class, that they are dispersing subadults. And they no longer can depend on their mom or their mom and dad, that now they are dispersing. And it's scary out there, and you now depend on your group as your survival, your buddies, your brother, sisters, your whatever. Your pack. When you're criticized for having cliques or having tight friendships, realize that this is part of your DNA. You're just like any other dispersing mammal, dispersing subadult. And you're smart to have your closed group because that's survival. And all of a sudden, they're like ‘oh’.

You're just like any male grizzly bear or mountain lion cubs that are leaving mom and facing the world. And yes, you had learned your lessons, but all of a sudden, now they're real, and how well are you going to do, and how are you going to survive? And then I bring up testosterone and say, there's a reason you guys have higher insurance, because testosterone can be a wicked drug, and this part of your brain is not developed. We actually talk about that, why isn't this part of your brain developed? Because if it was, you would never leave home. You would never take off. You'd be saying, ‘I am not stupid. I'm going to stay with mom’. And then genetically, we have problems. There's an evolutionary reason why guys develop slower. So they're stupid enough to take off and go and try to live their lives because they don't think about those dangers, or it's less. And so I tell them, ‘guys, that's what happens with testosterone. That's why you make stupid decisions. Be aware of your biological constraints’. So anyway, that's always fun to talk about.

Capacity for Logic and Reasoning For Anna, her overarching goal for the class is not only learning wildlife biology, but building the mental abilities of using logic, using reasoning, posing questions and practicing cooperative problem-solving. Anna notes that logic can be taught through mathematics such as algebra, but it can also be taught through biology, through incorporating wildlife ecological and biological principles, so students see that logic doesn’t have to be abstract but can be applied to the processes of animal biology. She encourages students to talk about wildlife sightings they have made

outside of class. As a class they discuss, using logic and reasoning, why the wildlife would be in those places doing those actions.

When she points out the parallel behaviors between wildlife and students, it creates personal connections for students that help them think of ‘evolutionary pathways and connections’. She adds that trying to make those parallels is fun, too. Anna states that she sees, through continuing discussions, students beginning to make connections and come up with ideas, while she scaffolds their insights with little steps and hints. She notes that the sophomores need more hints than the juniors and seniors, but everyone needs them. And then, as she puts it, “‘all of a sudden somebody is there’, and they’ve got it.”

The Outdoors as a ‘Special Place’ Another of Anna’s motivations for teaching outdoors is that she can provide situations in which students feel the experience of being outdoors to be ‘of a special nature, something different from the feeling of learning traditionally in a classroom’. One of the ways she does that is to ensure that on her field trips students feel safe to break through social barriers, and secure enough to express their excitement in seeing wildlife without fear of social ridicule. Anna notes also that for her, time spent outdoors has a significant role in her life. As an introvert who teaches all day, she uses time in the outdoors to recharge herself.

Individual Students’ Success Anna has noticed that occasionally, there are students who may not be performing at a relatively high level in traditional academic subjects, but who excel at wildlife biology and ecology. In those situations, she sees “the 4.0 students would just turn around and look at them, like, ‘what? you got that, and I

didn't?'. And these kids would just come alive because they knew that they had nailed it." As Anna puts it, it gives those students different strengths, or they see different strengths in themselves. She goes on to say that she doesn't know if it's the naturalistic brain, from Gardner's intelligences, but "it's fascinating when it happens, and very obvious, especially to the high-end kids, because they expect that they're the ones that are going to put the pieces together, and they don't always do it".

Anna sees those 'naturalistic brain' students respond out in the field and also in the classroom when the class is dealing with wildlife biology and ecology topics. She notes that it can be unsettling for those students, and to the other students who don't expect that type of input from those students. She has seen the other students in class, instead of sulking or getting franticky because they've been beat out, compliment the knowledgeable students and incorporate those students' thoughts into their own understandings. Anna noted that those students now start talking more in class, throwing out ideas and contributing to the discussion. Anna attributes that to her work to create a safe environment where students can voice their thoughts, whether correct or not.

In considering if the mix of diverse students in the vans during the field trips contributes to the acceptance and safe environment of the classroom, she stated that those experiences help, in her opinion, to grow connections among students, and that it carries back to the classroom, though she doubts it carries beyond the classroom due to the pack-like nature of high-school relationships.

Professional Wildlife Background Much of the science content and data collection skills she teaches in the wildlife ecology and management classes are drawn

from her experiences and training as a professional wildlife biologist. A further advantage of her professional history that she brings to her science classes are the connections she has within the wildlife biology and professional conservation communities. She has called on those professionals to share their information about animal locations, research, and policy actions on public and private land in the state. She also asks wildlife professionals in various fields and at the universities to help in their specialties with her classes in the field. In a conversation with one biologist, the biologist mentioned that Anna's students are sometimes more knowledgeable than some graduate students they have worked with.

Personal Passion and Student Interest Anna shares her passion for wildlife ecology and management in a number of ways, as when she is exclaiming over one of her favorite wildlife, the ruddy duck. She shows her deep knowledge of wildlife behavior in her ability to locate wild animals like grizzly bears relatively easily by knowing their preferred habitat and habits. Anna speculates that her enthusiasm is one of the reason why students show their interest, but also that 'this is real stuff'. She points out that students choose her WEM class because 'they kind of care or think at least something about wildlife is fun or cool'. She has noticed that students in that class are typically willing to share. She explains that "when they share, and no one 'flashes them the evil eye', or considers them 'weird', they get even more into it, and start developing security, which 'with juniors and seniors, is huge'".

When discussing how her WEM class taps into students' enthusiasm and potentially lead them into wildlife careers, she mentions that she is careful to point out to

students that there are not that many careers in wildlife biology, and that there are important ways they can be more effective helping to enact policy decisions as knowledgeable citizens. She mentioned that, “it's one of the things I say to kids. ‘You can have a greater impact.’” She describes to students her work on an advisory committee on a predator management issue in which she helped influence the management plan that determined how government agencies would respond to predation of domestic livestock. She notes that she had more influence doing that advisory work as an informed citizen than she did in her years working professionally as a wildlife biologist.

Research Question 2. How Does Anna Accomplish Outdoor Teaching?

Planning for Outdoor Teaching

Planning for teaching outdoors entails establishing the context to enable outdoor teaching to take place in the school and community in which a teacher practices their pedagogy. In Anna’s case, establishing the context for her involved working with her administration to modify travel regulations, obtain permission to develop the types of classes and curriculum she wanted to teach, and identify sites to teach outdoors. When asked about planning for teaching outdoors, Anna states that it’s a lot of extra work, that arranging things does add difficulty to her life. In speaking about the impetus to take on the extra work, she mentions that “certainly, in my wildlife ecology and management class, what I see is it’s almost a requirement”.

General Pattern of Field Trips Anna conducts her wildlife biology field trips from a van that she rents for the day. She and members of her class go on at least 5-6 field trips in a school year. Each trip is day-long, and usually involves a very early departure (5:30 a.m.) and early return to try to catch the buses that leave the high school at 3:45 or so. Going on a field trip is an elective in the class. Some of her students never go on a trip, and some students go on every trip. The configuration of students for each trip varies, but according to Anna, the same configuration of students never happens more than once.

Working with Administration A condition that Anna encountered when she was hired at her current school was the school's transportation insurance policy, which mandated the use of school buses to transport students on field trips. In her first year, Anna took all her students, up to 30 at a time, on one school bus, and found that she wasn't able to provide the type of educational experience that she envisioned and felt students deserved. During her first year she worked to change policy to allow her to drive smaller vans and take fewer students at one time. She explains that her method to work toward a change to improve her circumstances was to find advocates within the administration to assist her in enacting the policy change. She also called on those advocates to support her in creating the wildlife ecology and management class that she developed and teaches. Anna has found her administration supportive through the years in granting permission for her field trips in a wide variety of seasonal weather conditions.

Sites for Field Trips Yellowstone National Park, across the northern part of the park from the Mammoth area to the Lamar Valley and Slough Creek, is an area Anna frequents for field trips. She also utilizes private property and public lands throughout SW Montana. Some of the private land she accesses are large ranches that are habitat for elk herds, enabling her classes to study elk migration and grazing impacts. For field trips in Yellowstone Park, Anna has taken them so often through the years that she knows the types of wildlife she and the students will probably see at specific pull-out spots

Timing of Field Trips Anna takes out field trips to various areas at specific times of the year throughout the school year. The majority of Anna's field trips are matched to events occurring in the natural world in each season. Anna explains that she leads at least 6 trips in a year, roughly two per season, though there are more trips in the winter. Each trip can have more than one focus, such as collecting data on riparian bird habitat and bird identification. Examples of seasonal events are the elk rut in the fall, the migration of snow geese in late winter/early spring, and elk calving season in spring. Each of these events occur for a limited period of time, several weeks to a month, and some, such as the snow geese migration, peak over a period of days. Past data records show the general dates when each event will most likely occur, and on-the-ground data each year confirms the timing of the events.

Anna schedules her field trips to provide the fullest experience for students, but each trip is contingent on safe weather travel conditions and whether the animals are at a place where they can be viewed, so Anna notes that she must remain flexible in whether she is able to take her students on a given field trip. She explained that for each trip, she

lines up a sub, and she has everything in place, but if the weather comes in or the animals don't arrive or are not visible, the trip will be canceled or delayed. She deals with the possibility of cancellation by keeping her administration informed and being ready to shift at the last minute, and she contacts students personally to make sure they are aware of the cancellation. She also requires her students to call in to cancel if they can't make it, but she will not cancel a trip if a student can't make it, she will try to find a substitute student to fill their spot.

Funding for Outdoor Teaching Since Anna's field trip costs are spread among the students who go on the trips, she does not use any funds from her school or district for field trips. The grant-writing she has done has provided equipment for students. Using grant funding, she has purchased three top-of-the-line Leica spotting scopes and tripods, as well as high quality binoculars for students to use.

A project on her school campus that she has done extensive fund raising for is the restoration of the creek on campus to restore it to a natural pattern and flow regime, combined with the creation of outdoor classrooms. Her intention with the project is to provide outdoor learning areas and to use the creek for educational purposes for both her sophomore biology classes and WEM classes. She also planned it to be used by other faculty in multiple disciplines throughout the school.

Co-Teaching Outdoors Anna co-taught outdoors on her school campus with one other biology teacher who had the classroom next to hers until he recently retired. She describes their teaching styles as similar, and they at one point co-taught the same group of students. She explains that there are some people that don't want to be bothered

teaching outdoors, and she respects and understands that attitude. She notes that it's extra work, and they don't get paid for it. She mentions that there are a couple of new people on the science faculty that are considering outdoor teaching, but they have a lack of knowledge and experience, in addition to the lack of outdoor teaching classroom management skills.

Managing Outdoor Teaching

Managing outdoor teaching consists of the actions and decisions that take place for each outdoor teaching event. Management entails the enforcement of behavior expectations for students during field trips, and the logistics required during field trips. Curriculum and learning goals for students are also elements of outdoor teaching management.

Preparing for Field Trips For a trip to actually occur, there needs to be enough students interested in going, so the first step to planning a specific trip is to have a show of hands in the classroom of who is interested. Anna takes 10-12 students per trip, or as many as there are seatbelts for in the vehicle she rents for the trip. Since she has chosen to use the smaller vans, only a portion of her class goes at a time. If there is a sufficient number of students, then Anna goes through the steps required for a trip, including creating a permission form for students. She asks students to sign up, or commit, to going on the trip in advance on a first come, first serve basis and to pay a small non-refundable fee. If students haven't been out in the field before, they get a small priority in signing up. The fee pays for everything, including gas, rental costs, insurance and substitutes for Anna in the classroom. If a student who signed up can't make it, their seat

can be transferred to another student. As Anna explains, “I go to the next person on the list if time allows because there's always waiting kids.”

Students who go on field trips can be dealing with various health issues, such as diabetes and allergies, and Anna has taken students who have had more serious health issues as well. As Anna describes it, “the reality is this could fall apart really fast. It never does, but wow, it could.” The conditions of the field trip are written out in advance, so students know the options. She tells about one kid didn’t show up for a trip. “Now, we were at four in the backseat, so actually, it was a relief. But he also overslept. Kids do that, but okay, did you have several alarm clocks? Did you?” She uses as it an opportunity for them to problem solve and learn that you don’t flake out, that you have made a commitment.

Anna describes as an example a field trip she takes annually in the spring. She wanted to take the class to see the thousands of snow geese that stop at Freezeout Lake, west of Great Falls, MT on their migration to Northern Canada and Alaska. Anna explains how she handled the planning for the Freeze Out Lake field trip:

And for that one, it's different because the birds are on the ground such a short time. So, I actually had kids putting in [indicating which days they could go] for the next five days, school days, which days would be possible for them. And then I looked at the weather, looked at the bird concentrations, and made my best choice [of which days to go to the lake]. And some of the kids were like, ‘no, we can’t go, can we change? [pick different days to go]’ And I said no. That’s the reality. I had to get a full vehicle.

Field Trip Equipment Key pieces of equipment that Anna uses in the field are spotting scopes and binoculars. Students use the scopes on a regular basis, doing both

the assembly and dismantling. In the years Anna has taught using the scopes, no accidents have occurred.

Students carry and write in field notebooks, and they also have cellphones, which they use for photos and to record notes. Anna discourages them from keeping all their notes on their phones, and she asks the group to record data in their phones only if they must, but definitely in their notebooks. Anna notes that phones are not ideal because people type more slowly than they write so they minimize the amount of data they record.

Students are required to wear appropriate footwear on field trips. Depending on the field trip, if students showed up in sandals, they would not be allowed to go. Some field trips entail hiking up hillsides, so ‘sandals would be out of the question’. To prepare students for this, Anna will hold a meeting before the trip to emphasize that she will not let them in the van without the necessary equipment, including shoes, for the trip.

General Class Management Because of the length of time Anna has been teaching at her school, she feels that she has a reputation about how she manages her class, and students are aware of her approach. Anna explains that “kids come in knowing that I can be very loose and very fun. But if they cross the line, watch out.” She has been known to use a commanding approach. She notes that, “in most situations, I don’t even have to do that. I mean, they come in and I uphold my reputation. And we get moving, and they better jump on.”

On the first day of class, Anna makes it clear to her students that she does not tolerate any inappropriate or illegal behavior and tells students not to come on field trips if they cannot follow the rules. Anna tells students that there will not be any field trips if their behavior is not appropriate because it would be no fun for her, and if she's not having fun, the field trips are never going to happen again. She says that she lets her class know "'if I'm stressed, we're done. I have to be happy,' and so that, of course, puts the behavior back onto them". As the teacher in charge on a trip with students, she takes on the role of their parent in what's called 'in loco parentis', with rights that enable her to search and seizure. Anna mentions one situation in which a group of students who hadn't been coming on trips decided to come on one but were found doing illegal behaviors. Anna had been excited that these students had chosen to come but was disappointed in the outcome. Due to that incident, she strengthened her behavior expectations in the field trip permission forms, which also clearly state the consequences if students behave inappropriately or illegally while on a trip.

Student Outdoor Preparation Anna has a number of ways to prepare students to be outdoors, but her primary philosophy is that high school students need to take responsibility for themselves, and that they should experience the consequences of their decisions. How well students are prepared impacts their ability to pay attention and have enough stamina to be successful during the field trip. To help students prepare, Anna provides them with equipment lists of what they should bring with them into the field, though she explains that some students don't necessarily follow it. The lists include bringing enough food and warm clothes, and she has found that when students don't

bring enough, the situation becomes a learning opportunity for the students. As she describes it,

They have an equipment list. And some kids don't necessarily follow it and end up being a little cold. It's okay, that's a good lesson. Your feet are wet, your socks are wet, take them off, we'll try to dry them. But the reality is, is that you need to be prepared. And there are some situations in which kids don't bring much food. I bring extra food and the other students are wonderful at sharing what they have.

Because of the early start to the morning, some students arrive with little sleep from the night before. Anna makes a point of asking students how much sleep they've had, and how much food they've brought, so she has some idea of different students' stamina and attention through the day. Anna notes, "I always do that because I'm thinking, 'okay, who to push a little bit and who not to' because they physically are tired." She explains that, "you don't want it to be negative, but you also want them to go, 'wow, I should have gotten more sleep'".

She goes on to say, "some of it I just let happen, so they experience that it's not like littler kids, where I'd go through and say, 'does everybody have their boots, does everybody have...?' It's 'no, you're old enough, there is a list'". Anna describes how some students' actions of not getting enough sleep, not bringing food or water, or not bringing the needed equipment such as notebooks or appropriate shoes, can be their choice, but can also be a result of their circumstances outside of school. Typically, she will step in and make accommodations, so students can participate and not be held back. For future trips, their actions are not held against them, and those students who weren't prepared have usually learned their lessons and promise to bring what they need the next time. On the observation field trip one of the students wore sandals and, in her case,

since it was her first time on a trip and she had come without friends, Anna was supportive and accommodating, in part because the observation field trip was vehicle-based so there was little actual hiking.

Student Behavior Expectations Anna's philosophy about behavior on field trips is to encourage appropriate and productive behavior by pointing out what can be seen and where to look, and to not be too regimented about what students can't do while on the trip. She teaches from the vehicle, and she asks questions and points out things as they travel. Anna explains that just being in the vehicle, you see so much, and waking them up to that is part of her curriculum.

The academic purpose of field trips is to practice observation and data collection techniques. The procedure is for students collect data as a group during the field trip, and when they come back to the classroom, they share their data, photographs and stories with the whole class. Anna explains that it is an academic day and there's structure to the field trip, but there are also opportunities for some relaxed social interaction. When students get in the vehicle, they have their notebooks out, ready to make notes on their observations. They can take a nap while she starts driving to their destination, but as soon as it is daylight, the class starts to collect data. She allows students to use electronics (iPods, phones) during the times they are not traveling through areas they should be observing. After they've been out in the field for ten or twelve hours, they can use their headphones or sleep on the way back to school.

Goals for Students as Learners A significant goal in Anna's WEM class is for students in the field to feel successful and empowered in finding, observing and sharing

wildlife observations. As Anna watches students observing areas for wildlife, she is careful to support their experiences so that they are independent, but not to the point of frustration. At a stop to observe and identify birds in an aspen grove off the side of the road, students used binoculars to spot birds, and then described what they are seeing as they tried to identify the birds. Anna explains that she listens to the tone of their voices to gauge if they are getting frustrated or overwhelmed with the task. Anna notes that toward the end of the field trip,

I try to watch and see when they start getting fatigued. Sometimes I push it over, you know, like developing like a runner. ... So when I see fatigue starting I remind them of a potential reward, like a carrot with a horse, so that they might get this. So kind of pushing it, but by the end of the day though, I sort of go shorter, because you don't want them to start feeling frustration.

Part of it is being patient, but they are high school kids, so ... I spend a little bit more because they need a little more focus. It depends on who's in the group, how much I participate and how their voices sound. I mean if they're starting to get a little frustrated, then I'll sort of step in more.

She explains that she gives students the opportunity to have ownership of what they find and can do, which includes the skill of directing people to what they are seeing by sharing their observations. She listens to their voices and is alert to them 'reaching the point of being angry', which is when she steps in and helps students verbalize what they are seeing and how to describe it to other people. Anna describes it as 'reading the landscape, as Aldo Leopold calls it'.

A further opportunity for students to develop ability and ownership is the assembling the tripods and scopes that she brings along on field trips. She mentions that she could easily assemble all the equipment but chooses to stand back and not engage with them to enable the students to try, though she will troubleshoot if necessary.

Another important goal for Anna's class is to develop community among her students and for her students among wildlife observers. She downplays the competitiveness that comes up within the student groups and encourages students to work together to spot wildlife. Anna requires her students to learn the etiquette of being part of the community of wildlife observers, in the park and elsewhere. To that end, she coaches them on not asking people what they are observing as they drive past someone, and to be quiet as they observe and not shout out when they see something. Anna explains that she tells students how to approach a group of observers watching wildlife:

Okay. Now remember, when you get up there, don't charge up to people and say, "What do you see?" Stand and listen, and then slowly integrate yourself into their group." And they'll say, "Oh, would you like to look through our scope?" But you don't go up there and say, "What are you seeing?"

As she says, "what I want to see is kids pointing and helping others and sharing with others. Sharing scopes.... being part of a community." She notes that sometimes students will act on impulse as a group while in the field, such as charging up a hillside to see wildlife dens or hiking across a field to a specific stand of trees. She understands and tolerates that behavior but also provides a word of caution about carrying bear spray and watching for hazards in the landscape.

Sharing Field Trip Data While students are in the field, they collect data on data sheets, and they also take pictures of what they are witnessing on transects. Students collect data on predator and prey species, and on bird species. Since bird identification is a content area that Anna teaches, she uses field trips to see birds in their habitat and identify them in the wild.

On the field observation day, students collected data on numbers of adult and calf bison, bear sightings, elk and deer population estimates, and wrote down bird identifications in specific habitats. The data provides examples of the principles of wildlife biology, which was part of the science content that Anna had been teaching all year. When students share field trip data with the rest of the class, everyone in the class learns how those principles are applied. Anna describes the process by saying,

When we come back we share, we talk about it and we kind of digest it, but I also have to illustrate that in a part of the curriculum somewhere else. For instance, if we're sampling elk, then I have to bring it up when we're talking about bighorn sheep. So I'll say, 'what is that whole recruitment thing again? We talked about it after that elk trip.'

After field trips, students share with the whole class, but not by standing up in front of the class and giving a talk. Anna explains:

I usually don't have them stand up because that's a little too ... That separates them from the group. I don't want them to be separate. I want them to be part of the class sharing, so I keep everybody in their seats, but they're telling stories and sharing data. Because I don't want the kids that didn't attend to feel out of it.

Through the shared data, the entire class has the data for all that school year's field trips. She explains: "all the kids in class have data for the entire year, and so as they fill in the entire year's data sheets, they start seeing the trends over the months." In that way, the whole WEM class can interpret data together, discuss their observations and conclusions, and benefit from the field trips that various sections of the class had taken throughout the school year.

Outdoor Teaching on Campus Besides the field trips Anna organizes for the WEM class, she will occasionally use the creek running through the side yard just

outside her classroom door for teaching water quality and stream flow lessons outdoors. The proximity of the creek allows Anna to approach outdoor teaching on campus in several ways. One method she uses is to have the whole class out in teams of twos or threes, and depending on how involved she needs to be, she can walk up and down the creek to see that everybody is working. The area is somewhat open, and she can watch everybody as one big group along the creek.

However, if the lesson or activity requires more one-on-one input from her, she splits the class in half, with a group that stays in her classroom and a group out at the creek. She notes that ‘her classroom is the perfect set up’, because, “I can have the door open, so I’d be watching these guys, but also the guys outside. I’ll have a group inside doing a reading and answering questions or something, while I’ll have the other group outside, and then I’d switch.”

Curriculum

Science Classes, Content and Skills The two different classes Anna teaches at her high school are sophomore biology, a year-long required class for all tenth-graders, and the elective WEM course for juniors and seniors. Anna typically teaches 4 sections of biology and one section of wildlife ecology and management. Students can choose to take the WEM class for one or both semesters in a school year.

The science content of the sophomore biology classes is dictated by district and state standards for that content area and grade. Anna can and does use a variety of teaching strategies of her choice for those classes, and for some science topics, such as water science, she teaches outdoors at the restored creek that flows through her campus.

For the WEM class, she draws on her own education, professional training, and experience in wildlife biology, as well as the proximity of resources like Yellowstone Park, for the science content and teaching strategies of the class. The content of the WEM class focuses on bird identification, anatomy and adaptations; biology, adaptations, and population dynamics of local big game animals such as bears, bison, elk, and wolves; and wildlife management, including policies and economics. The ecological connections of wildlife and habitat are a fundamental element in the curriculum. Anna explains that “it’s easy to incorporate biological principles that students learn in sophomore biology, and then take them further.”

Anna schedules the science content of her classes in response to the seasonal behaviors of wildlife and birds. She plans her field trips so that students can observe biological principles illustrated in natural phenomenon as it is occurring in the lives of the birds and animals they are studying. Most of her outdoor experiences are designed to teach information about specific wildlife species, which students then relate to general biological principles that are extrapolated through extended portions of her curriculum. Some field trips are meant to examine specific wildlife management situations, which Anna explains students can use to illuminate underlying wildlife management principles are similar for most species

Science skills are an integral element in Anna’s curriculum. In her classes she provides opportunities for students to learn skills such as observation, data collection and data evaluation. During field trips and in the classroom, students are asked to work on collaborative data sharing and interpretation. Anna expects students to apply their

content knowledge to field observations to interpret and understand the data they collect on field trips and share in the classroom. With her connections to professional wildlife biologists working in Yellowstone Park and elsewhere, she receives current data on animal populations and locations, to which students are asked to evaluate their data and data collection techniques by comparing their information and interpretations to the professionals' data. She explains that she asks students questions like, "'Did you do a good job? Is this valid? Are they valid, or are we?' And I pose to the kids: they did a sample. We did a sample. What's the difference between their sample and our sample?" She teaches sampling principles and techniques with her own students, so they can use their own characteristics to help understand data sampling validity.

Field Trip Curriculum Goals Anna sets up the field trip curriculum to mimic data collection as a professional wildlife biologist would do it, from a fixed wing plane. The field trip van becomes the proxy for a plane, and students make observations and count wildlife as though they are looking out of the sides of the plane. As Anna drives the van past on a herd of bison or elk that the students need to count, she tells them, "there's no slouch time, it's a fixed wing and I can't stop, I'll stall out, I can only slow down." As the class travels in the van, the students collect data along both sides of the road, looking and writing as she drives, with the road as the line of transect. During the Yellowstone Park observation field trip, the sections of the road transect through the Lamar Valley were divided by habitats, with types of wildlife dependent on who lived in each habitat.

Anna states that in her opinion, "if we're going to spend the day in the field or a period in the field or whatever, it's gotta be a job. High school kids want a job." By that

she means that students need to feel that their work is significant and relevant, worth the effort. She accomplishes that through training students in professional scientific practices and having them compare their results to wildlife biologists' data.

Anna enriches her science curriculum through incorporating interdisciplinary objectives in ELA, writing and math. To fulfill some of the reading objectives, she draws on literature in the conservation field. She mentions that every spring:

We all go out and read on the side of the mountain and have a great half hour of reading out in sagebrush. We go down the Lamar and we watch the grizzly bears and we'll see all the baby elk calves. And then at the end of the day when it gets too hot and everybody beds down, we bed down with Thinking like a Mountain by Aldo Leopold.

The conservation literature places the students' wildlife biology science content into the bigger picture of recognition and acknowledgment of the value and impact of healthy wildlife populations on the ecology of their habitats. It also meets Anna's motivational goals of developing students' connections to and appreciation for their own natural environments.

Teaching Strategies Anna describes her teaching style as primarily teacher-centered, with some direct teaching and extensive questioning on her part, along with cooperative learning among students. She explains that she teaches using a German gestalt theory of learning, where students learn patterns of factual information and identification of birds and animals, until they are able to pull the facts and identifications together to see the bigger picture of the organism in its habitat, in a form of constructivism. As she says, "It's not until they learn the individual trees that all of a sudden, they start seeing the trees."

She emphasizes questioning and logic, often employing a Socratic method of teaching in her classroom. As an example, she describes how every Monday morning she asks her students to describe any experiences they've had with wildlife over the weekend, and as a class they think out the logic of why the animal was there and what it was doing. She expects students to think both inductively and deductively, depending on if they go from specific observations to general principles, or use general principles to answer specific questions. One of the strategies she employs is to present the bigger picture of a natural phenomenon, or wildlife management situation, and ask students to try to see the elements or characteristics that make up the whole. As she says, "So it's just teaching them to think, to see."

Anna plans her curriculum to be rigorous, which she feels is appropriate to upper level high school students. Anna notes that people who observe her class comment that she does not seem to have discipline problems. She explains that she feels there is no time to waste in her class and she expects students to apply themselves and be engaged the entire class period. She says that she tells students, "I have you for this hour. We're going to go for it. There's no time to waste. You can't waste life. And I'm definitely not going to waste the time that I have with you. If you want to waste it, go away." She explains that it is 'very much my teaching philosophy. I hit it.' It's her opinion that if you do not, 'high school kids will find something else to do. They're not angels. And that's how I feel in the field also. Now, we can have quiet times, but you gotta work towards that.'

Assessment In describing the different types of assessments she uses when teaching outdoors and indoors, Anna lists all types, “informal, formative, summative in the field, and then also quizzes and finals. So I do every single hit that I can.” She goes on to clarify that she has developed different techniques for assessment during field trips as opposed to in the classroom. In her outdoor teaching, she states that ‘most of it’s verbal, and group’, and that she uses student-generated questions and comments to lead group discussions to build on the ideas presented. Anna considers the discussions ‘more of a group assessment, not individual assessments’.

She explains that she had tried written assessments in the field, but she wanted the field to be ‘a different experience, not something sculpted like the classroom’, and felt that the written questions had been ‘a little downer or a damper’. Anna describes an example of her outdoor teaching assessments now as opportunities to “sit at the picnic table, with their ice cream, and fill out data tables while they fight over how many pronghorns they saw in that section of a transect.”

In the assessments that Anna gives in her classroom, Anna notes that, since students who go on field trips share their data with the rest of the class, all the students can be assessed over something that has been observed in the field. To do that, she explains that she does quizzes, and then she ‘kills them on the final’. She prepares and gives a college-level exam for the experience of taking a high-level exam. In her experience, ‘some students just fly’. She states that, in her WEM class, “I don’t care about grades. I will give them all A’s and B’s.”

For standardized testing, Anna does not take it into account in her WEM class, though the sophomore biology students take state-required standardized science tests in the spring. The upper-level students in her WEM class take the ACT standardized test in preparation for college. She does keep the ACT test in mind as she teaches the WEM class as she considers the test an exercise in logic, which she considers one of the overarching goals for the course, along with reasoning and problem-solving.

Summary of Anna Leopold's Pedagogical Ecology

In conclusion, Anna Leopold takes students outdoors to observe wildlife in their habitats and experience wildlife biology principles firsthand because she is concerned about the future of wildlife populations and the preservation of wildlife habitat. In her own words, she expresses the need for students to understand the reality that “without human involvement, wildlife is destined to be eliminated from our continent unless the next generation cares.” She is also motivated by the social and academic achievements her students show when they interact and share during field trips and in class, and she observes students developing a sense of connection with the natural world when they realize it exists all around them.

Anna Leopold planned and developed her outdoor teaching methodology by working with her administration to initiate the option of small group field trips, thereby creating personalized field trips with a unique depth of interaction between herself and her students as they observe wildlife in their habitat. The timing of trips takes advantage of seasonal wildlife phenomena occurring in selected habitats accessible in a day's drive from her school. On her field trips, she draws on her extensive knowledge and

experience in wildlife biology to offer experiential learning for her students and to share her passion for the wildlife and ecology of the wild landscapes she introduces to her students. She successfully manages her outdoor teaching events through long experience with the high school student psyche, deliberately creating a safe environment for students to both interact with others from outside their normal social groups and to express their growing understanding of, concern for, and connection to their environment. She has developed a rigorous curriculum based on applying biology principles logically and teaches using Socratic questioning and cooperative learning. Students in her wildlife biology classes have gone on to work in wildlife biology professions and become informed citizens on environmental issues in their communities.

Preparing future citizens to make informed decisions, and sharing her passion and knowledge of wildlife biology, led Anna Leopold to create and teach her successful wildlife biology and sophomore biology classes. Many scores of students have learned to observe wildlife in their native habitats through her efforts and dedication, and she has created a legacy for fellow and future educators at her school of incorporating outdoor teaching and learning into their pedagogy.

Section Two

Cross-Case Analysis: Pedagogical Ecology of Outdoor Teaching

In my cross-case analysis of the interviews and observations of the three study teachers, I identify an interrelated set of factors that emerged from the teachers' collective stories that work together to enable the teachers to teach outdoors. These factors, taken together, are a 'pedagogical ecology' of outdoor teaching, due to their interdependence and necessity of being present. I developed the concept of teachers' pedagogical ecology as I began examining the individual teachers' stories for patterns of interrelationships within each teacher's situations and patterns of similarities throughout all three teachers' stories. After completing the individual case analyses, I began explaining my research findings to interested individuals, which gave me the opportunity to synthesize my thoughts and observations as I articulated what I had discovered about each teacher. As I drew conclusions about each teacher's outdoor teaching, I recognized that why and how each teacher taught outdoors was a result of their own particular motivations and circumstances, but that there were consistent common factors among the three teachers. I reviewed the teachers' stories to identify the common factors in the teachers' pedagogies and motivations and mapped out the interrelationships between them. I created the 'pedagogical ecology of outdoor teaching' (PEOT) model to show the common factors and their interrelationships.

Table 4 serves as an audit trail to illustrate the identification of the commonality of factors between the teachers' pedagogies.

Table 4. Outdoor teaching commonalities in the three teachers' pedagogies.

Cross-Case Analysis of Teachers' Pedagogy	Bruce	Henry	Anna
Personal History, Education, and Professional Development			
Childhood experiences in the outdoors	x	x	
Graduate degree	x	x	
Science education in teacher training programs		x	x
Professional development in outdoor science teaching	x	x	x
Motivations to Teach Outdoors			
Personal desire to spend time outdoors	x	x	x
Personal desire to learn and teach about outdoor sciences	x	x	x
Increase student engagement and motivation to learn	x	x	
Increase (some) students' academic success	x	x	x
Increase students' self-esteem	x		x
Develop students' connections to nature, the environment	x	x	x
Develop students' sense of wonder and appreciation for nature	x	x	x
Instill stewardship values for the environment		x	x
Develop students' place-based connections	x	x	x
Develop students' sense of community and citizenship	x	x	x
Encourage students' cooperation and respect in group work	x	x	x
Develop students' sense of resiliency and accomplishment	x	x	x
Take advantage of local environment attributes	x	x	x
Planning for Outdoor Teaching			
Working with administration and community to teach outdoors	x	x	x
Developing access to outdoor sites at schools and nearby areas	x	x	x
Having teaching skills and experience for outdoor teaching	x	x	x
Managing Outdoor Teaching			
Doing due diligence – safety, permission, scheduling, etc.	x	x	x
Working with students with disabilities and special needs	x		x
Training for appropriate student behavior outdoors	x	x	x
Preparing students to be outdoors - equipment, clothing, etc.	x	x	x
Curriculum			
Outdoor science topics directly connected to class curriculum	x	x	x
Class curriculum takes advantage of local environments	x	x	x
Science is the major focus of outdoor class time	x	x	x
Curriculum has been adapted for outdoor experiences	x	x	x
Standardized testing is not a consideration	x	x	x

The pedagogical factors and their interrelationships, described in the pedagogical ecology of outdoor teaching (PEOT) model, are shown in Figure 6.

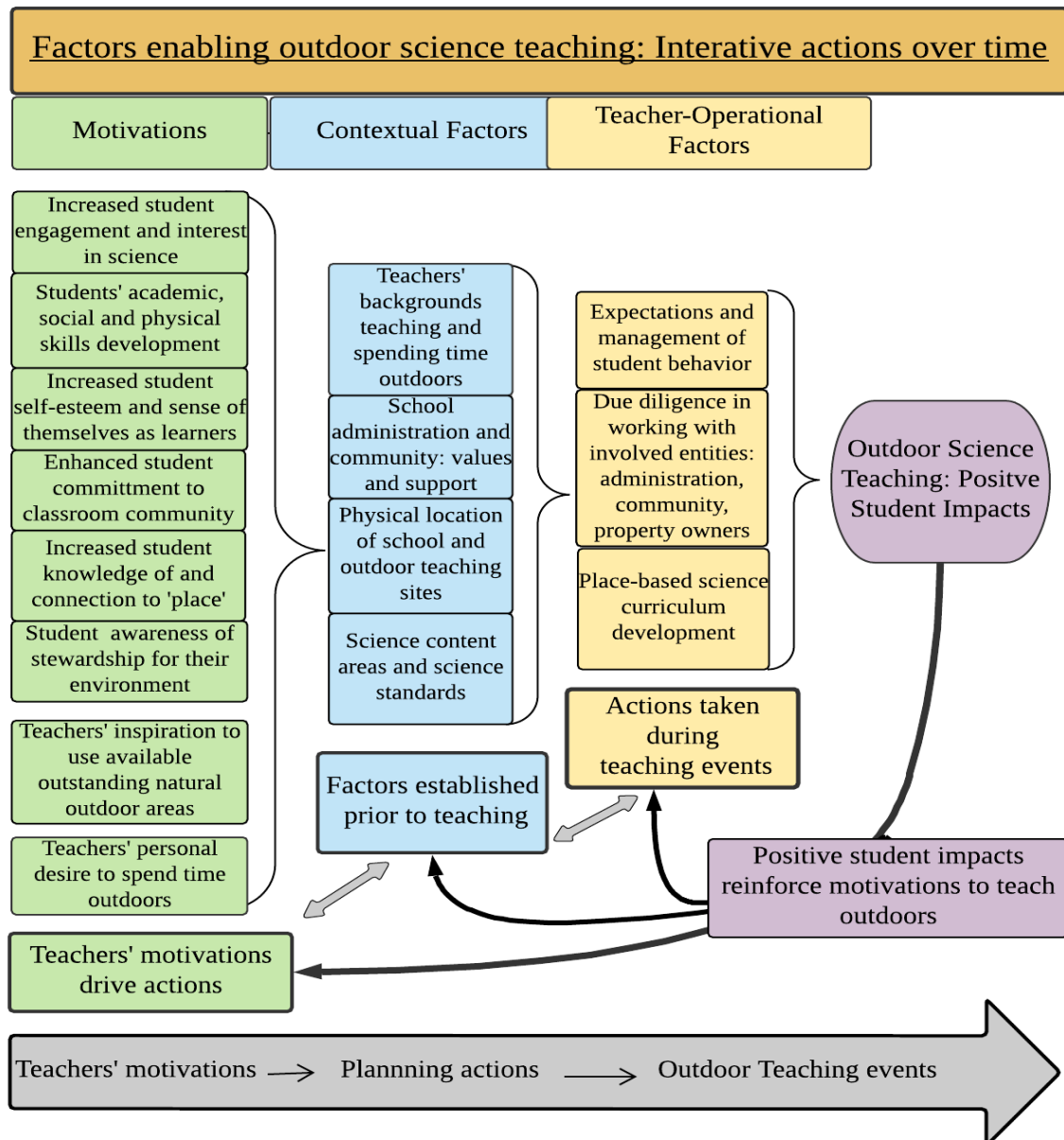


Figure 6. Proposed pedagogical ecology of outdoor teaching (PEOT) model showing the factors and relationships in the teachers' situations enabling outdoor teaching

In the PEOT model, three categories of factors are suggested as necessary elements in teachers' pedagogy: teachers' motivations, contextual factors and teacher-operational factors. The PEOT model can be considered a form of grounded theory, as Maxwell ((2013) applies the concept, in that the PEOT model is grounded in the actual data collected in this research, and using the research data, inductively explains and predicts the circumstances that need to be present in order for teachers to teach outdoors. I define each factor and explain the PEOT model in the following paragraphs.

Teachers' motivations explain the reasons why teachers choose to do the work of teaching outdoors. Contextual factors are the elements within a teacher's context that teachers put into place to enable outdoor teaching. Teacher-operational factors are teachers' actions in managing outdoor teaching events prior to, during and after each event. The three categories of factors can be arrayed on a timeline, with teachers' motivations existing prior to contextual factors, which are put into place before teacher-operational factors are needed. While there is a sense of the three categories existing in a past-to-present relationship, the relationships are also iterative, and not strictly linear in time or between the categories.

An example of the interrelationships of the categories of factors is that teachers' efforts to develop contextual factors are dependent on their motivations to teach outdoors, and that as they experience success in developing those factors, such as gaining administrative support to teach outdoors, they are further motivated to work to create outdoor teaching opportunities. Success in one area, such as incorporating outstanding natural phenomenon into their science curriculum (a teacher-operational

factor) provides positive feedback and incentive to continue to set up opportunities to teach outdoors (a contextual factor). This illustrates the iterative as well as the interrelated aspects of teachers' motivations and circumstances, as shown in the PEOT model.

Motivations

I propose teachers' motivations are the drivers for teachers to choose to teach outdoors. In the PEOT model, teachers' motivations are a foundational factor; without some form of motivation, there is much less likelihood that teachers will make the effort to do the extra work involved to set up and manage outdoor teaching situations (Carrier et al., 2013). In the narratives of the three study teachers, teachers are extrinsically motivated by the recognition of perceived positive student outcomes and benefits to students of learning outdoors (Cotton, 2006, Ernst, 2007); a primary source of motivation to teach outdoors. Teachers are also inspired by the outstanding natural environments available to them. Intrinsic motivations for the study teachers are derived from their own knowledge and experience in the outdoors, concern for the environment, and personal desires to spend time in the outdoors (Chawla, 1998). In the PEOT model, the study teachers shared eight different motivations in the areas mentioned.

Contextual Factors

I define contextual factors as those factors the teachers put into place to create opportunities to teach outdoors. In the PEOT model, I identify four contextual factors: 1) the teachers' training in outdoor teaching and experiences in the outdoors (Carrier, Turgurian & Thomson, 2013, Dymont, 2005); 2) teachers' community and

administration support and values (Carrier et al., 2013; Dymont, 2005); 3) outdoor teaching sites at and near the school's location (Bentsen, et al. 2013, Dymont, 2005); 4) teachers' science standards and science content areas (Barakos, Lujan, & Strang, 2012).

Teacher-Operational Factors

In the PEOT model, teacher-operational factors are built on the foundation of contextual factors. I consider teacher-operational factors as the actions the teachers took on an on-going basis before, during, and after their outdoor teaching events. I identify three teacher-operational factors. Those factors are: 1) expectations and management of student behavior (Carrier, et al., 2013); 2) due diligence in working with involved entities, such as the community, school administration, and private property owners (Dymont, 2005, Dillon, 2013); and 3) place-based science curriculum development (Dillon, 2013; Mannion et al., 2013). Specifics of how each of the teachers express the three categories of factors in their pedagogical ecology will be discussed in the following paragraphs.

Teachers' Motivations

In the analysis of the teachers' responses, the teachers' motivations to teach outdoors originated in three general areas. Those three areas were the experiences of the perceived positive impacts on students from learning outdoors, inspiration from outstanding available outdoor areas, and personal desire to spend time outdoors.

Positive Student Impacts In their interviews each teacher expressed their experiences of perceived positive impacts to students of learning outdoors. A range of perceived positive impacts were noted by each teacher, with multiple commonalities

between all three teachers. Significant perceived positive impacts that they all mentioned were found in cognitive, affective, and physical areas. Teachers also commonly spoke of wanting their students to develop knowledge of and connection to their local environment. The teachers' experiences of perceived positive student impacts echo the findings of a number of studies of outdoor teaching and learning (Becker et al., 2017; Dillon, 2013; Kuo et al., 2018; Malone, 2008; Rickinson, 2001).

A common motivation among the teachers was that their students benefitted cognitively through increased understanding of the relevancy of the science content they studied, and through increased interest and engagement in science specifically and learning in general. Each teacher noted that there were particular students who 'came alive' in the outdoors and were especially motivated to learn science content related to the outdoors. In each of the teachers' experiences, those particular students were often not as successful in a typical indoor classroom setting, but when they experienced themselves as knowledgeable learners in the outdoor classroom, they were frequently able to carry over their new identities into all their classroom work. The teachers felt that, in general, the increased interest and engagement in learning led to greater academic achievements, which helped some students with a sense of increased self-efficacy and a rise in self-esteem. Henry also noted that his 4th grade students increased their resiliency and gained a sense of accomplishment due to spending extended time outdoors in groups in challenging conditions. This phenomenon has been noted in research as well (Turgurian & Carrier, 2016, Waite, 2011).

The increased ability of their students to work respectfully with others was a further important common affective motivational factor for each teacher. Each teacher noted that when their students were learning outdoors, interactions tended to be more positive and cooperative. As examples, in Anna's high school field trip groups, students interacted together outside of their normal exclusive circles, while Bruce's middle school students preferred to spend time outdoors because they experienced fewer bullying types of behaviors that happened in the hallways of their school. For both Anna and Henry, developing a classroom community, with students exhibiting an allegiance to their class of fellow students, was mentioned as an important goal for them,

Students gaining knowledge and appreciation of their local environment, and developing a 'sense of place', was another important motivational factor for teachers. For each teacher, the focus of their students' 'sense of place' differed slightly, with the scope expanding geographically and with deeper understanding of human impact and interaction with their landscapes as students matured into high school. To illustrate, Henry's focus for his 4th graders was to have them begin to realize that their local environment was part of the much larger environment it is embedded in. For Bruce, his focus for his middle school students was to not only understand and appreciate their local environment, but to begin to understand the interrelationship of their area's economy and the environment. In Anna's case, the 'sense of place' she cultivated in her WEM class expanded to include the ecological landscapes of SW Montana and Yellowstone Park. She helped her students begin to see impacts of human decisions about large-scale land use and their subsequent effects on wildlife populations.

A corollary impact the teachers mentioned is that as their students gained a greater appreciation of their local environment, they also developed an increased sense of citizenship and stewardship. Both Henry and Anna mentioned creation of environmental conservation and stewardship ideals as a desired outcome for their students.

Inspiring Outdoor Sites The accessibility and quality of outdoor teaching sites near schools can be inspiring and motivating teachers to spend time outdoors (Bentsen, et al. 2013, Dymont, 2005). All three teachers have outstanding natural areas near their schools, and each teacher utilizes nearby Yellowstone National Park for field trips.

Personal Desires to be Outdoors In the teachers' narratives of this study, each teachers' personal desires to spend time outdoors were based on their appreciation of the natural environment and the affective, cognitive and physical benefits they experience when they are outdoors. Each of the teachers have their own personal reasons for spending time outdoors, which are reflected in the activities they choose to do with their classes. For Bruce, his desire to ride bicycles and share his love of bike-riding is a powerful personal reason to take his students outdoors. The physical benefits of biking and walking are important ways for him to maintain his physical fitness. He also expresses the affective benefits of a sense of wonder about the natural phenomena, such as nesting owls and bald eagles, that are often seen in his local outdoor environment, and he makes a point of sharing his sense of wonder with his students.

In Henry's case, he states that he 'doesn't want to spend every day indoors'. He experiences the affective and physical benefits of the outdoors as a place to renew his

connections to nature for health and well-being. He also explains that he grew up spending time outdoors with his family, and he does that now with his own family, so that spending time outdoors is meaningful to him as a way to share experiences with the significant people in his life.

For Anna, spending time outdoors is important personally as ‘a way to recharge’ and experience solitude, since she is an introvert in an essentially extrovert career. For Anna, spending time outdoors on her field trips provides affective, cognitive and physical benefits. The field trips let her observe wildlife in their natural habitats, and share her observations, a personal passion and professional endeavor for her.

Contextual Factors

Teachers’ Backgrounds and Outdoor Experiences Personal outdoor experiences become a contextual factor when teachers’ experience teaching and learning in the outdoors gives them a sense of self-efficacy to do the work of outdoor teaching (Ernst, 2007; Moseley, Huss, & Utley, 2010). Personal outdoor experiences that impact confidence to teach outdoors can include life experiences from childhood through the present day (Chawla, 1999; Shuman & Ham, 1997; Williams & Chawla, 2016). The three teachers each stated that their confidence to teach outdoors stems in part from their years of experience in outdoor teaching, and that they felt strongly capable of planning for and managing outdoor teaching. They each stated that they continue to learn more about outdoor teaching through professional development and mentorships, but that outdoor teaching has been an element of their pedagogy from the beginning of their teaching careers. Bruce referenced his first experiences teaching physical education on

St. Croix, Virgin Islands, and stated that he has taught outdoors throughout his teaching career. Henry explained that he has incorporated outdoor teaching from his earliest days as a teacher, and that through his continuing education and professional development, he became more confident and accomplished in teaching outdoors. Anna brought her experiences as a wildlife biologist as a guide to help her establish her WEM class and elsewhere in her high school science teaching career.

Administration and Community The support of a teacher's administration can be a key factor in whether a teacher feels they can teach outdoors (Carrier et al., 2013; Ernst, 2012), and in the PEOT model acts as a foundational contextual factor for teaching outdoors. Discussions with the teachers showed that each teacher had worked out their own unique agreements and accommodations with their administrations. For Henry, an allowance was created within his weekly schedule to accommodate outdoor teaching time, so that he had between 3-4 hours on most Fridays to go outdoors with his students. Other teachers' schedules were also adjusted to free up Henry's Fridays from daily special classes. In Anna's case, she worked with her administration to adjust policy to change the number of students she could take on a field trip at one time. Bruce worked with his administration and one principal in particular to gain permission to use bikes and to define parameters for class bike trips.

When considering curricula, all three of the teachers' school administrations have worked with the teachers through the years in adapting curricula to outdoor teaching. The administrations have supported the adaptations as a means to meet standards and to enhance and improve students' academic, social and physical

achievements. In each of the teachers' situations, other faculty in their schools have also supported their outdoor teaching, in co-teaching situations and through the integration of outdoor teaching into content areas taught by those faculty.

Community Outdoor Values The value of the local environment, or 'place' to a school's community can lend support to teachers' motivations to develop the contextual factors that enable outdoor teaching (Smith & Sobel, 2010) . In southwestern Montana, in the greater Yellowstone ecosystem, people often choose to live here because of the qualities of the outdoor environment and the activities they can pursue in the outdoors. For instance, all three teachers teach in communities in which spending time outdoors pursuing recreational opportunities and making a living in businesses supported by outdoor recreation are common and well-regarded activities. In general, the teachers' communities tend to value outdoor teaching and learning, and approve of the stewardship values students develop as they learn about their local environment.

School Location and Teaching Sites Identifying a place to take students outside can be a key contextual factor. Access and safety issues of outdoor sites, along with desirable attributes, are elements that teachers look for when considering teaching outdoors (Bentsen et al., 2013; Dymont, 2005; Rickinson, 2001). The teachers in this study developed this contextual factor through identifying and arranging the use of outdoor sites near their schools or in the surrounding area. For Bruce, this meant obtaining permission from private land owners for sites along the river near his school, and for Anna, on private ranches in surrounding areas. Anna also modified transportation requirements to reach appropriate areas by van instead of school bus.

Henry had access to nearby natural areas designated for school use and National Forest land within walking distance of his school campus.

Science Content and Standards Science standards calling for relevance in content areas and student engagement in environmental issues, as in citizen science projects, can be fulfilled through outdoor science teaching (Hackworth, 2015; Jorgenson, 2016; Klemmer, Waliczek, & Zajicek, 2005; Rios & Brewer, 2014). Some science content areas may be more directly relevant to outdoor teaching than others. In the research study, each of the three teachers spoke about how outdoor teaching provided relevant examples in a range of science content areas such as plant science, wildlife biology, ecosystem biology and ecology. In addition, each teacher included aspects of water science in their outdoor teaching. Bruce and Henry used citizen science projects based on local environmental issues as powerful place-based science education tools.

Teacher-Operational Factors

Teacher-operational factors are proposed as the actions teachers take as they teach outdoors, along with actions they prior to and following outdoor teaching, to enable each outdoor teaching event. From the analysis of the responses of each teacher to questions about how they manage outdoor teaching, teacher-operational factors can be categorized in three ways: 1) setting student behavior expectations and managing student behaviors, 2) doing due diligence in terms of responsibilities to involved entities such as the school administration, parents and other community members, and private property members if their property is utilized in outdoor teaching; and 3) developing and using place-based curriculum as needed to suit attributes of available outdoor sites, to

engage with natural phenomena encountered during outdoor teaching experiences, and to meet science standards.

Behavior Expectations and Management Two key categories of actions that each of the teachers took to succeed in teaching outdoors were to set clear behavior expectations before outdoor teaching events and to closely manage student behavior while teaching outdoors. For each teacher, behavior expectations for students included following safety protocols, behaving as learners while outdoors, exhibiting respectful and cooperative behavior among themselves and with the public, and accepting personal responsibility for taking appropriate actions while learning outdoors. An example of setting clear behavior expectation was what Henry called developing the ‘personal ecology’ of each student, where each of his 4th grade students becomes aware of the interrelated impacts of their behavior on each other and their environment.

How each teacher managed their students while teaching outdoors was in response to the needs and actions of their individual students in the specific situations of each outdoor event. Each teacher dealt with a different age group. Levels of autonomy and personal responsibility increased with the older students, as did the potential consequences. As an example, Henry spent considerable time in his 4th grade class teaching about appropriate clothing to wear and gear to carry when outdoors all day. In contrast, Anna simply provided a field trip equipment list to her high school students, and the potentially serious nature of infractions for Anna’s high school students compelled her to caution her students against illegal behavior.

Due Diligence Practicing due diligence means taking the degree of care that is to be reasonably expected or that is legally required in a situation, (“Due Diligence,” 2016)). In teaching outdoors, doing due diligence entails taking the actions necessary to ensure compliance with safety and management directives that may be co-authored with school administration, parents and other community members, and private property owners. Specific actions taken by teachers may include ensuring all communication has been made, maintaining schedules, having needed equipment ready, arranging transportation, and being informed of any safety issues. In general, doing due diligence means making decisions and managing situations to maintain a safe and productive learning environment.

For the teachers, specific actions varied according to their situations. Maintaining schedules was critical, especially in Bruce’s multiple-class middle-school scenario. Having needed equipment ready included curriculum-oriented gear like field notebooks and binoculars. Transportation varied with each of the teachers: Bruce used bikes, Anna rented vans, while Henry walked to his outdoor sites. Safety issues also varied with each teacher, but in general the concerns were with students’ actions and health, and with environmental hazards at teaching sites, such as rivers in Bruce’s case, and bears and other wild animals for Henry and Anna.

Place-Based Science Curriculum An important advantage of school-based outdoor teaching mentioned by each teacher was that they could make use of local environments to increase relevancy and provide experiential examples of their science content. To do so, the teachers adapted their science curriculum as needed to take

advantage of natural phenomena available in their local environments. Adaptation occurred prior to outdoor events and also during outdoor teaching as opportunities presented themselves, such as wildlife and bird sightings. The opportunity to observe inspiring natural phenomena, resulting in spontaneous curricula adaptation, was cited by the teachers as one of the advantages to teaching outdoors. The teachers' actions tended to be in accordance with the theory proposed by Mannion, Fenwick & Lynch (2013) of 'place-responsive pedagogy'.

Summary of Cross-Case Analysis

The cross-case analysis of the responses and actions of the three teachers in this research are summed up in the proposed pedagogical ecology of outdoor teaching (PEOT) model. The model proposes a series of categories of factors that are generally sequential in order and can be iterative and cyclical. The three categories of factors, in order, are motivation, contextual factors, and teacher operational factors. Teachers' motivations are the drivers for them to do the work to develop the contextual factors that enable outdoor teaching events to occur. With contextual factors in place, teachers take actions, called teacher-operational factors, to manage outdoor teaching prior to, during, and after outdoor teaching events.

Each of the teachers indicated that they chose to continue to teach outdoors because of the perceived positive impacts they see in their students, which is in line with the research on the effects of outdoor teaching on students. The proposed model's cyclical nature stems from the recognition that the perceived positive student impacts motivate teachers to continue their effort to create opportunities and do the work of

teaching outdoors. The iterative element is evidenced by the teachers' repeated work of developing contextual factors and then acting to teach outdoors, described by the teacher-operational factors. All three teachers' responses and actions are represented in the proposed PEOT model. The term 'pedagogical ecology' characterizes the model, since all the factors are inter-related and necessary to enable outdoor teaching to occur successfully.

CHAPTER FIVE: CONCLUSION

In conducting this research, I chose to study exemplary teachers who successfully and consistently took their students outside to learn science because, while the barriers to teaching outdoors are well-documented, much less is understood about what it takes for teachers succeed in outdoor teaching. Students gain in many diverse ways from learning outdoors, as is shown in the study teachers' observations and comments and in the research literature. However, during my science teaching career I witnessed the lack of opportunities to learn science outdoors that students experience in typical public schools. Teachers tend to not take their students outside to learn science or any other content, even when outstanding natural areas are easily accessible on their school campuses or within a short walk. The reasons why teachers do not teach science outdoors are real and varied. Teachers experience those reasons as barriers to teaching outdoors. The research on this subject contains numerous references to the many barriers teachers typically face when considering teaching outdoors (Carrier et al., 2013; Dillon, 2013; Dymont, 2005; Ernst, 2009; Rickinson, 2001). In my informal conversations with a number of teachers, they frequently confirm the barriers indicated in the research. Not all teachers experience every barrier; the barriers teachers face are specific to each teacher and their situation.

Despite these barriers, there are teachers who do teach outdoors, and while there is some research (Edwards-Jones, Waite, & Passy, 2016; Eick, 2012), little is known about why and how those teachers consistently and successfully manage it. Developing an understanding of the motivations and actions of teachers who successfully teach

science outdoors can inform others who see the benefits to students of outdoor science learning, yet are uncertain how to achieve it.

Research Methodology Summary

Case study methodology enabled me to look deeply into the motivations and contexts of the three teachers I worked with and learn about their thoughts, feelings, plans and actions about outdoor science teaching. In that way I could begin to understand the many influences they dealt with when making decisions to teach outdoors. I looked for examples of exemplary teachers, and using replication logic, chose specific cases to shed light on why and how the teachers taught outdoors. Three experienced teachers agreed to work with me, one each in elementary school, middle school, and high school. I was fortunate to work with remarkable, dedicated teachers with extraordinary stories to tell.

Using a semi-structured interview protocol, with questions based on outdoor teaching research, I interviewed each teacher, and collected field notes, photos and videos during field days with their classes. I sat down with each teacher later to review the videos and photos of the field days and recorded our conversations, using prompts about what they were thinking, feeling and doing. After coding interview data using NVivo, I wrote analytical narratives of each teacher based on themes in the data, and then analyzed the three narratives in a cross-case analysis. The analysis resulted in the development of the pedagogical ecology of outdoor teaching (PEOT) conceptual model. The model provides a graphic explanation of the complex, interrelated factors of the reasons why and the actions of how exemplary teachers successfully teach outdoors.

Methodological Reflections

The multiple case methodology was successful in that it enabled me to understand at depth the study teachers' pedagogy, context, and motivations. Additionally, aspects to my methodological choices provided added dimensions of data acquisition and analysis to my research. One of those aspects was the use of video-recall interviews, and another was the creation of graphic organizers of the individual study teachers' pedagogical ecology and the PEOT model.

The video-recall interviews with the study teachers offered unforeseen opportunities to me, as the researcher, to hear from the teachers in a relatively unstructured way. As we talked while viewing their teaching and their students' responses to that teaching, the study teachers explored their own ideas of what was taking place in their class and between their students, what their intentions had been for their lessons, and what they saw their students getting out of the experiences. We had rich and meaningful discussions, for example, about goals for the classes, and deeper discussions of the teachers' motivations, that I believe would not have occurred without watching the visual records of their classes. The visual records prompted topics that became emergent themes in later analysis, such as the perceived positive impacts of social equity in students' behaviors and student behavior management choices. Without the teachers' narration and analysis of their students' actions and interactions, I would not have realized those behaviors were taking place in the teachers' classes, as the teachers hadn't mentioned those topics in our previous semi-structured interviews. The video-recall experience was very worthwhile to understanding more clearly and deeply the outdoor teaching experiences of the study teachers.

Another way the video-recall experience was worthwhile did not have to do with data collection for my research, instead, it had an unexpected impact on the study teachers. Teachers in general may video themselves to a small degree when teaching, or someone else, perhaps an administrator or fellow teacher, may video a segment as they teach during a class. During my field observations I thoughtfully videoed and photographed the study teachers all day, for most of their teaching time, and for one teacher, I recorded them for several days. As we sat and watched the videos and photographs that documented their teaching, they were able to watch themselves teach, and see their impact on their students, in an in-depth, extended way. In the end, I felt as though I had given them the gift of themselves - documented evidence of their strong and powerful roles as teachers, the responsiveness of their students, and their deep impact on their learners. It also felt to me that I was able to repay them, in a small way, for the time and thoughtful effort they put into allowing me to spend time with them and document their work.

In another added dimension to my research methodology, the use of graphic organizers of the teachers' pedagogical ecology enabled me to display the elements of each teacher's teaching and life circumstances, their motivations for teaching outdoors, and the interconnections between all of them, in a clear and understandable way. I was able to use visual language as well as the written word to more clearly convey what I had induced in researching each teacher, and to pull the elements and connections together to express my interpretation of their stories. As I shared the graphic organizers of each teacher's narrative and the PEOT model with other people, we were able to

discuss at depth what I felt I had perceived with each teacher and the teachers as a whole. The graphic organizers were effective both in conveying information collected during my research and aiding mutual understanding of my interpretations.

Why Do Exemplary Teachers Teach Outdoors?

A primary finding of this study is that teachers' motivations to teach outdoors are driven by the many, varied, perceived positive impacts they witness in their students from being and learning outdoors. Teachers are also motivated to teach outdoors from personal desires to spend time outdoors, which may be an element of their nascent or fully-realized identity as an outdoor educator. When I asked each teacher why they taught outdoors, each one said, in effect, "it's a lot of work, but I teach outdoors because it is worth it". Each teacher reinforced this statement with anecdotal evidence from their teaching and personal experiences.

While I was aware of positive student impacts from the research literature and my own teaching experiences, and asked specifically about them in the interview protocol, what emerged in teachers' responses was the range and depth of perceived positive impacts. All three teachers cited a wide range of perceived positive impacts they witnessed in their students, and each teacher related anecdotes illustrating the depth of impact and change in students. The perceived positive student impacts described by the study teachers were found in all realms of learning: cognitive, affective, and behavioral (Novak & Gowin, 1984).

Responses I expected to hear from teachers were stories of students finding science content clearer and more relevant, and stories of increased student engagement,

interest and motivation to learn, responses in the cognitive realm. These impacts were referred to and considered important by the teachers, but the teachers also spoke of observing students displaying positive affective responses that were highly significant to them. The perceived positive affective responses appeared to strongly influence the teachers' behaviors; they made it clear that they deliberately elected to teach outdoors because they wanted their students to experience those positive affective responses and the personal growth they felt students gained from those positive responses.

The three teachers suggested that the perceived positive affective responses were due to several reasons. Those reasons included the improved quality of student interactions with classmates in the outdoors, interactions that enhanced their self-esteem, leadership skills, and perceptions of themselves as members of a community. Teachers spoke about students being more respectful and civil with each other; student interactions being more spontaneous and open; and interactions that crossed social barrier lines, such as age and gender differences and clique boundaries. It has been noted in some research that the leveling of social capital and lowering of social barriers are characteristics of outdoor interactions that can increase social equity in the classroom and school culture (Dyment & Bell, 2008).

Perceived positive affect impacts also occurred in students' increased self-esteem and improved perceptions of themselves as learners, impacts the teachers theorized were due to students' improved mastery of science content, gained through their perceptions of increased science relevancy through connection to real life phenomena. The teachers also attributed students' perceived positive affect to simply being outside, able to move

freely, explore the world with their senses, and experience being in nature. Some of these perceived positive outcomes witnessed by the teachers are corroborated in both qualitative and quantitative studies in various countries, such as those that practice the Forest School approach in Scandinavian countries (Bentsen et al., 2013; Fagerstam, 2014), and those that mandated outdoor learning, such as Great Britain (Dillon, 2013; Malone, 2008).

In regard to the perceived positive student impacts, I suggest that for the teachers, their sense of efficacy and agency as teachers is an integral aspect of their motivation to teach outdoors. Having agency is defined by Edwards (2015) as being “able to make responsible strong judgements about the worth of our intentions when we take actions. (p. 780).” Or as Bandura (2001) states, “To be an agent is to intentionally make things happen by one’s actions.” (pg.2). In the teachers’ situations, an example of their agency is the decisions they make when taking responsibility for their students’ success, along with their commitment to the greater good of their students through their roles as teachers (van der Heijden, Geldens, Beijaard, & Popeijus, 2015). The teachers’ decisions to teach outdoors constitute an example of their agency in their classrooms and with their students. This is in response to their sense of efficacy as teachers who value outdoor learning for its potential to enhance learning for all students (Tschannen-Moran & Hoy, 2001). Teachers’ sense of efficacy speaks to the perceptions of themselves as effective teachers who have positive impacts on their students (Bandura, 2001).

The teachers indicated that they are also motivated to spend time outdoors because of their own desires to be outdoors. Their personal desires to spend time

outdoors may be an element of their identities of themselves as outdoor educators, and people with meaningful connections to the outdoors and the environment. Connections to the outdoors and environment have been termed as having an environmental identity, by Clayton and Opatow (2003), and considered by Schultz et al. (2004) to possibly be an unconscious core belief. Chawla (1998), in her review of research on sources of environmental sensitivity, noted that in a number of studies, the top two reasons indicated by environmental educators that influenced their positive attitudes toward the environment were their time outdoors in significant life experiences and their concern for the environment. Those same reasons are present in the teachers' narratives, in Henry David's narrative of his time spent outdoors with his family, and Anna Leopold's concern for the environment. For Bruce Wilson, sharing his enjoyment of bike riding and appreciation of the natural world are the motivations he spoke about to spend time outdoors.

Another element of the teachers' outdoor teaching identity is that each of them chose to live and teach in areas with outstanding natural attributes. Those choices are an interwoven element of their motivation to teach outdoors. For each of the teachers, their identities as outdoor teachers take on different aspects in relation to their school's location in areas of outstanding natural attributes. As examples, when I spoke with Henry David about whether he would teach outdoors if he lived in another area, he answered by saying he chose to look for work at his school because of its location amid wild, natural areas, and because of the school and community's support of outdoor teaching. He hypothesizes that he was chosen to teach there because he explained how

he would incorporate outdoor teaching in his curriculum. Bruce Wilson spoke of being able to incorporate bike riding into his pedagogy as a motivation to teach outdoors, and also how he is inspired, and tries to generate inspiration in his students, by the amazing natural phenomena he often sees around his school. Anna Leopold uses the abundant wildlife available in nearby Yellowstone National Park as an experiential learning lab for her students in her wildlife ecology and management class. In essence, the teachers chose their teaching locations, and their locations enable and inspire them to teach outdoors.

How Do Exemplary Teachers Accomplish Outdoor Teaching?

Another primary finding of this research is that the teachers accomplish outdoor teaching through their ‘pedagogical ecology’, a term I define as the interactions of their pedagogy, experience and context. Teachers’ pedagogy includes the choices they make as teachers and the values that inform those choices. Their experience includes professional training, personal experiences, and teaching histories. The teachers’ context includes their content areas, such as general science, life science or biology, the outdoor environment of their schools, and their community and school culture, attitudes, and expectations. The previously proposed conceptual framework for this study, the theory of ‘place-responsive pedagogy’ of Mannion et al. (2013), is an element within the study teachers’ pedagogical ecology. Pedagogical ecology is related to Bronfenbrenner’s (1977) theory of the ecological context of development, which he defines as

the progressive, mutual accommodation, throughout the life span, between a growing human organism and the changing immediate environments in which it lives, as this process is affected by relations obtaining within and

between these immediate settings, as well as the larger social contexts, both formal and informal, in which the settings are embedded. (pg. 514)

Bronfenbrenner (1977) describes the ecological environment as ‘a nested arrangement of structures, each contained within the next’. For the study teachers, the ‘nested arrangement’ is both physical- their class, within the school and its grounds, within the community, within its geographical region; and social – their pedagogy, within the school’s expectations, within the community’s values, within the state’s standards. Further, the concept of an ecological environment in education is similar to Lewin’s field theory (1939), in which he posits that the individual’s interdependent social field influences behavior, expressed as $\text{behavior} = \text{function of the person and environment}$ $= \text{function of the life-space}$. Field theory can apply in these teachers’ situations since each teacher indicated that their behavior in choosing to teach outdoors was derived in part from their choice to live and work in their chosen schools and environments, and that they were inspired to teach outdoors by these environments of choice.

I propose that in their pedagogical ecology, the teachers are located within their ‘social field,’ and are both influenced by and influence the interactions and context they teach within. In doing so, the teachers draw on their sense of themselves as outdoor educators, living and teaching in the schools and communities they choose, to create opportunities to teach outdoors, to instill positive community and environmental values, and generate positive impacts in their students. They enact their value systems in regard to learning, the outdoors, and the environment, and they work to pass on those values to their students.

Rival Explanation

According to Yin (2017) rival explanations afford an opportunity to regard research data in a new light. In my initial analysis of the teachers' narratives to determine their responses to the research questions of 1) why do exemplary teachers choose to teach outdoors? and 2) how do exemplary teachers accomplish outdoor teaching? I concluded that their motivation to teach outdoors was generated primarily by the perceived positive student outcomes the teachers witnessed and described, and are a manifestation of the teachers' efficacy and agency. My reasoning for that conclusion was derived from the teachers' first comments when asked why they taught outdoors, that for them, it was 'worth it', which the teachers then correlated it to the many perceived positive student impacts they witnessed.

But what if the teachers' deeper primary reason was that they, themselves, wanted to keep in contact with the outdoors because their own desires and connections to the outdoors drive their actions? This would align with Chawla's (1998) findings of environmental sensitivity being predicated on experiences in the natural world, which act as motivations for environmental educators. It is noted in the PEOT model that teachers' desires to spend time outdoors is one of the motivations, but not the primary motivation that I suggested from my analysis of teacher interview responses. It is possible that I did not delve deeply enough into that aspect of the teachers' personal feelings about being outdoors, or that those motivations were not actually recognized in themselves by the teachers, because they are 'unconscious core beliefs, also known as primitive beliefs' as described by Schultz et al. (2004). If personal connection to the

environment and desire to spend time outdoors are the primary motivations for outdoor teaching, rather than the perceived positive student outcomes and the teacher efficacy derived from those outcomes, then other teachers' lack of motivation to teach outdoors could be explained by their own lack of connections to the environment and the outdoors. In this scenario, professional development that offers opportunities for teachers to spend time outdoors to develop environmental sensitivity and connection to the natural world would be a key first step to developing their motivation to teach outdoors, which in turn would lead to their creating opportunities to teach outdoors. This rival explanation places the findings of this research in a relativist, constructivist paradigm, rather than the somewhat more post-positivist stance of the PEOT model.

Revising the Conceptual Framework

Using the results of this cross-case analysis, I propose the pedagogical ecology of outdoor teaching (PEOT) model as the conceptual framework for this research. In my initial conceptual framework, I considered the place-responsive pedagogy theory developed by Mannion, Fenwick and Lynch (2013) as a conceptual framework of the motivations and actions of the teachers. In the place-responsive pedagogy theory, teachers are motivated by their natural environments to teach outdoors. My findings suggest that 'place' is only one of the sources of motivation. These study teachers appear to be strongly motivated by the perceived positive outcomes they generate and witness in their students, with 'place' motivation as a significant motivation as well.

I had also initially proposed that the study teachers may be motivated by a critical pedagogy of place (Gruenewald, 2003a) , that their desire to teach science

outdoors was in recognition of the need for change of the systems and restrictions they taught within. However, it was evident to me that critical pedagogy was not an underlying force for action. In my opinion, with perceived positive student outcomes as a significant driver for action, as well as personal desires to teach outdoors, changes in the system were in service to creating opportunities to achieve those goals. Once the teachers had arranged their situations to suit their needs, it appeared that they did not continue to advocate for change within their circumstances.

Limitations and Significance of the Study

This research study is limited by the similarity of the geographic locations of the all three teachers. The three teachers teach within a 100-mile radius around Yellowstone Park, within the Greater Yellowstone Ecosystem, and the schools of all three teachers had remarkable natural environments to take their students to that were easily accessible. This constitutes a limitation because it limits the transferability for other teachers who are not as fortunate to have such resources. In effect, these teachers' locations cause others to comment: 'of course they teach outdoors, look where they teach!' and so inexperienced teachers may assume that outdoor teaching requires such outstanding natural attributes to be successful. A further limitation is that as the researcher, looking through my own personal outdoor science teaching lens, I feel had the potential to be pre-disposed to look for the successes of the three teachers, and through my own bias, may not have gathered all the data possible that might have indicated other interpretations of the teachers' situations.

Benefits of the study design are in several areas. One is that the case study methodology allowed me to gather in-depth data about each teacher. The depth of data allowed me to develop detailed narratives of each teacher that offered rich descriptions of their actions, responses, and thoughts about teaching outdoors. The detailed narratives may increase the transferability of the research findings for other teachers due to those teachers being able to find common ground with some aspect of the study teachers' situations. A further benefit of this study pertains to positive affects for the teachers themselves. Through the careful collection of evidence of their outdoor teaching and subsequent member-checking of the data and data analysis, the teachers were able to see themselves through the eyes of an informed, non-judgmental observer. Each teacher expressed an appreciation of the opportunity to see the depth and impact of their work as a result.

Significance of the Research

The significance of this research lies in several areas: understanding why and how teachers accomplish outdoor teaching in the face of the numerous barriers, and in the depth and richness of the case study descriptions, which increases the potential transferability of the findings to other teachers and school districts. This research begins to identify the factors and their interrelationships of outdoor science teaching so that the complexity of the situations that teachers face in their teaching situations can be understood. However, while it is possible to generalize about the types of factors needed to successfully teach outdoors, each teacher's situation is unique. Each teacher brings their own strengths and experiences to their situations that combine with the assets

inherent in their contexts to enable them to teach outdoors. Recognition of the complexity of outdoor teaching in combination with the uniqueness of each teacher and their respective situations means that there is no ‘one size fits all’ approach to enabling teachers to include outdoor science teaching in their pedagogy.

Ultimately, if more teachers felt capable of teaching outdoors and included outdoor time in their curricula, more students would benefit from being outdoors. Outdoor time in classrooms could counteract the lack of time children spend outdoors in this age of electronic options and fear of the outdoors. Teaching outdoors offers an opportunity for students to spend time outdoors learning about their environment and connecting with their ‘place’ (Sobel, 2004). The benefits students gain from spending time outdoors are so wide-spread and well-known (Chawla, 2015; Dillon et al., 2006; Ernst & Monroe, 2004; Fagerstam, 2014; Kuo et al., 2018; Malone, 2008; Mygind, 2007, 2009; Rios & Brewer, 2014; Waite, 2011; Wells & Lekies, 2006; Wells et al., 2015), that our children and our society can only gain from assisting teachers to take their students outside.

Implications for Practice

The implications for practice for the findings of this research are in several areas. The findings can serve as a means of informing teachers and school administrations of their potential to implement outdoor teaching in their schools. The PEOT model could be used as a tool to analyze teachers’ pedagogical ecology to determine areas of assets and deficits to apply in the development of a theory of change (Funnell & Rogers, 2011). A logic model utilizing a theory of change can be used to develop an action plan

to ‘fill in’ the deficits and build on the identified assets that might exist in each teachers’ context. With the personalized information obtained in the PEOT model, action plans can be tailored to the needs of specific teachers, schools and districts.

A further implication for practice is the recognition that outdoor teaching has a wide range and depth of positive student impacts. That recognition can serve as a means to motivate teachers and school administrators to take steps to create outdoor teaching opportunities. The goal of positive student impacts could be an incentive for identifying relevant personal experiences and professional development that would enable teachers to deal with the barriers to outdoor teaching that are so prevalent.

Recommendations for Future Research

There are several areas where research could offer significant information to further teachers’ use of outdoor science teaching. One of those areas would be to test for accuracy of the PEOT model with additional teachers of science and other content areas. Additionally, research using the PEOT model as a conceptual basis could test the assumption that teachers’ motivations are the driving force for their outdoor teaching. Further research specifically into teachers’ motivations would help determine whether perceived positive student outcomes, or the rival explanation of teachers’ connections to the environment, were the primary drivers for initiating and continuing outdoor teaching, or if these two combined motivations operate together. Identifying primary motivations would have implications in decisions about future courses of actions, or interventions, to increase outdoor teaching events; for example, decisions about types of professional development would be derived from studies of teacher motivations. Further

research in this area could examine the effectiveness of different types of interventions such as professional development, mentoring, or administration and community support.

Another research area that would add to the body of knowledge about outdoor teaching would be to gain a sense of the amount and types of outdoor teaching that are actually taking place on and near school campuses. This could be conducted in different regions in Montana to gain comparative data for rural, suburban and urban areas in the state. Related to this topic would be further research into outdoor science teaching in specific types of educational settings such as rural vs. urban areas, with a potential research question being: do rural areas have increased access to outdoor teaching areas, due to their rural nature, and do rural teachers take more advantage of those more accessible outdoor areas than suburban or urban teachers?

A further research area is the social and academic equity potential of outdoor teaching. Anecdotal evidence in the results of this research study and others are that one reason students experience positive impact from outdoor learning is the leveling of disparity in social and academic advantages. Pinpointed research into this area could verify, and perhaps quantify, that evidence and potentially reveal the mechanisms that enable students to experience greater equity.

It would also be useful to research the phenomenon of ‘teacher accountability’ described by Gruenewald (2005) as the need teachers may feel to demonstrate accountability when teaching outdoors in ways that are not necessary when using classroom-based pedagogy. Increased accountability due to outdoor teaching can act as a barrier to teaching outdoors by adding to teacher workload and stress, and forcing

teachers into attempts to justify their actions related to teaching outdoors. However, the pressure of increased accountability may not be recognized by teachers as an active element at work in their teaching situations. Uncovering these types of pressures and expectations surrounding teachers would help to clarify aspects of their situations that may be influencing their decisions to include outdoor teaching in their pedagogy.

An area of research that could benefit public school education in the United States would be to conduct comparative studies of the United States public school system with models of outdoor teaching in public schools in other countries, such as the Forest School approach in the Scandinavian countries, and the Learning Outside the Classroom (LOtC) initiative in Scotland and England. Such a study could look for ways to apply aspects of those successful models to the United States system, and could develop recommendations for changes to accommodate outdoor teaching on a wide-spread basis in the U.S. The study may have the potential to strengthen information exchanges between countries and to draw other countries considering outdoor teaching into discussion and support.

The proposed ideas for future research are suggested as means to verify, extend, and explore the findings of this study. Those findings are that teachers may be motivated primarily by the many varied perceived positive student outcomes, and that the PEOT model illustrates the complex interrelationships of teachers' motivations and their contextual factors. Further studies regarding the PEOT model would serve to refine the model and verify its' veracity in describing why and how exemplary teachers accomplish outdoor science teaching.

Value of the Study

Concluding Thoughts

This research study felt important to me in a number of ways. For one, this research helped clarify the puzzling situations that I had observed and wondered about during my years as a science-in-residency teacher in southwest Montana public schools: why didn't the school teachers use the resources available right outside their doors to teach science? I now feel that I have the beginnings of an understanding of the complexities of a public school teacher's circumstances, and an idea of what elements need to be in place to enable teachers to successfully teach science outdoors. I have developed a model to analyze teachers' circumstances which can lead to steps to take to increasing outdoor science teaching.

Another way this research feels important to me is that it documented the work of three exemplary teachers. Collecting the evidence of their hard work, wisdom, and knowledge, and acknowledging their successes, provides a way to pay forward the dedication, expertise, caring and commitment of these three teachers. I am honored to have been able to work with such outstanding professionals and plan to pass on what I have learned.

For me, this research has reflected and justified my own professional choices and experiences as a science teacher who teaches outdoors. Including outdoor teaching in a science teacher's pedagogy, on the surface, can seem to be a relatively trivial matter, but this research and others have documented the significant positive impacts on students in so many important ways of spending time outdoors. Students' development as learners

and citizens of this world is now taking place in a way where they are increasingly distanced from the natural environment. To counteract that phenomenon, countries around the world have implemented national measures to mandate that students spend time outdoors being in and learning about their natural, local environments. In the United States, individual states have enacted environmental education curriculum standards and some have encouraged outdoor learning with state measures to get all students learning outdoors at specific grade levels. Even with such measures, it is overwhelmingly up to individual teachers to have students spend time learning outdoors.

My intention for this research is to add to the possibility that more children will spend time learning and being outdoors. Spending time outdoors is crucial to our health and emotional and mental well-being as humans on this natural world, and essential to our growing children. There is no substitute.

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APPENDICES

APPENDIX A

SUBJECT CONSENT FORM FOR PARTICIPATION
IN HUMAN RESEARCH AT MONTANA STATE UNIVERSITY

**SUBJECT CONSENT FORM FOR PARTICIPATION IN HUMAN
RESEARCH AT MONTANA STATE UNIVERSITY**

Research Study Title: Teachers' Use of Outdoor Spaces On or Near Their School Campuses: A Multiple Case Study of School-based Outdoor Teaching and Learning

This research study seeks to understand the factors that account for how, in what ways, and why some teachers successfully incorporate outdoor learning spaces in their teaching practices.

Rationale of research: A number of studies have shown that students of all grades benefit in many different ways from outdoor learning, but teachers face barriers using outdoor learning into their teaching. There are few records of the actions, thoughts and feelings of teachers who successfully teach use outdoor spaces at and around their schools. This research hopes to show how teachers like you succeed in using outdoor spaces on and near your school campuses. The research is important because if common factors of successful teachers are identified, those factors can be shared in teacher training programs and professional development, and so students will benefit when more teachers use outdoor spaces in their teaching practices.

You are being asked to participate in this study because you use outdoor spaces at and near your school campus in a consistent and scholarly way for teaching and learning opportunities.

Sharing your experiences and thoughts will provide the data for this research study. Your participation will consist of interviews, a short questionnaire, and an observation by the investigator of one of your outdoor teaching event, along with its curriculum. The interviews may take 30-60 minutes, and there may be several during the study. The questionnaire will be delivered to you and collected electronically and can be filled out when it suits your schedule. The interviews and observations are planned to take place during the 2017 fall semester. The interviews will be recorded and then transcribed and notes will be taken during the observations. You will be given copies of the transcriptions and notes for your verification and approval.

Participation is voluntary and you can choose to not participate at any time. There is no penalty if you choose not to participate. There are no foreseen risks in participating in the research study. The principal investigator may choose to terminate the data collection process regardless of this signed consent due to unforeseen circumstances. Source of funding of project: NA. Cost to subject: None.

Your information and responses will be kept in complete confidentiality for the research project and in any further use of the collected data.

If you have any questions about this study or your answers, please do not hesitate to ask the principal investigator Rose Vallor at 406-451-8025. If you have questions regarding your rights as a human subject, please contact Dr. Mark Quinn at 406-994-4707 or mquinn@montana.edu.

"AUTHORIZATION: I have read the above and understand the discomforts, inconvenience and risk of this study.

I, _____ agree to participate in this research. I understand that I may later refuse

to participate, and that I may withdraw from the study at any time. I have received a copy of this consent form for my own records.

Signed:

Investigator:

Date:

APPENDIX B

DEMOGRAPHIC SURVEY

Information Questionnaire

Rose Vallor, June 2018

For the Dissertation Research Study: Teachers' Use of Outdoor Teaching: A Multiple Case Study of School-based Outdoor Teaching and Learning

- for the completion of a Doctor of Education degree in the Department of Education, Montana State University

Hello,

I very much appreciate your time in providing this information for my research study. I am asking you to share this information to help establish the context of my case study research.

Your answers are invaluable in learning about you and the context in which you teach. I want to assure you that your information and responses are being kept in complete confidentiality. You and your school are being referred to with a pseudonym for this research project and in any further use of the collected data.

You may choose not to answer any, or all, of the questions.

Would you give me a brief overview of your teaching career? Please include such information as:

- How many years have you been teaching in your career?
- In how many different schools have you taught? How many and what different grades have you taught? How long did you teach in each grade?
- What are the dates that you have been teaching at your current school?
- How many students do you typically have in your classes?
- How many and what different subjects or courses do you teach, and have you taught? Do you, and did you, teach primarily in one or two specific subjects?
- Is there a specific subject area that you consider your specialty – your area of emphasis or deepest knowledge?
- Have you published articles or information, about teaching or other topics?

How long have you been incorporating outdoor teaching in your teaching career? When and where did you start adding it to your curriculum? Did you incorporate it in various grades, if you've taught different grades?

What about your early years? Where did you live as a child? Did you grow up in a city, town, rural area or other? How would you describe the area you grew up in – the size of the town or city, what type of area you lived in?

What were you involved in as a young person – sports, recreation, music, family, interests, hobbies, and so on?

Where did you attend college or university? What degree or degrees did you earn? Did you start in education or in a different area?

Have you worked in other fields besides education? If so, what fields or areas?

How would you describe yourself? Your age, the stage of your career, your background, your future aspirations?

Once again, I thank you for taking the time to provide me with this information. If you have any questions or considerations, please don't hesitate to get in touch. Please send this questionnaire back to me via email when you have finished. I would appreciate receiving it before the end of June.

Thank you very much!

Rose
406-451-8025
rvallor@gmail.com

APPENDIX C

SEMI-STRUCTURED INTERVIEW PROTOCOL

Interview Questions and Protocol

Study Title: School-Based Outdoor Teaching

Interviewee:

Place:

Time of Interview:

Date:

Duration of Interview:

Thank you for agreeing to meet with me for this interview. I value your thoughts and experience about teaching outdoors with your students, and I appreciate the time you are taking to talk with me. As you know, I am interested in learning how, and why, experienced teachers such as yourself incorporate outdoor teaching in their pedagogy when they use outdoor spaces near their schools for teaching opportunities. This is a multiple case study, with each participating teacher one of the 'cases'. I will interview and observe each teacher separately as individual case studies. I will analyze each person's data separately and then all the 'cases' will be analyzed together in a cross-comparative manner.

During this interview, I will ask you several open-ended questions, primarily in three areas: management, pedagogy, and motivations. You may choose not to answer any, or all, of the questions. I will be taping this interview, and will transcribe it verbatim, and will give you copy of the transcript for approval. Your replies are confidential, and you will not be identified individually.

INTERVIEW QUESTIONS

Opening questions – informal, friendly check-in questions such as: how are you today? How has your class been going this year?

Questions relating to class and administration management

Frequency, class management:

- Can you give me a sense of how often you take your students outside in your school year? On average, how long are students outdoors?
- Would you say you take your students outside on a scheduled basis, such as a specific day of the week, or when it's appropriate for your content area, or a combination of those? Or is there a different pattern to your use of the outdoors? I'll ask about outdoor teaching related to content knowledge later in the interview.
- Can you describe what a typical day is like when you are taking your students outside?

- How have you incorporated outdoor *spaces* in your teaching practice? Are there specific places on your school campus, or near your school, where you choose to teach, and if so, what are the reasons you choose to use those spaces?
- Are there specific class management issues you are concerned about when teaching outdoors, such as traveling to outdoor learning spaces? How do you deal with those issues?

Safety: Safety issues are something that can hold many teachers back from taking their students outdoors.

- What safety issues are you concerned with in your teaching situation?
- How do you manage those issues?

Administration, fellow teachers, parents and community concerns:

- What's your administration's opinion of outdoor teaching? Do they support your efforts or not? Do they provide accommodation, supplies, or contacts? Do they put restrictions on outdoor teaching?
- Do fellow teachers support outdoor teaching in your school? If they do, in what ways?
- What are your students' parents' opinions about outdoor teaching?
- What is your community's opinion of your outdoor teaching? Do you depend on community members to help out? Have you incorporated private land as part of your outdoor spaces?

Questions relating to pedagogy

Outdoor teaching in curricula:

- In what ways are outdoor teaching experiences woven into your curricula? Are outdoor experiences incorporated through an extended portion of your curriculum, or in smaller, bounded segments or in specific content areas? Do you have specific learning objectives associated with outdoor teaching (affective, behavioral, cognitive)? How are your outdoor teaching elements blended into your curricula when your students are indoors?

Specific outdoor teaching pedagogy:

- How does outdoor teaching differ from other teaching practices you regularly use?
- Have you developed new and/or specific teaching practices to use outdoors?

Student assessment results:

- Do you assess in different or specific ways when outdoor teaching is part of your curriculum?
- Do you take standardized testing into account when planning outdoor teaching for your class? If so, in what ways?
- Do you think outdoor teaching affects your students' assessment results? Do you have evidence that you can point to?
- Would you say assessment results are a motivator for you to incorporate outdoor teaching in your practice?

Questions related to motivation*Motivation:*

- What motivates you to teach outdoors?
- Would you say you have a specific or primary reason for taking your students outdoors, or do you have a range of reasons? If you do, what are those reasons?
- Are there specific reasons that enable you to feel capable that you can teach in the outdoors?
- Have you received any training in teaching outdoors? If you have, what kinds and when?
- Do you have personal experiences in learning outdoors?
- Do you choose to spend time outdoors outside of school?
- Do your own outdoor experiences influence your choice to teach outdoors?

Future outdoor teaching:

- Do you foresee yourself continuing to incorporate outdoor teaching in your classroom? What changes would you make in your program, or with your school, if you could make any changes you wanted?
- Are there emerging issues or trends that would impact or create new barriers to teaching using the outdoors?

Advice to other teachers/professional development:

- What is your advice for other teachers who want to begin taking their students outdoors?
- What training or experience would you advise teachers to receive to help ensure success in teaching outdoors?

Closure:

Thank you for your time and thoughtful responses. Your information and responses will be kept in complete confidentiality for the research project and in any further use of the collected data.

If you agree, Can I contact you about a follow-up interview at a future date, if it is necessary for this research study?

I appreciate your participation in this research study.

Observation Protocol – after the interview

Interviewer:

Location:

Date: _____ Length in minutes:

Interviewee Info

Name/Alias:

School

1. How did the interviewee appear to me?
2. Atmosphere/Location/Timing of interview in relation to outdoor events
3. Disposition to talk / Motivation to take part in the interview

4. Gestures, eye contact, non-verbal signals
5. Interaction during the interview / difficult passages