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Essential characteristics, learning, and knowledge sharing in K-12 environmental education partnerships: an exploration study

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ESSENTIAL CHARACTERISTICS, LEARNING, AND KNOWLEDGE SHARING IN K-12

ENVIRONMENTAL EDUCATION PARTNERSHIPS: AN EXPLORATORY STUDY

A dissertation submitted in partial satisfaction

of the requirements for the degree of

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by

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This dissertation, written by

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DOCTOR OF EDUCATION

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DEDICATION

To all the individuals and organizations committed to advancing environmental literacy throughout our community and beyond: Your passionate commitment to the environment and fostering an informed, caring citizenry is an inspiration.

To my daughters, Sara and Lauren: Your love and understanding during this journey has meant more than you could ever know.

To my family and friends: Your continual encouragement and support propelled me forward.

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ABSTRACT

To realize California public education's vision of fostering an environmentally literate citizenry, students will require a strong foundation in environmental education, especially during their elementary years. Yet, many students are not exposed to the foundational knowledge and authentic experiential learning necessary to develop environmental literacy. Although they are not widespread, collaborative partnerships between K-12 teachers and local environmental educators offer unique experiential learning opportunities for students that are usually beyond the means of a single classroom teacher to provide. This qualitative study explored the essential characteristics of sustained partnership activities between formal K-12 teachers and informal environmental educators in a rural Northern California county known to have an active environmental educator network. Semi-structured individual interviews with 12 environmental educators and four elementary teachers, along with two observations involving collaborative meetings and outreach programs, were conducted. Emergent findings indicated that most long-standing partnerships are relational rather than contractual, built upon mutual respect, empathy for teachers, and strong beliefs about environmental education. Effective outreach programs are therefore designed to be as accommodating and accessible as possible for teachers. It was discovered that engagement is predominately initiated by the teachers out of their desire to access resources and offer unique experiential activities afforded through the partnerships. These findings support the conclusion that most environmental education partnerships are teacher-driven and sustained as a result of the positive experiences, accessibility, and rewarding outcomes achieved. This study also found that environmental educators are highly knowledgeable professionals in their respective fields and skilled in

the unique student-centered pedagogical approaches necessary for facilitating outdoor

inquiry and learning for students as well as teachers. Furthermore, they credited much of

their continued professional learning and growth to the environmental educator network.

Thereby concluding that partnership activities produce opportunities for dynamic

communities of learning and knowledge sharing involving teachers, students,

environmental educators, and the community. Moreover, the existence of an effectual

environmental educator network strengthens outreach programs and their collective

impact across the region. By its very nature, experiential environmental education crosses

the boundaries of formal and informal learning, thus central figures are exposed to, and

learn from each other's practices.

Chapter 1: Introduction

K-12 education in California has an opportunity to leverage the current transition to the Next Generation Science Standards (NGSS) by recognizing the importance of fostering an environmentally literate citizenry. Although definitions of environmental literacy continue to evolve over time, leading international, national, and state frameworks provide similar, yet nuanced objectives and terminology (Hollweg et al., 2011; Hoody, 1996; Roth, 1992; Roth, 1996). These various frameworks describe environmental literacy as a developmental continuum across cognitive, affective, and behavioral domains (California Department of Education, 2015; Hollweg et al., 2011; United Nations Educational, Scientific and Cultural Organization, 1978). The California Blueprint for Environmental Literacy defines an environmentally literate person as someone who "has the capacity to act individually and with others to support ecologically sound, economically prosperous, and equitable communities for present and future generations" (California Department of Education, 2015, p. 7). Development of environmental literacy occurs across a person's lifetime through a variety of learning experiences including formal science courses across K-12 school and college, visits to informal science institutions such as museums, science centers, and zoos, as well as personal exploration of the natural world (Coyle, 2005; Hollweg et al., 2011; Lieberman, 2013; Louv, 2008; United Nations Educational, Scientific, and Cultural Organization, 1978).

Environmental literacy is the ultimate goal of environmental education (Roth, 1992). Given that environmental literacy is acquired across a person's lifetime through a variety of formal and informal learning experiences (Bevan et al., 2010; Coyle, 2005), K-12 education plays a critical role in its development (California Department of Education,

2015; Lieberman, 2013; Roth, 1992). To realize California's goal of fostering an environmentally literate citizenry, it will be imperative to address the challenges associated with the integration of environmental education into instruction. Environmental education is not a stand-alone or core subject in elementary grades. These concepts are found in science and, at times, in history social-science curriculum. However, the lack of science instructional time in elementary classrooms severely limits students' exposure to learning about our environment. Partnering schools with local environmental science professionals around authentic activities has the potential to mitigate these challenges and advance environmental literacy in both teachers and students (Cannon & Sandler, 2000; Brooks, Dolan, & Tax, 2011; Evans, Koul, & Rennie, 2007; Falloon, 2013; Monroe et al., 2016; Robertson, 2007). Collaborative partnerships between K-12 educators and local environmental science professionals are an especially viable option for schools in rural areas lacking access to colleges, universities, and larger science institutions that offer science professional development or outreach (Minner & Hiles, 2005; Parsley & Barton, 2015; Wilson & Ringstaff, 2010).

Although the literature contains extensive examples of successful outcomes of cross-sector science and environmental science partnerships (Eshach, 2007; Stocklmayer, Rennie, & Gilbert, 2010), this practice remains sporadic and temporary (Bevan et al., 2010). While much of the literature profiles particular partnerships and outcomes, there is a gap in the research exploring how formal educators and informal science professionals negotiate practices as they cross the boundaries of formal education and informal science learning. The California Blueprint for Environmental Literacy (2015) identifies the need to strengthen partnerships and collaboration as one of its key action strategies to elevate

environmental education in K-12 classrooms.   Collaborative partnerships designed to transverse these educational sectors provide unique opportunities to extend the learning and experiences beyond the boundaries of classroom walls (Banks et al., 2007; Bevan et al., 2010; Lee & Roth, 2003; Valli, Stefanski, & Jacobson, 2014). Understanding how formal educators and informal environmental science professionals successfully negotiate the boundaries of formal education and informal environmental science institutions could provide useful insights.

Historically, the term formal learning refers to the system of accredited educational institutions, such as K-12 schools, trade schools, colleges, and universities, that are intentionally organized and structured for the delivery of educational objectives (Bevan et al., 2010). However, there is less consistency and agreement in the literature on the distinction between non-formal and informal educators and learning settings. In the context of science and environmental education, non-formal learning settings and associated educators often refer to science-rich cultural institutions such as museums, science centers, planetariums, and zoos that are designed to offer enrichment activities and information (Eshach, 2007). Whereas informal educators and learning settings are commonly associated with less structured experiences such as visits to parks, fish hatcheries, botanical gardens, and various other outdoor settings (Louv, 2008). Yet, a large body of literature makes no distinction between non-formal and informal learning environments and educators, referring to all actors and agencies outside the formal education system as 'informal' (Bevan et al., 2010; California Department of Education, 2015). Throughout this dissertation, the term 'informal educator' or 'informal learning setting' will refer to all science and environmental science professionals, organizations, and

settings operating outside the formal education institutions. As such, the terms science professional, environmental educator, and environmental science professional will refer to those operating in the non-formal and informal learning arenas.

Background of Problem

High-quality environmental education for K-12 students has the potential to establish the foundational skills, knowledge, and dispositions necessary to foster an environmentally literate citizenry (Archie & McCrea, 1996; California Department of Education, 2015; Hoody, 1996; Lieberman, 2013; Lieberman & Hoody, 2002). However, environmental education faces several significant barriers such as location within standard classroom instruction (Disinger, 2001, Hungerford & Volk, 1990; Lieberman & Hoody, 2002; Lin & Shi, 2014), the overall decline in time and quality of science instruction in the elementary grades (Dorph, Shields, Tiffany-Morales, Hartry, & McCaffrey, 2011), and teacher efficacy, especially in elementary grades, for providing environmental science instruction (Disinger, 2001). Collaborative partnerships between K-12 teachers and environmental science professionals could simultaneously address these barriers if districts and schools are open to the concept. The following discussion provides a context for understanding the complexity of the challenges facing integration of environmental education in K-12 classrooms along with the limited and inconsistent practice of collaborative partnerships.

Non-traditional core subject. Historically, environmental education has struggled to find its place in K-12 classrooms (Disinger, 2001, Hungerford & Volk, 1990; Lieberman & Hoody, 2002; Lin & Shi, 2014), lacked a consistent definition of goals and objectives (Disinger, 1985; Fraser, Gupta, & Krasny, 2015), experienced criticism of instructional

materials and curriculum (Disinger, 2001; Fraser, Gupta, & Krasny, 2015; Hungerford, 2010; Salmon, 2000), and became a controversial political topic by those with opposing worldviews (Disinger, 2001; Lieberman, 2013; Reiner et al., 2006; Sund & Ohman, 2014). Since environmental education is not a traditional stand-alone subject, it typically appears in elementary or middle school curricula as a subtopic within a science class. Many high schools offer an advanced placement (AP) environmental science class as an alternative science course available for higher achieving students (Disinger, 2001). Consequently, unless teachers independently sought out supplemental environmental education curricula, most K-12 students received very little instruction directly related to environmental science and the impact of human interactions within the natural world. Partnering teachers with environmental education professionals could increase students' exposure to environmental education across their K-12 experience.

Decline in science instruction for elementary grades. While environmental education is considered an integrated, multidisciplinary topic (Archie & McCrea, 1996; California Department of Education, 2015; Hoody, 1996; Lieberman, 2013; Stapp et al., 1969; United Nations Educational, Scientific and Cultural Organization, 1980), in traditional classrooms it would most likely occur during instructional time allocated to science. Yet, in light of the focus on STEM (science, technology, engineering, and math) education, the lack of science instructional time in elementary grades presents a barrier to environmental science education and establishing an early foundation for environmental literacy (Lieberman, 2013). It is estimated that as few as 10% of California K-5 students receive high-quality science instruction on a regular basis. In addition, 40% of elementary teachers surveyed statewide indicate they spend 60 minutes or less on weekly science instruction

(Dorph, Shields, Tiffany-Morales, Hartry, & McCaffrey, 2011). This data reflects a national trend in the steady decline of elementary science instruction. Longitudinal data from the 2008 SASS Public Teacher Survey showed a continual decline since 1994 in instructional hours devoted to science in elementary classrooms (Blank, 2013). Several published reports suggest that state and federal accountability measures during the No Child Left Behind (NCLB) era that placed an emphasis on ELA and mathematics assessment scores resulted in the reduction of elementary instructional time in other subjects and enrichment activities, including science, history, physical education, music and art (Dorph, Shields, Tiffany-Morales, Hartry, & McCaffrey, 2011; McMurrer, 2007).

Similar concerns regarding elementary science instruction were raised in response to the 2012 National Survey of Science and Mathematics Education, designed to assess preparedness for implementing NGSS and associated instructional practices and pedagogy. Citing the limited frequency and duration of elementary science instruction as noticeably inadequate researchers state that schools and districts are not prepared to provide NGSS aligned instruction (Trygstad, Smith, Banilower, & Nelson, 2013). These new science standards and California's inclusion of Environmental Principles and Concepts (EP&Cs) place a strong emphasis on environmental science concepts and the human impact on the environment. As a result, teacher preparedness for science and environmental education is tightly bound to their understanding and efficacy of NGSS aligned instruction. Partnering with local environmental science professionals could increase elementary teachers' understanding of environmental science concepts.

Elementary teacher efficacy. Elementary teachers' self-efficacy for science and environmental education further compounds the challenges for providing a needed early

foundation for these concepts. The 2011 Statewide Science Education Survey of Elementary School Teachers, reported that approximately only one-third of the teachers indicated they felt very prepared to teach science. Whereas, approximately 90% of teachers surveyed indicated they felt very prepared to teach English Language Arts (ELA) and mathematics (Dorph, Shields, Tiffany-Morales, Hartry, & McCaffrey, 2011). Research indicates that most elementary teachers have limited formal science education making science instruction challenging, if not intimidating (Blank, 2013; Dorph, Shields, Tiffany-Morales, Hartry, & McCaffrey, 2011). Very few California elementary teachers hold a science-related major or minor for their undergraduate or graduate degrees. Teachers with a science-related major usually teach science courses at a middle or high school. It is estimated that only 1.4% of multiple-subject credentialed elementary teachers hold a science-related bachelors or master's degree, based on information obtained from the California Commission on Teacher Credentialing (Dorph, Shields, Tiffany-Morales, Hartry, & McCaffrey, 2011). Partnering elementary teachers with local environmental science professionals could increase the teachers' understanding of environmental science concepts as well as their self-efficacy for providing environmental science instruction.

Inconsistent occurrences of partnerships. The literature provides extensive examples of collaborative partnerships between formal educators and scientists from local businesses (Cannon & Sandler, 2000), environmental agencies (Brooks, Dolan, & Tax, 2011; Evans, Koul, & Rennie, 2007; Monroe et al., 2016; Robertson, 2007), science centers (McLaughlin, Broo, MacFadden, & Moran, 2016) and local science research institutes (Falloon, 2013). However, conducted research by the Center for Advancement of Informal Science Education (CAISE) found that many such partnerships are sporadic and temporary,

stating that this practice is not the norm (Bevan et al., 2010). Understanding how existing formal-informal environmental education partners have successfully maintained ongoing collaboration could provide helpful insights into more sustainable partnership practices. Research suggests that a coordinator, or boundary-broker, operating from within formal education may be a central figure in developing and sustaining collaborative environmental education partnerships (Lee & Roth, 2003; Waitoller & Kozleski, 2013). Exploring the critical roles and practices of central figures in existing K-12 environmental education partnerships could advance our understanding regarding necessary key positions and collaborative practices. This information would be particularly useful to interested stakeholders seeking to initiate or enhance local environmental education partnerships.

Challenges for rural schools. Funding models for public education can be complex and vary across the states. California's most recent funding policy places greater control of expenditures at the local level with base funding calculated on the per pupil average daily attendance by grade spans (https://www.cde.ca.gov/fg/aa/lc/lcffoverview.asp). Avery (2013) asserts that districts and schools located in rural or remote areas that have lower population density receive less state and federal funding than urban schools. In addition, the lower funding and more remote locations can impact a district's ability to attract and maintain highly qualified teachers, especially in the more technical STEM subjects (Avery, 2013; Minner & Hiles, 2005). Teachers in rural areas with low population densities often teach multiple grades in a single classroom at the elementary level. Similarly, many high school science teachers may need to teach multiple science disciplines. These situations greatly increase the amount of time needed for daily preparation. In addition, science institutions and colleges typically located in urban areas are not easily accessible to

teachers and students in rural or remote locations, giving them fewer opportunities for science-related experiences and professional development (Avery, 2013; Minner & Hiles, 2005). However, many rural areas, especially in Northern California, have access to various natural resources such as oceans, rivers, and forests and the agencies that service them. Partnering with local environmental science professionals would allow rural schools to efficiently maximize available human and natural resources within their community.

Problem Statement

The existing literature regarding school-science partnerships has generally profiled individual collaborations with nearby universities and larger science institutions in predominately urban settings (Bevan et al., 2010; McLaughlin, Broo, MacFadden, and Moran, 2016; Walsh & Backe, 2013). Several studies highlight the critical importance of a central figure or boundary broker with the ability to bridge the boundaries of formal education and informal environmental science institutions (Lee & Roth, 2003; Waitoller & Kozleski, 2013). What remain unclear are how these central figures, serving as boundary brokers, establish and sustain collaborative environmental education partnerships in rural areas.

Purpose of Research

The purpose of this exploratory qualitative study is to understand the roles and practices of central figures involved in existing formal-informal partnerships around K-12 environmental education in rural Northern California. At this stage in the research, environmental education partnerships will be defined as collaborations between formal K-12 educators and informal science or environmental science professionals who engage in activities for the purposes of advancing environmental literacy within K-12 classrooms.

Research Questions

The central guiding question of this study is: *How do central figures contribute to developing and sustaining formal-informal environmental education partnerships in a rural Northern California region?* To explore this topic more fully, this study will address the following sub-questions to understand the perspectives of individuals who organize, lead, and coordinate partnerships activities:

1. What are the roles and practices of central figures in K-12 environmental education partnerships?

2. How and why are K-12 environmental education partnerships formed?

3. What strategies, practices, or processes are present in successful K-12 environmental education partnerships?

4. What are the tensions or challenges in K-12 environmental education partnerships?

Significance

Rural school districts. This study explores innovative solutions for rural areas that could simultaneously address the voids in science instruction as well as the need to foster an environmentally literate citizenry. Establishing local formal-informal environmental education partnerships empowers rural communities to leverage their human capital and resources in the service of education and the environment (Minner & Hiles, 2005). Local partnerships in environmental education offer unique opportunities to rethink traditional approaches to instruction and curriculum. Collaborative partnerships with local environmental science professionals provide opportunities for both teachers and students

to learn the science concepts from experts in the field through place-based educational experiences (Avery, 2013).

Informing K-12 environmental education partnerships. Existing research recognizes the affordances of K-12 partnerships with informal environmental science professionals (Eshach, 2007; Stocklmayer, Rennie, & Gilbert, 2010). However, this is not a common or consistent practice across most districts or schools (Bevan et al., 2010). Although the current literature has focused on specific K-12 formal-informal partnerships and outcomes, little is known about how the individual professionals negotiate activities across these sectors (Cannon & Sandler, 2000; Brooks, Dolan, & Tax, 2011; Evans, Koul, & Rennie, 2007; Falloon, 2013; Monroe et al., 2016; Robertson, 2007). There are fundamental differences in practice between K-12 educators and environmental science professionals. It is imperative to understand how practitioners navigate across the boundaries of their respective institutions to support sustainable partnerships. Exploring the roles and practices of central figures in existing K-12 environmental education partnerships could provide useful insights into key strategies that help sustain the partnership.

Formal educators and informal environmental science professionals interested in establishing or enhancing K-12 partnerships would benefit from understanding how key personnel and practices converge in successful partnerships. This information could provide useful insights into how the boundaries of their respective institutions are negotiated toward mutually beneficial goals. Awareness of structures and strategies within successful K-12 environmental educator partnerships holds the potential to foster more sustainable, long-term partnerships.

Advancing environmental literacy in California schools. The complexity of K-12 educational standards has increased along with growing threats to the environment and quality of life on our planet. The California Blueprint for Environmental Literacy serves as a current call to action for K-12 educators to elevate environmental education for students across the state. This document presents several key strategies that include leveraging the transition to the new science standards, enhancing integrated STEM opportunities, and fostering stakeholder collaborations and strategic partnerships (California Department of Education, 2015).

Scientific literacy and environmental literacy are lifelong endeavors and much too complex for K-12 education to accomplish alone (Bevan et al., 2010; Roth, 1992; Stocklmayer, Rennie, & Gilbert, 2010). Development of environmental literacy occurs across a person's lifetime through a variety of formal and informal learning settings (Coyle, 2005; Hollweg et al., 2011; Lieberman, 2013; Roth, 1992; United Nations Educational, Scientific, and Cultural Organization, 1978). Effective K-12 environmental education partnerships capitalize upon the strengths of formal and informal educators and settings to provide dynamic environmental learning experiences for students. Authentic, environmentally based science activities have the potential to develop an informed, proactive citizenry that realizes the power of civic and community involvement in local, regional, and global environmental issues (Evans, R., Koul, R., & Rennie, L., 2007; Fraser, J., Gupta, R., Flinner, K., Rank, S., & Ardalan, N., 2013).

Theoretical and Conceptual Foundations

This study explores two theoretical foundations for collaborative partnerships along with the conceptual focus on environmental education and environmental literacy.

Environmental education and environmental literacy are related concepts. Environmental education is the context for how a person comes to understand the natural world. Environmental literacy is the ultimate goal of environmental education, much like literacy is the goal of English language arts instruction. These concepts will be explored more fully with an associated definition of terms following each discussion.

This research emerges from the conviction that fostering an environmentally literate citizenry has reached critical urgency due to the increased environmental threats to the quality of life on our planet. Furthermore, K-12 education has a responsibility to recognize and take up this challenge through the implementation of high-quality, experiential environmental education for all students. Partnering with local environmental education professionals may be an important first step toward to accomplishing this goal, especially in rural areas.

Environmental education and environmental literacy. Environmental education is defined by the place, setting, and context for learning. It encompasses the many ways a person comes to understand the natural world as well as the human impact upon it. Environmental education occurs throughout a person's lifetime (Coyle, 2005; Hollweg et al., 2011; United Nations Educational, Scientific and Cultural Organization, 1978) across a variety of contexts including formal education settings from Kindergarten through college (Hollweg et al., 2011; Lieberman, 2013), informal learning experiences at science centers, museums, planetariums, and zoos (Hollweg et al., 2011), personal visits to parks, nature centers, aquariums, or wildlife preserves (National Research Council, 2009), and simply time spent outside exploring and interacting with nature (Louv, 2008).

The ultimate goal of environmental education is an environmentally literate citizenry. Environmental literacy is defined across cognitive, affective, and behavioral domains and viewed as a continuum from environmental awareness and knowledge to stewardship. Environmental literacy is deeply centered on the practice of pro-environmental behaviors and actions (Hungerford & Volk, 1990; Roth, 1992). This exploratory study adopts the assumption that environmental literacy is developed across a person's lifetime through a variety of learning experiences and that no two people have the same experiences throughout their lives (Roth, 1992). These learning experiences occur across formal education settings from preschool to college, as well as informal learning experiences such as visits to museums, science-centers, observatories, wildlife centers, parks, and zoos, participation in habitat restoration projects, and personal observations of the natural world.

This proposed qualitative research extends the notion of practice to a social constructivist application of situated learning. As such it assumes that an environmentally literate citizenry is fostered through direct contact, activities, and interactions within the natural world and that learning, meaning, and identity are interwoven products of experiential practice through expert guidance. The degree to which children and adults have opportunities to learn about, interact with, and improve the quality of the natural world directly impacts their level of environmental literacy, identity, and agency as environmental stewards (Monroe et al., 2016).

Definition of terms associated with environmental education and environmental literacy.

Blueprint for Environmental Literacy: Educating Every California Student In, About, and For the Environment. A 2015 report by the State Superintendent of Public Instruction's Environmental Literacy Task Force that serves as a call to action for fostering an environmentally literate citizenry through K-12 environmental education.

Constructivism. Theoretical approach to learning and cognition by which the learner constructs new knowledge based on their current ideas and understanding of the world.

Elementary education in K-12. Schools and/or classes that serve students in elementary grades Pre-Kindergarten through 5th or 6th grade. Elementary education classes are typically self-contained classrooms taught by a single teacher specifically credentialed to teach multiple core subjects at the elementary level.

Environmental education. Environmental education is a broad concept of how a person comes to understand the interdependent relationships within the natural world as well as mankind's impact upon it.

Environmental literacy. Environmental literacy is the ultimate goal of environmental education. Environmental literacy is defined across cognitive, affective, and behavioral domains and viewed as a continuum from environmental awareness and knowledge to stewardship and action.

Formal education. The system of accredited educational institutions, such as K-12 schools, trade schools, colleges, and universities, which are intentionally organized and structured for the delivery of educational objectives.

Informal education. In the context of this research, informal education refers to all science and environmental education professionals, organizations, and settings operating outside the formal educational institutions.

K-12 education. Refers to the system of schools, district, county, state, and federal agencies that support formal, compulsory education from Kindergarten through grade 12.

Next Generation Science Standards (NGSS). The curricular science standards formally adopted in 2013 by the California State Board of Education for use in all K-12 public schools.

Non-formal education. In the context of science and environmental science, non-formal education refers to learning from science-rich cultural institutions such as museums, science centers, planetariums, and zoos that are designed to offer enrichment activities and information.

Secondary education in K-12. Schools and/or classes that serve students in middle school and high school. Secondary education classes are typically focused on a single subject, taught by a teacher specifically credentialed for that subject.

Social constructivism. Theoretical approach to learning that focuses on the processes by which a person socially negotiates new knowledge based on previously constructed ideas and social interactions with tools, language, and objects of the concept(s) under investigation.

Situated learning. A contextual theory of social learning that places the learner's development of knowledge, meaning, and identity on a trajectory from novice to expert within a community or practice. The learner evolves through interactions with knowledgeable experts within a community or practice.

STEM education. An integrated approach to education focused on science, technology, engineering, and mathematics.

Collaborative partnerships. Partnership theory contents that successful partnerships recognize the affordances of collaborative advantage through combined resources and human capital, positing that individual entities can accomplish mutually beneficial objectives more effectively together than separately (Huxham, 2003). The conceptual foundation of cross-sector partnerships reinforces the theoretical perspective of social constructivism through communities of practice.

Cross-sector partnerships require collaboration across the practices and boundaries of the respective institutions. The task of cross-sector partnerships is to transfer elements of one practice into another through a process of translation (Wenger, 1998). Brokering is the active and ongoing negotiated engagement between and among participants across institutional boundaries. Boundary brokers are central figures who operate at the nexus of these communities. Their task is to foster new meaning and learning for participants through introduction and integration of practices, knowledge, and tools shared from one institution to the other (Wenger, 1998).

Definition of terms associated with collaborative partnerships.

Boundaries. A conceptual representation of the tangible and intangible aspects that define a community from the outside world.

Boundary broker. Central figures who operate across different institutions or communities. Their task is to foster new meaning and learning through introduction and integration of practices, knowledge, and tools shared from one institution to the other.

Boundary negotiation. The process by which participants of a community negotiate new meaning through integrating aspects of practice from another community.

Collaborative advantage. An aspect of partnership theory that forms the rationale for the collaboration in that the combined resources and human capital can accomplish mutually beneficial objectives more effectively together than separately.

Collaborative inertia. An aspect of partnership theory that characterizes the slow, and often arduous process toward shared action and the challenges of working across institutional or organizational boundaries.

Community of practice (CoP). The sociocultural theoretical perspective on how a person's participation in the world develops his or her learning, meaning, and identity through the lived experiences and participation in social communities.

Cross-sector partnerships. Collaborations between different organizations or institutions for the purposes of advancing joint activities that integrate aspects of the practices of the individual organizations or institutions.

Exploratory research. An approach to research on a topic for which little is known and usually serves as the initial investigation that leads to more defined hypotheses or grounded theory.

Knowledgeability. The term used to describe the level of knowledge a person develops across related communities within the landscape of his or her professional practice.

Landscapes of practice. Built upon social theories of learning, meaning, and identity development, landscape of practice takes a broader view of how knowledgeability includes

a person's interactions and competencies across multiple, often interrelated communities within a profession.

Partnership theory. A dual theoretical perspective on leading partnerships that provides both the rationale for the partnership, collaborative advantage, and collaborative inertia, the theory directed at the tensions and challenges that lead to slow or no progress.

Delimitations

The unit of analysis for this study is the roles and practices of individuals who manage, lead, and coordinate activities within existing formal-informal science partnerships in the service of advancing environmental literacy in K-12 education. The delimitations of this research include:

- Existing partnerships between formal K-12 educators and local environmental science organizations
- Partnerships within Northern California communities
- A focus on the roles and practices of the collaborative partners.

Exploratory research is focused on establishing a broader understanding of the basic social processes of a group, process, or activity for which little is known (Stebbins, 2001). Exploratory findings may be used as a catalyst for further research to advance a hypothesis or theory. It is assumed that these collaborative K-12 environmental education partnerships are not widely practiced throughout Northern California, thus necessitating an exploratory design.

Summary

Partnering schools with local science professionals around authentic environmental science activities provides students and teachers opportunities for direct engagement with

the natural world under the guidance of environmental experts. Understanding how partnerships between K-12 schools and local environmental science professionals are established and maintained is a foundational step toward integrating sustained environmental education into Northern California classrooms. Focusing on the central roles and practices of individuals leading and coordinating existing K-12 environmental education partnerships could provide essential insights for district and school leaders interested in establishing similar practices.

The following chapter provides a triangulated review of the existing literature on the history, definitions, and frameworks for environmental education and environmental literacy, boundaries and brokers operating within communities of practices, and a social constructivist perspective on learning, meaning, and identity.

Chapter 2: Review of Literature

The following section offers a review of the literature regarding the theoretical

foundations of collaborative partnerships. It is followed by a contextual examination of

K-12 environmental education partnerships and the significance for rural areas. The

concept of partnerships is explored through two theoretical perspectives. The first theory

conceptualizes partnerships from the perspective of leadership; the second examines the

sociocultural aspects of learning, meaning, and identity as products of cross-sector

collaborations. The theoretical foundations are followed by a review of the research

focused on collaborations between formal education and informal science institutions.

Collectively, these studies offer multidimensional considerations for the roles of central

figures in K-12 formal-informal partnerships. The review of literature also includes related

concepts of environmental education and environmental literacy. Chapter two concludes

with implications for school-science partnerships in rural areas.

Theoretical Foundations

Huxham's theory of managing partnerships. A large volume of literature on

collaborative partnerships emerged from over 20 years of published research by Huxham

and various associates (Huxham, 2000, 2003; Huxham & Vangen, 1996, 2005; Vangen &

Huxham, 2003). Huxham's extensive body of work and research began in the early 1990s

through case studies and direct action research projects across an extensive range of

settings from smaller public-private sector partnerships to large multinational

organizations (Huxham & Vangen, 2005). The methodological approach of action research

positioned the researcher as a central figure in the studies. This approach afforded

Huxham and Vangen insights into leadership actions as the collaborations transpired as

well as input on follow up intervention strategies (Huxham & Vangen, 2005). Huxham and

Vangen's early research resulted in the construction of the diametrical partnership theories

of collaborative advantage and collaborative inertia.

Huxham and Vangen operationally define collaborative partnerships as "any

situation in which people are working across organizational boundaries towards some

positive end" (2005, p. 4). The development of a partnership is largely based on the central

guiding theory of collaborative advantage, in that the combined resources and human

capital can accomplish mutually beneficial objectives more effectively together than

separately (Huxham, 2000, 2003). The concept of collaborative advantage provides a

justification for the establishment and purpose of the partnership. Common rationale for

collaborative advantage includes access to resources, shared risk, efficiency, coordination

and seamlessness, and learning. Many public sector partnerships are based on a moral

imperative to address pressing societal issues, such as substance abuse, poverty, or crime,

that are considered too complex for any single organization to tackle alone (Huxham &

Vangen, 2005).

However, Huxham's collective research on collaborative partnerships found that

frequently outcomes do not meet initial expectations, progress is much slower than

anticipated, and many partnerships dissolve without achieving their goals. Partners come

together around a shared mission or vision, yet each organization is not entirely altruistic

and may have their own aims and agendas; some are transparent, while some are not

(Huxham, 2000, 2003; Huxham & Vangen, 2005). As a result, a great deal of time and

energy is spent negotiating the tensions, challenges, and changes in inter-organizational

partnerships. Huxham's theory of collaborative inertia depicts this phenomenon as it

represents the downside of partnerships. Collaborative inertia characterizes the slow, and often arduous, process toward shared action and the challenges of working across institutional or organizational boundaries (Huxham, 2000, 2003). Circumstances such as lack or loss of funding, changes in partnership leaders or participants, and waning commitment from individual organizations also contribute to collaborative inertia.

Vangen and Huxham (2003) explored the leadership styles and practices of partnership managers within public sector partnerships to understand how tensions and challenges are negotiated in an effort to move collective action forward. They noted that leading collaborative action is a continual negotiation between ideology and pragmatism. Vangen and Huxham (2003) determined that partnership managers must balance two opposing leadership approaches; one being facilitative, supporting the spirit of collaboration, and the second being directive, or what they call collaborative thuggery.

During their research in the mid-1990s, Huxham and Vangen (2005) identified a framework of 17 overlapping key themes in collaborative practice that emerged from their research on the perceptions of those responsible for leading or managing collaborative partnerships. The key themes were derived from practitioner interviews and represent the interviewees' initial thoughts and concerns regarding collaborative practice. The most predominant themes are: common aims, communication, commitment and determination, compromise, appropriate working processes, accountability, democracy and equality, resources, and trust and power.

Continued action research led to more detailed analysis around these key themes to better understand the challenges associated with collaborative inertia. Huxham and Vangen (2005) discovered that practitioners' use of the key themes to identify tensions led

to an oversimplified view of the issue and possible solution, often resulting in contradictions between practitioners' perceptions of an issue and the actual reality of problem. For example, many partnership managers expressed the need to establish common aims among the members as the reason for tensions leading to collaborative inertia. However, upon deeper examination, Huxham and Vangen (2005) found an inherent contradiction in this perception since the motivations of various members are most likely very different. Therefore, as long as the partnership managers maintained these contradictory and oversimplified perceptions, progress toward collaborative action would most likely be stalled as tensions continue.

Huxham and Vangen (2005) maintain that being a successful partnership manager requires a higher degree of awareness of the contradictory nature and complexity veiled within these key themes. They conclude that adept partnership managers learn to avoid collaborative inertia by understanding that progress toward collective action can occur without complete agreement on the key themes. Huxham and Vangen (2005) suggest that during times of impasse, a directive leadership approach is may be more productive when there is a lack of agreement among the members. Therefore, managers must skillfully navigate between facilitative and directive leadership styles to maintain progress and limit collaborative inertia.

Huxham's collective research illuminates the promises and challenges of leading cross-sector partnerships (Huxham & Vangen, 2005). The theory of collaborative advantage characterizes the possibilities and rationale for establishing the partnership. However many joint efforts become stalled due to unanticipated tensions and challenges as depicted in the theory of collaborative inertia. Environmental education leaders and

change agents identify K-12 school-science partnerships as an important part of a

comprehensive strategy focused on advancing environmental literacy (California

Department of Education, 2015; Lieberman, 2013). A rationale for promoting K-12 formal-

informal environmental education partnerships is grounded in the fact that the scale and

scope of fostering an environmentally literate citizenry is beyond the means of

K-12education to accomplish this vision alone (Bevan et al., 2010). This rationale echoes

the collaborative advantage justification Huxham and Vangan (2005) refer to as the moral

imperative, in which the societal issue is beyond the scope of one single organization.

     In sum, Huxham provides a comprehensive theoretical perspective on leading

partnerships in cross-sector collaborations (Huxham & Vangen, 2005). The following

section explores Etienne Wenger's theory of boundary crossing as a social enterprise

founded upon the shared practices of the participants (Lave & Wenger, 1991; Wenger

1998; Wenger-Trayner, Fenton-O'Creevy, Hutchinson, Kubiak, & Wenger-Trayner, 2015).

Wenger's work focuses less on the role of the manager and more on how relationships and

shared meaning are developed among and across the participants within a social

community.

     Wenger's theories of social learning. Wenger (1998) offers a perspective that

centers the act of managing on the activities rather than the people. His research and

theory development on communities of practice examines the phenomena of social

negotiations, learning, and identity within a particular community. His concepts on

landscapes of practice were built on these foundational theories. Wenger takes a broader

view in landscapes of practice of how knowledgeability includes a person's interactions

and competencies across multiple, often interrelated communities within a profession

(Wenger-Traynor et al., 2015). These theories will be discussed together as interactions

and learning occurs within communities and landscapes of practice.

Wenger's (1998) theories of social learning are built upon the assumption that our

reality emerges from the social structures of our world, thus placing knowledge, identity,

and meaning within the practices of the social communities of the learner.   The idea of

communities is used to illustrate the many social configurations a person belongs to or

identifies with, such as family, school, work, or interest groups. Wenger (1998) identifies

the following four integrated components of social learning that serve as a foundation or

initial inventory to characterize the phenomenon of learning within our world:

- Meaning: learning as experience

- Practice: learning as doing

- Community: learning as belonging

- Identity: learning as becoming

Wenger's (1998) community of practice (CoP) theory provides a sociocultural

perspective on learning, identity, and knowledge sharing developed through a person's

actual experiences gained through their active participation in the world. CoP theory is

grounded in the idea that connections are established and maintained through three

dimensions of practice: mutual engagement, joint enterprise, and a shared repertoire.

Relationships across the community are established and fostered through the shared

practices of participants. It is through the activities and shared practices that connections

and histories among participants are created.

Through ethnographic fieldwork in 1989-1990, Wenger (1998) further developed

the concept that learning, meaning, and identity are deeply contextual and connected to

shared practices of individuals within a specific group or community. His research,

focusing on learning and knowledge sharing among medical claims processors, advanced

the theory of CoP, a term that was first introduced in his earlier collaborative research with

Jean Lave (Lave & Wenger, 1991) on situated cognition. Their concept of situation

cognition centered on the trajectory of the individual within a community. Lave and

Wenger (1991) theorized a process of learning, meaning, and identity as a journey of

moving from novice to mastery. Whereas, Wenger's (1998) theory of CoP places the unit of

analysis on the collective learning of members within the community.

 CoPs do not assume complete and total harmony of a group. Wenger's (1998)

ethnographic field research of medical claims processors revealed that disagreements,

tensions, and conflicts coexist alongside shared practices and mutual relationships.

Learning within a community serves the basic purpose of replicating its social order as

transacted through the idea of apprenticeship (Lave & Wenger, 1991). Yet, Wenger's

(1998) research into CoPs established that participation involves both reification of

tradition and negotiation of new elements.

 Boundary brokering is the negotiation of new elements, practices, and meaning

between a community and the outside world (Wenger, 1998; Wenger-Trayner et al., 2015).

Boundary brokers are participants of multiple communities who possess the ability to

integrate elements of another practice into their own. A boundary broker's role is complex.

It requires the ability to negotiate connections across practices through a process of

translation, coordination, and alignment. Most often, brokering initiates change within a

practice. Their competency and legitimacy emerge from unique positions of multi

membership that allow them to connect practices in meaningful ways. The meaningful

practices and shared activities propel the community forward. Conversely, at times of impasse boundary brokers imagine and articulate possible actions as a means to maintain connections across the participants.

Boundary encounters such as meetings, conversations, and visits, provide opportunities for the negotiation of shared meaning among the participants. Wenger (1998) describes three types of boundary encounters and their implications for facilitating shared meaning.

- One-on-one. These encounters involve individual conversations or communications between two members of separate communities. This form of encounter allows for more candid discussion and sharing, yet the sharing does not extend to other members of the communities.

- Immersion. Visits to another community allows for an immersive experience into the practices of a different group. This experience can provide deeper contextual insights for the visitors. However, the boundary crossing is a one-way experience in that the host community remained within their own practices.

- Delegations. These encounters involve multiple participants from the different communities. Meetings are one form of delegation encounter in which all participants have a common experience allowing the negotiation of meaning to be shared across the group. The risk is that participants may go back to their established ways of thinking after the encounter.

Wenger (1998) proposes that encounters alone are not sufficient for creating connections across the communities. Rather, Wenger contends that connections are established and maintained through the joint enterprises and practices across the group.

Practices entail doing. They provide a common context for shared activity and production.

The shared activities offer opportunities for negotiating differing meanings and

perspectives toward a tangible outcome. Over time, connections are established through

practice and creating a shared history.

Wenger-Trayner et al. (2015) expanded upon theories of learning, meaning, and

identity within a community to an understanding of knowledge development and

competency within a professional practice. Using landscapes of practice as a metaphor,

they examined the distribution of professional knowledge across a body of related

specialties, each specialty its own community. The term knowledgeability is used to

describe the level of knowledge a person develops across related communities within the

landscape of his or her practice. Knowledgeability is developed through cross-boundary

learning experiences. Boundary brokers facilitate connections between communities

through the various processes of negotiating practices.

An example of knowledgeability across a landscape of practice can be understood by

considering the competencies of a professional photographer. At a basic level, the

photographer understands how to utilize the tools of trade, elements of composition, and

more advance shooting techniques.   There are many specialized fields across the practice

known as photography, each carry their own set of skills and competencies. A wedding

photographer operates in an entirely different context than a landscape photographer.

Knowledgeability involves developing a competency across both landscapes. A wedding

photographer needs to be skilled in indoor photography and lighting techniques, but also

understand elements of landscape photography to capture outdoor weddings and photos.

At some point, the wedding photographer entered into the community of knowledge and

practice known to landscape photography to bring elements of these skill to bear on her own practice of wedding photography.

In summary, Wenger's (1998; Wenger-Trayner et al., 2015) collective theories of brokering across communities or landscapes of practice suggest a facilitative managing style in an effort to perpetuate shared actions. To be effective, brokers need to be nimble enough to propose ideas but savvy enough to allow participants to contribute. Through the shared actions of mutual engagement, joint enterprise, and shared repertoire connections are created between the communities.

Wenger's theories applied within the context of K-12 environmental education partnerships serve as a framework for attending to the collaborative activities and practices between the communities. The concept of boundary crossing offers a lens by which to examine the bidirectional learning and new meaning from all parties. Teachers gain insights into the practices of environmental specialists, they increase their understanding of particular science concepts, and develop a broader identity as a teacher of science. In this way they integrate the practices of environmental scientists into their own teaching. Environmental science professionals are exposed to the curricular standards and expectations for student learning placed on teachers. They learn age-appropriate pedagogical strategies and classroom management techniques demonstrated by teachers. However, teachers hold the greatest accountability for their students' learning objectives. Sharing the practices of formal education, environmental science professionals have an opportunity to develop an identity around teaching and facilitating learning. Together, the partners create a hybrid space of learning, meaning making, and identity that exists between formal and informal learning environments.

Conceptual Foundations

    K-12 education partnerships. The proliferation of various K-12 partnerships

began in the 1980s in response to a sense of urgency to meet national challenges expressed

in the 1983 report, *A Nation At Risk* (California Alliance of Pre K-18 Partnerships, 2004;

Druckman, Peterson, & Thrasher, 2002) and continued calls for educational reform to close

the achievement gap (California Academic Partnership Program, 1998; Minner & Hiles,

2005). Many large-scale programs were funded at the federal level through agencies such

as the National Science Foundation (NSF) and the U.S. Department of Education to establish

partnerships between K-12 educators and institutions of higher education (Minner & Hiles,

2005; Orcutt, 2002). These school-university partnerships focused on a variety of aims

with the most predominate centered on teacher pre-service credentialing programs and

professional development (Callahan & Martin, 2007), while others concentrated on

curriculum development, educational leadership, and student outreach (Walsh & Backe,

2013).

    Emergence of science partnerships. In addition to capacity development for K-12

teachers and administrator, many school-university partnerships were focused specifically

on improving science and math education (Goebel, Umoja, & DeHaan, 2009; Minner & Hiles,

2005). School-university partnerships dedicated to the advancement of science and math

education flourished beginning in the mid-1990s in response to a national imperative to

better prepare U.S. students for careers in the fields of science, technology, engineering,

and math (STEM) (Orcutt, 2002) and the 2001 passage of the No Child Left Behind policy in

the reauthorization of the Elementary and Secondary Education Act (Minner & Hiles, 2005;

Walsh & Backe, 2013). This recurring call to action at the federal level echoed previous

concerns for national security and maintaining global technological advantage through a science-literate citizenry initially raised decades earlier in *A Nation At Risk* (Orcutt, 2002). Previous studies of school-university partnerships that focused on improving elementary science instruction through teacher credentialing and pre-service programs have found significant increases in teachers' science content knowledge and self-confidence for providing science instruction (Goebel, Umoja, & DeHaan, 2009; Jones et al., 2016). School-university partnerships dedicated to ongoing science professional development have also resulted in elementary teachers' increased classroom instructional time for science (Goebel, Umoja, & DeHaan, 2009; Sandholtz & Ringstaff, 2013).

It is important to note that the federal accountability measures associated with NCLB ended in 2014. In accordance with the federal Every Student Succeeds Act (ESSA), California has recently established new state accountability metrics (https://www.cde.ca.gov/re/es/index.asp). At the current time of this study, ELA and mathematics remain the only academic measures at the state and federal levels. California, like many other states are transitioning to the new science standards. The first statewide operational science assessment aligned to the NGSS is scheduled for spring 2019 (https://www.cde.ca.gov/ta/tg/ca/caasppscience.asp). This science assessment will be administered to elementary students in grade 5, middle school students in grade 8, and once during high school at a grade level determined by the local school. As of spring 2019, it is yet to be determined when and how the new science assessment metrics will be included in the academic measures at the state and federal levels.

A broader review of the research on school-science partnerships provides alternative models through the lens of formal and informal science collaborations.

Examples include a variety of cross-sector collaborations with local scientists from business/industry (Cannon & Sandler, 2000), environmental agencies (Brooks, Dolan, & Tax, 2011; Evans, Koul, & Rennie, 2007; Monroe et al., 2016; Robertson, 2007), science centers (McLaughlin, Broo, MacFadden, & Moran, 2016) and local science research institutes (Falloon, 2013).

Partnerships between the K-12 education sector and outside science professionals or science-rich organizations are commonly referred to as formal and informal collaborations. Building collaborative networks between schools and informal science institutions such as museums, nature centers, zoos, aquaria, land preserves, and other science-rich cultural organizations provide additional opportunities to enhance science education (Bevan et al., 2010). Partnerships between K-12 education and environmental science institutions bring together aspects of formal education and informal science learning.

Formal-informal collaborations in science education. Bevan et al. (2010) established a foundational perspective for conceptualizing aspects of boundary crossing in formal-informal science collaborations. Their epistemological approach, grounded in sociocultural theories of learning, emphasizes the importance of "the relationship between purposeful participation, and the cultural tools of science, and learning" (p. 22). This study does not provide a perspective for leading or managing collaborative partnerships. Rather, it advances a framework for examining boundary crossing in formal-informal settings as well as the affordances for learning within these hybrid spaces. This research included a review of the relevant theories of science learning and case studies of collaborations in the United States and abroad, conducted from 2008 -2010. Bevan et al.'s (2010) definition and

criteria for formal-informal science collaborations are joint activities between K-12 education and informal education organizations or science-rich cultural institutions. Their research report identified examples of informal education organizations such as libraries, afterschool and youth programs, as well as science-rich cultural institutions, museums, zoos, nature centers, and aquaria.

Their research found a wide variety of settings for collaborative activities characterized in five general categories: supplementary classroom experience, integrated core academic curricula, student science learning communities, teacher professional development programs and communities, and district infrastructure efforts (Bevan et al., 2010). Their examination of these multiple settings provided a template for understanding the structural, social, and physical features of formal-informal learning environments and their affordances for science learning. Case studies organized within these areas offers findings of the impact on student learning and contextual details of their unique program structure.

Bevan et al. (2010) provide an organization of the characteristics and associated affordances inherent in formal and informal learning environments. This organization offers potential collaborators a means to identify, consider, and leverage opportunities for learning within their own contexts. These features define both the boundaries and affordances within each learning setting. Figure 1 provides a comparison of these features and a context for delineating the common boundaries between formal and informal science education settings. Clearly illuminating the boundaries and affordances within a specific cross-sector partnership allows central figures an opportunity to meaningfully leverage their collective strengths and mitigate potential challenges.

	Formal Settings	Informal Science Education Settings	
	K-12	Informal Education Organizations	Science-Rich Cultural Institutions
Structural Features	Abstract/textual Scoped and sequenced curriculum Mandated entry points and modalities Regular and required participation Dedicated children's spaces Professional structures and supports Formal assessments	Concrete/object-based and textual Sequenced curriculum Optional entry points and modalities Less regular and more volitional participation Borrowed learning spaces Little professional structure and support Few formal assessments; links to school scores	Concrete/object-based, little text Linked curriculum Multiple entry points and modalities Sporadic and volitional participation Public learning spaces Little professional structure and support No formal assessments
Social Features	Extended (year-long) relationships Individual learning Teacher-directed activities Teacher-paced activities High-stakes (evaluative)	Sustained relationships Collaborative learning Group-directed activities Group-paced activities Low-stakes (non-evaluative)	Short-term, sporadic relationships Collaborative learning Learner-directed activities Learner-paced activities Low-stakes (non-evaluative)
Physical Features	Classrooms in school buildings	Variety of spaces in the community	Variety of cultural institutions and natural settings

Figure 1. Reproduced from *Making Science Matter: Collaborations Between Informal Science Education Organizations and Schools*: *A CAISE Inquiry Group Report*, by Bevan et al., 2010, p. 26. Copyright 2010 by the Center for Advancement of Informal Science Learning. Reprinted with permission.

Their research highlighted 15 exemplary collaborative formal-informal science programs from the United States and the European Union. These 15 exemplar programs were derived from the following five general collaboration categories: supplementary classroom experience, integrated core academic curricula, student science learning communities, teacher professional development programs and communities, and district infrastructure efforts. Their findings speak to the opportunities for student learning as well as the challenges in sustaining collaborations. Bevan et al. (2010) advanced five recurrent themes that emerged from an analysis of the structural and social affordances of these programs (Bevan et al., 2010). Each theme contains elements from either Huxham's

(2000, 2003) partnership theory or Wenger's (1998; Wenger-Trayner et al., 2015) theories of social learning in communities or landscapes of practice. Table 1 provides connections between Bevan et al.'s (2010) recurrent themes associated with affordances of formal-informal collaborations and the theoretical foundations of Huxham (2000, 2003) and Wegner (1998; Wegner-Trayner et al., 2015).

Table 1

Theoretical Connections to Affordances of Formal-informal Collaborations

Emergent Themes Identified by Bevan et al. (2010)	Associated Theoretical Connection
Formal-informal collaborations can lead to conceptually rich and compelling science learning programs that build on the structural and social affordances of informal settings and objects.	Wenger's (1998) theories of authentic learning provide a sociocultural context for science learning that is developed through social interactions with experts in the field and the use tools and objects of science.
Formal-informal collaborations can lead to the creation of learning communities that develop practices, dispositions, and understandings that are valued across multiple institutional settings and boundaries.	Wenger's theories of communities and landscapes of practice (explore how learning, meaning, and identity develop through integrating the practices of another community (Wegner, 1998; Wegner-Trayner et al., 2015).
Formal-informal collaborations can create more equity and access for children, and teachers of children, from high-poverty communities.	Huxham's partnership theory of collaborative advantage identifies the moral imperatives as a common rationale for establishing partnerships to address social issues too large for a single organization to take on alone (Huxham & Vangen, 2005).
There is a lack of strong, valid, and meaningful evidence of the impacts of formal-informal collaborations, largely due to the lack of a well-theorized methodology that captures and describes impacts that have valence with both formal and informal stakeholders.	Huxham's partnership theory of collaborative inertia identifies accountability, and commitment and determination as two key themes around which tension can arise (Huxham & Vangen, 2005).
Formal-informal collaborations take significant time and energy, often unacknowledged by sponsors of the work, and are a continuing but valuable process of evolution for individuals and institutions.	Huxham's partnership theory of collaborative inertia characterizes the phenomenon that many partnerships experience inaction and struggle to move forward (Huxham & Vangen, 2005).

Bevan et al. (2010) determined that successful programs leverage the complementary affordances of each contributing organization. They add that well-developed formal-informal collaborations provide opportunities for engaging and meaningful student experiences, especially for underrepresented communities. Furthermore, high-quality cross-sector partnerships can meet the core objectives of formal education and the informal science institutions when intentionally and strategically designed. Yet, their research found that many partnerships are not sustained due to lack of funding or leadership. Cross-sector partnerships are vulnerable to changes in leadership within their individual organizations or if activities and funding streams are viewed as outside the organization's core mission. Their recommendations call for continued research of existing exemplar programs through a systems perspective of their complementary organizational benefits, identification of funding streams specifically for hybrid programs, expanded opportunities for cross-sector professional development for teachers and informal educators, additional research to further explore models that support systemic integration, and establish institutional relevance and value for collaboration within the formal education and informal science institution sectors.

Environmental education. Environmental education is a broad concept of how a person comes to understand the natural world as well as mankind's impact upon it. Fundamental aspects of environmental education include an examination of the interdependent relationships between and among living organisms and the non-living elements of their habitats and ecosystems, an understanding of the natural and human-built environment, the limitations of natural resources, and the human impact upon these resources and the environment (Hollweg et al., 2011; Lieberman, 2013; Stapp et al., 1969;

United Nations Educational, Scientific and Cultural Organization, 1978). Environmental

education occurs throughout a person's lifetime (Coyle, 2005; Hollweg et al., 2011; United

Nations Educational, Scientific and Cultural Organization, 1978) across a variety of contexts

including formal education settings (Hollweg et al., 2011; Lieberman, 2013), informal

learning environments such as science centers, museums, planetariums, and zoos (Hollweg

et al., 2011), personal visits to parks, nature centers, aquariums, or wildlife preserves

(National Research Council, 2009), and simply time spent outside exploring and interacting

with nature (Louv, 2008).

  Historical perspectives. Most individuals of past civilizations and cultures were

dependent on an essential understanding of their environment for survival. Throughout

history humans were intimately connected to the plant and animal species of their region,

local sources of water, and the available natural resources necessary for food, clothing,

shelter, and needed materials (Lieberman, 2013). Learning about the environment was a

way of life, passed down from generation to generation.

  Various cultures learned to create tools and technologies designed to leverage the

available natural resources, often yielding social advantage to those civilizations (Diamond,

1999).   Since the Neolithic period, developments in technology gradually afforded greater

exploitation of the environment providing short- to long-term human benefits (Ponting,

2007). However, some civilizations experienced devastating consequences, and even

collapse, when those resources were extinguished (Diamond, 1999; Ponting, 2007).

Personal interaction with nature was a way of life, yet scientific knowledge stopped well

short of an understanding of the interconnected balance of ecosystems and notions of

sustainability. More importantly, many cultures developed a way of thinking about the

legitimacy of man's dominance and exploitation of nature, increasingly shaping deeply held beliefs regarding our relationship with the environment (Ponting, 2007). Understanding the complexity of human connections to the environment includes cultural historical considerations of the geographic, economic, and sociopolitical systems that drive our interactions with the environment and the consequences of those actions (Diamond, 1999; Hollweg et al., 2011; Lieberman, 2013; Ponting, 2007; Stapp et al., 1969; & United Nations Educational, Scientific and Cultural Organization, 1978).

In 1969 Stapp et al. presented *The Concept of Environmental Education* that provided a seminal, contemporary definition of environmental education along with four major objectives stating, "Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution" (p. 34). The objectives of this concept encompassed the ideas of viewing environmental education through the interrelated sociocultural, political, technological, and biophysical systems that impact the environment and man's need and use of natural resources. The objectives also stressed the responsibility of individual and collective citizens to be informed and active participants in environmental action.

International context. The initial framework for environmental education emerged from the United Nations Educational, Scientific, and Cultural Organization (UNESCO) in 1975 at the Belgrade International Workshop on Environmental Education. Based on a global assessment of the current environmental situation, *The Belgrade Charter* (1975) outlined the overarching goals for the environment and environmental education that included environmental educational objectives, definition of the audience, and guiding

environmental principles. This document promoted the idea that environmental education

is a lifelong pursuit that occurs across multiple settings. In addition, it requires a systems

approach to understanding the connections of the natural and human systems that

influence our interactions and impact on the environment. *The Belgrade Charter* (1975)

called for cooperative approaches to environmental education at the local, national, and

international levels in the design of solutions to environmental issues. This framework was

further refined two years later at the UNESCO Intergovernmental Conference on

Environmental Education in Tbilisi. The ultimate aims and characteristics of

environmental education along with 41 recommendations that incorporated the role,

objectives, and guiding principles of environmental education were synthesized in the

1977 *Tbilisi Declaration* through the ongoing efforts of UNESCO and the United Nations

Environment Program (UNEP) (United Nations Educational, Scientific and Cultural

Organization, 1980). The Tbilisi *Intergovernmental Conference on Environmental Education

Final Report* (United Nations Educational, Scientific and Cultural Organization, 1978)

encompassed the broad concept, scope, and context of environment education stating:

>Environmental education, properly understood, should constitute a comprehensive
>
>lifelong education, one responsive to changes in a rapidly changing world. It should
>
>prepare the individual for life through an understanding of the major problems of
>
>the contemporary world, and the provision of skills and attributes needed to play a
>
>productive role towards improving life and protecting the environment with due
>
>regard given to ethical values. By adopting a holistic approach, rooted in a broad
>
>interdisciplinary base, it recreates an overall perspective that acknowledges the fact
>
>that natural environment and man-made environment are profoundly

interdependent. It helps reveal the enduring continuity, which links the acts of today to the consequences for tomorrow. It demonstrates the interdependencies among national communities and the need for solidarity among all mankind. (p. 24)

The *Tbilisi Declaration* provided a transformative model for considering educational objectives that reach beyond the limits of knowledge acquisition. The five categories of environmental objectives (awareness, knowledge, attitudes, skills, and participation) were aimed at empowering individuals, communities, and society (United Nations Educational, Scientific and Cultural Organization, 1978).   The intentions of the *Tbilisi Declaration's* goals and objectives are echoed in current definitions of environmental literacy, stewardship, identity, and agency.

Evolution of environmental education at the national level. Many large-scale environmental education efforts of the 20th century emerged in response to devastating events. As such, the scope, focus, and approach of environmental education programs largely reflected the environmental concerns being addressed (Disinger, 1985). The environmental and socioeconomic impacts of the 1930s Dust Bowl brought about greater emphasis on land and natural resource management in the conservation education movement of the 1940s (Fraser, Gupta, & Krasny, 2015; McLeman et al., 2014).

Two decades later the publication of Rachel Carson's *Silent Spring* (1962) spoke to the numerous consequences of pesticide use in agriculture. Carson's message, along with visible signs of air and water pollution such as the 1969 burning of the Cuyahoga River in Cleveland Ohio, increased public awareness and concerns for quality of life with respect to environmental issues (Archie & McCrea, 1996). The culminating effect of visible environmental disasters and greater awareness began to shift public focus to ideas of

pollution, environmental stewardship, and consideration of our impact on the environment

(Archie & McCrea, 1996). These events and public sentiment gave rise to national efforts

for environmental protection and education leading to the establishment of the

Environmental Protection Agency (EPA) in 1970 (Environmental Protection Agency, 1992).

The following year the North American Association for Environmental Education

(NAAEE) began under the title of National Association of Environmental Education (NAEE).

At that time the NAEE was focused on promoting environmental education through

community colleges in the United States (Disinger, 2001). The NAEE expanded its scope

and vision to encompass environmental education, research, policy, and management

across the North American continent and beyond. Today, the NAAEE serves as a

foundational organization supporting the diverse professional organizations dedicated to

environmental education, environmental literacy, and civic engagement (Disinger, 2001).

The tenets of the NAAEE echo those of UNESCO's in that effective approaches to

environmental education must extend beyond understanding and knowledge of our natural

world to fostering an informed citizenry capable of developing collaborative, system wide

solutions to environmental problems.

Early criticisms. During the conservation education movement of the 1940s, state

and federal resource management agencies developed and promoted K–12 classroom

materials designed to raise awareness of the conservation efforts of their particular agency

(Fraser, Gupta, & Krasny, 2015). However, the educational quality of many of these

materials was considered questionable and criticized as self-promoting, 'soft sell' messages

of the sponsoring agency (Disinger, 2001). Curricular materials were developed from a

variety of sources, many receiving the same criticisms of the 1940s regarding publisher

bias or oversimplification of topics, in addition to growing claims of alarmist messaging feeding the emerging controversy around environmental education.

In 1995 the Independent Commission on Environmental Education (ICEE) conducted a content evaluation of 70 classroom materials that commonly used recommended, or suggested by recognized organizations in this field (Salmon, 2000). These curricular materials were examined for their accuracy in relaying science and economic concepts, as well as their portrayal of this field of study and representations of scientists (Salmon, 2000). The ICEE findings and recommendations were published in the 1997 report, *Are We Building Environmental Literacy?* The panel of environmental education experts found a large range in the quality and rigor of the materials examined. Although several exemplar publications were noted, many of the materials were found to be superficial, inaccurate, didactic, and/or blatantly biased (Disinger, 1997; Salmon, 2000). As a result, the ICEE report yielded findings and recommendations that included the critical role of the teacher in delivering environmental education instruction. The report further suggested that the acquisition of knowledge should be the primary role of environmental education rather than the promotion of environmental activism (Disinger, 1997).

To address concerns and criticisms of environmental education programs and associated instructional materials, in 1994 the NAAEE initiated the National Project for Excellence in Environmental Education for the purpose of establishing high-quality standards and best practices for environmental education programs and materials across various contexts. The resulting *Guidelines for Excellence* established a set of recommendations for creating and evaluating environmental education programs, professional development, and instructional materials specific to their instructional

context, such as K-12 classrooms, non-formal settings, and early childhood programs

(North American Association for Environmental Education, 1996). Founded upon the

broad vision and goals for environmental education that emerged through the UNESCO

intergovernmental conferences and declarations of the 1970s, the NAAEE *Guidelines for*

Excellence put forth a set of essential foundations of environmental education based on key

environmental principles established at the international and national levels (1996). The

Guidelines for Excellence emphasized and reinforced concepts of systems thinking,

understanding the interdependent relationships between humans and the natural and built

environment, the importance of location from local to global, the interdisciplinary context

of environmental education, the use of authentic, real world investigations, and the idea

that environmental education is a life-long pursuit of understanding.

The NAAEE *Environmental Education Materials: Guidelines for Excellence* (1996) was

produced to serve as a foundational guide for both developing and reviewing curricular

materials. This publication put forth six key characteristics of high-quality environmental

education materials with clarifying suggestions for essential components in each category.

Characteristics of high-quality environmental education include fairness and accuracy,

depth of concepts presented, emphasis on skills building, action orientation in the

promotion of civic responsibility and problem solving, instructional soundness based on

proven pedagogy, and usability based on the design and particular instructional context

and intended audience.

California's focus on environmental education. California's commitment to

environmental education can be traced back to the mid-1970s with the stipulation that

applicable instructional materials need to include information pertaining to environmental

protection and the inclusion of humans as an integral part of an ecological system. Recognizing the need to coordinate and support local, regional, and statewide environmental education programs and partnerships, the CDE established the California Regional Environmental Education Community (CREEC) Network in 1990 (California Department of Education, 2015). Momentum accelerated in the early 2000s through the concerted and ongoing efforts of several state environmental agencies, the governor's office, along with the CDE to secure funding and negotiate strategies for educating students about California's diverse and unique ecosystems (Lieberman, 2013). This enduring commitment resulted in several significant outcomes including the establishment of state-level, interagency partnerships dedicated to the promotion of environmental education, the adoption of California's Environmental Principles and Concepts EP&Cs and the collaborative development of the Education and the Environment Initiative (EEI) that produced and published a K-12 environmental education curriculum, (Lieberman, 2013; California Department of Education, 2015). California's adoption of the NGSS in 2013, and the added stipulation that all recommended curricular materials will include the applicable EP&Cs, demonstrates the State's continued commitment to science and environmental science education.

More recently, the CDE released the 2015 report, *A Blueprint for Environmental Literacy: Educating Every California Student In, About, and For the Environment* (Blueprint), developed in partnership with the State Board of Education (SBE) and Public Superintendent of Instructions' Environmental Literacy Task Force (ELTF). The *Blueprint* provides a set of actionable recommendations, goals, and next steps for strengthening and scaling up environmental education in K-12 classrooms in partnership with broad

representation of essential stakeholders, from local communities to regional and state-level collaborators. It is designed to build upon California's established, statewide environmental education infrastructure and seize the current changes in core subject standards to leverage this moment of opportunity to impact lasting change. Fostering environmental literacy for all students is the ultimate goal set forth in the *Blueprint* (California Department of Education, 2015)*.*

To achieve the onerous goal of an environmentally literate citizenry, the ELTF outlined a strategic framework to serve as an action plan to position environmental education as an integrated concept within the changing landscape of core standards and state education priorities (California Department of Education, 2015). The *Blueprint* reemphasizes California's previously adopted EP&C as fundamental overarching ideas stressing the importance of understanding man's impact on the environment and designing solutions with contextual consideration for the larger historical and socioeconomic systems in place. In addition, partnerships between schools with non-formal and informal environmental educators are recognized as a key strategy for providing students with authentic, hands-on learning experiences and supporting local, community-based programs.

Environmental literacy. The definition and context of environmental education continues to be an ever-evolving subject: so too is the idea of learner expectations and outcomes that are expressed across a continuum of goals ranging from knowledge acquisition, skills development, behavior change, and action. Although numerous international and national frameworks have been developed containing nuanced characteristics defining the cognitive, affective, and psychomotor domains of learner

outcomes, their key aspects can be traced backed to the original declaration that emerged

from the 1997 Tbilisi Conference (United Nations Educational, Scientific and Cultural

Organization, 1976). The *Tbilisi Declaration* defined expected outcomes for the general

public as awareness, knowledge, attitudes, skills, and participation (Hollweg et. al. 2011;

United Nations Educational, Scientific and Cultural Organization, 1978).

Overarching objectives reflected a continuum of outcomes beginning with

awareness and knowledge, leading to environmental stewardship and action.

Environmental literacy emerged as the most commonly sited goal of environmental

education programs with many associated perceptions as to the nature of environmental

literacy (Roth, 1992). This variation in definition continued as more nuanced ideas of

environmental literacy emerged.

Summary. The systems approach to environmental education places its core

context at the intersection of ever changing environmental, socioeconomic, and political

considerations. A multitude of factors continues to influence the field of environmental

education, including increased concerns regarding the effects of climate change, advances

in science and technology, as well as innovative approaches to instruction and K-12 science

standards. Growing concerns about climate change have placed an increased emphasis on

understanding the consequences of human impact on the environment and the need to

develop feasible solutions and environmental stewardship. Thus, the perspective of

environmental education has evolved to include issues surrounding social equity, social

justice, economics, culture, and political perspectives (NAAEE, 2010).

Environmental education has emerged as a multidisciplinary subject with a

continuum of aims ranging from knowledge development to action-oriented civic

engagement. A high degree of agreement exists across international, national, and California state frameworks regarding its aspects, features, and critical importance for the continued quality of life on our planet. While environmental education broadly defines the subject and its many contexts, there is continuing debate about its goals. The following section provides a discussion of environmental literacy and related expectations for learner outcomes.

Review of Literature

Impacts of K-12 environmental education. Although the purpose of this study is to explore the practices of central figures in K-12 environmental education partnerships, it is worth elucidating the essential foundation for their existence. This section provides a review of literature to illuminate potential student outcomes that are the basis for this focus. It also serves to characterize the unique nature of environmental education and the range of possibilities for partnerships.

Environmental education is not a core subject in K-12 education (Disinger, 2001, Hungerford & Volk, 1990; Lin & Shi, 2014). As such, there is great variability in environmental education programs and experiences offered in K-12 schools (Lieberman & Hoody, 2002). This variability is reflected in the review of literature focused on student outcomes. To date, the most comprehensive study on environmental education outcomes is found in the work of Lieberman and Hoody (2002) from their nationwide case study of 40 school programs using the environment as an integrated context for learning (EIC). EIC programs integrate instruction across the disciplines of English language arts, math, science, and social science by utilizing the local environment as context for student learning. The study included 252 teachers and administrators along with 403 students

from 15 elementary schools, 13 middle schools, and 12 high schools. The methods were predominantly qualitative in the form of interviews and observations involving participating educators as well as students and parents. A total of 655 interviews were conducted. Four separate surveys were administered over the course of the study as a means to obtain uniform data. A general site survey of 18 items captured descriptive data. A learning survey of 32 items to assessed student attitudes and learning. A teaching survey of 25 items gathered data regarding teaching and instruction, and a domains survey of 25 items to examine the effects of EIC across the domains of knowledge, skills, retention, and attitudes toward learning. In addition, comparative analysis of various data was conducted in 14 of the 40 schools. Comparative analysis data included academic measures of standardized test scores and student grade point averages (GPA), as well as attendance, discipline referrals, and attitude. EIC schools conducting comparative analysis of grade level standardized test scores were compared to local county grade level averages. Lieberman and Hoody (2002) conclude that the comprehensive study results suggest that most students who experience environmentally based instruction have higher academic as well as social-emotional and interpersonal indicators. They report that the comprehensive analysis of academic achievement measures in all 14 schools found that most students performed higher on standardized tests and maintained a higher GPA than peers in non-EIC programs. In addition, 100% of the learning survey respondents indicated that students learn science better in an EIC program than traditional science instruction.

While Lieberman and Hoody (2002) provide a comprehensive study of EIC programs, the majority of research that explores the impact of environmental education focuses on specific programs or partnerships. These studies often examine outcomes as a

continuum of knowledge, skills, and attitudinal domains that lead to environmental literacy (Ballard, Dixon, & Harris, 2016; Stevenson, Peterson, Bondell, Mertig, & Moore, 2013; Zoldosova & Prokop, 2006). Definitions of environmental literacy and attitudinal indictors vary but taken holistically they point to dispositions of knowledge, stewardship, identity, and agency.

Ballard, Dixon, & Harris (2016) conducted case studies of two established community and citizen science programs, the Long-term Monitoring Program and Experiential Training for Students (LiMPETS) program and the East Bay Academy for Young Scientists (EBAYS) located in the San Francisco Bay Area. Both programs center on habitat monitoring and conservation and involve student participation over time. Their research examined student outcomes to identify processes that foster environmental science agency (ESA) in middle and high school youths. Qualitative data was captured through in-depth pre-and post-program interviews and observations. Ballard, Dixon, and Harris (2016) found that student engagement in authentic citizen science monitoring activities fostered ESA through the process of data monitoring, analyzing findings, reporting findings to authentic audiences and investigating complex ecosystem interactions.

Stevenson, Peterson, Bondell, Mertig, and Moore (2013) investigated predictors of environmental literacy for middle school students in North Carolina. A three stage sampling method was used to randomly select 85 teachers from schools offering school-wide environmental education programs. A control group of 85 teachers was randomly selected from schools not offering environmental education programs. The Middle School Environmental Literacy Survey (MSELS) was consistently administered to 739 students in

grades 6 and 8 in January of 2012 and again as a post-test survey between April and June

2012. The MSELS consists of 64 multiple choice or 5-point Likert scale questions regarding

eight specific conceptual variables. The conceptual variables are grouped into the four

environmental literacy dispositions of ecological knowledge, environmental affect and

awareness, cognitive skills, and behavior. Teachers were given a short follow-up survey to

capture implementation data such as class time spent outdoors, their use of published

environmental education curriculum, and professional development received since the

student pre-tests. Their findings indicated that predictors of positively associated

environmental literacy factors include the use of published environmental education

curricula and class time spent outside. In addition, teachers with advanced degrees and

having three to five years of teaching experience were positively related to student

environmental literacy scores. However, MSELS scores for students in minority groups

such as Hispanic, black, and American Indian/Alaskan Native showed a negative

association in post-test survey comparisons. The researchers speculate that ethnicity

related differences in MSELS scores might be in reflection of general education trends

regarding achievement gaps and recommend further studies of outdoor educational

experience with minority students. Stevenson, Peterson, Bondell, Mertig, and Moore

(2013) conclude that overall environmental education activities have a positive impact on

student development of environmental literacy competencies. They recommend that the

use of quality environmental education curricula should be used in conjunction with class

time spent outdoors to achieve the maximum benefits for students.

Zoldosova and Prokop (2006) sought to explore possible influences of an informal

science program toward students' ideas and interests in science. The population for this

study was students ages 10 -14 who participated in a five-day field trip at science field

center in Slovakia. Students in the experimental group were randomly selected and

represented seven different schools. A control group of students who did not participate in

the five-day field trip was randomly selected from the same seven schools. The

experimental group consisted of 153 elementary students from seven schools and the

control group included 363 students from the same schools. To examine students' interest

in science, researchers asked students to select five out of a list of 45 fictitious book titles.

The fictitious book titles represented a variety of possible high interest topics with 16 titles

of topics related to the field trip experience. Students were also asked to draw an ideal

science learning environment. The two researchers scored drawings independently and

scoring differences were discussed and resolved. Drawing elements were scored based on

the presence of six categories: nature, laboratory, computers, non-traditional class settings,

athletics/sports fields, and rest areas. Zoldosova and Prokop (2006) found that student in

the experimental group showed significantly more interest in the 16 book titles related to

the field trip course than the student in the control group. In addition, students in the

experimental group drew significantly more items related to the identified categories than

their peers in the control group. However, the researchers wonder how long the increased

interest would last. They recommend addition studies to determine the long-term impact

of situational interests following immersive experiences.

School-university partnership frameworks. There is a long-standing tradition of

school-university partnerships around science education (Goebel, Umoja, & DeHaan, 2009;

Minner & Hiles, 2005). An examination of school-university partnership frameworks could

provide useful insights to inform practitioners interested in establishing formal-informal

environmental education partnerships. A review of the recent literature regarding school-science partnership frameworks discovered a comprehensive approach developed by Jones et al. (2016). They conducted a longitudinal study of five Australian universities for the purposes of establishing an interpretive framework for school-university partnerships. Although their work centered on pre-service programs for future science teachers, their resulting frameworks for growing university school partnerships (GUSP) and representations of partnership practice (RPP) provide insights into essential characteristics of successful and sustainable partnerships. Seven case studies were carried out at separate campus locations involving five Australian universities. A three-phase iterative design was used to inform the progressive analysis leading to the development of comprehensive frameworks that address the complexities of the social and structural elements of partnership practice. Collectively, the two-dimensional interpretive frameworks attend to the growth and development of participants as well as the partnership. A deeper look at the framework components reveals elements of Huxham's (2000, 2003) theories of partnership management and Wenger's (1998) theories of social practice across communities. The GUSP matrix is provided in Figure 2 to offer a visual representation of this framework.

Figure 2. GUSP framework reproduced from "Successful University-School Partnerships: An Interpretive Framework to Inform Partnership Practice," by Jones et al., 2016, *Teaching & Teacher Education, V60*, p. 114. Copyright 2016 by Elsevier Ltd. Reprinted with permission.

By contrast the RPP framework, designed to inform the practices of partnerships, echoes themes from Wenger's (1998) theories of learning within communities and boundary crossing. The RPP framework attends to the dynamics of interpersonal relationship development of the participants across three levels of embeddedness: connective, generative, and transformative. An example Wenger's (1998) ideas of shared practice and the importance of mutual professional learning can be found in Jones et al.'s (2016) convergence of purpose at the generative phase. Similarly, the RPP framework provides a parallel notion of mutually beneficial activities found at intersection of the nature of partnership and the generative level (Jones et al., 2016). Figure 3 displays Jones et al.'s (2016) RPP framework.

	A. Purposes	B. Institutional structures	C. Nature of partnership	D. Linking theory with practice
1. Connective	Engagement based on provision of curriculum or other service need.	Partnership activities are short-term and opportunistic and sit within existing structure.	Both partners provide short-term services with a focus on one partner's needs but with mutual benefits and value for all.	Both partners recognise schools as important sites for PSTs to link theory and practice.
2. Generative	Partners recognise opportunities for mutual professional learning.	Partnership activities are considered long-term and are planned and catered for in the teacher education and school programs.	Partners jointly plan the structure of the school-based practices to the benefit of both.	Opportunities exist for both partners to reflect on practice that may be linked to theory.
3. Transformative	Partner involvement based on active professional learning	Partnerships are embedded in the ongoing structures and practices of the institutions.	Partners take joint responsibility for mutually agreed practices and outcomes that are embedded in their respective core outcomes.	Both partners engage explicitly in reflective inquiry guided by theories of professional identity development.

Figure 3. RPP framework reproduced from "Successful University-School Partnerships: An Interpretive Framework to Inform Partnership Practice," by Jones et al. 2016, *Teaching & Teacher Education, V60*, p. 116. Copyright 2016 by Elsevier Ltd. Reprinted with permission.

Formal-informal science partnerships. This area of the literature review concentrates on studies attempting to understand elements of effective formal-informal partnership practices. Since there are no standard protocols for formal-informal science partnerships, a high degree of variability as to the nature of these partnerships is found in the research. Examples of informal science partners include science professionals from industry (Falloon, 2013), local environmental agencies (Weiland & Akerson, 2013), university scientists (Shein & Tsai, 2015), and more complex, multi-agency configurations (Robertson, 2007). The follow review will serve to shed light on the unlimited configurations and contexts in which formal-informal science partnerships occur. It will also highlight potential challenges in maintaining these partnerships.

The New Zealand government sought to explore possibilities for partnering schools

with eight, independently operated, state-owned science research institutes. The

overarching goals were to increase teacher and student content knowledge and support

greater student engagement and interest in science. Falloon (2013) utilized a grounded

theory approach to inform the design of a sustainable and logistically feasible partnership

framework. Interview and surveys were conducted with each of the science research

institute CEOs in a collective case study design. A thematic analysis of the semi-structured

interviews and the quantitative survey led to the emergence of the following four

prevailing themes:

- Institutes consider engagement with schools to be important, but not crucial to

  their core business;

- Institutes view improving the knowledge of teachers as the best way they can

  support school science;

- Institutes view technology as a means of cost-effectively sustaining interactions;

- Institutes' drivers for engagement relate to concerns about general science

  literacy and changing student's perceptions of science and scientists (p. 395).

This study informed the development and design of a virtual platform to connect

research scientists to classrooms. The conceptual design of an e-Science Framework links

specific science content specialists with teacher requests for experts based on upcoming

science lessons or units. The framework design calls for a coordinator position to act as a

liaison in brokering relationships to establish partnerships based on the needs of the

school. Falloon's (2013) findings of CEO concerns speak to the tensions between positive

intentions of science agencies and the challenges of allocating resources on objectives slightly outside their core mission.

Weiland and Akerson (2013) conducted an in depth case study of a collaborative partnership between a fifth grade teacher and an environmental scientist/informal educator employed by the county park's department in a rural Midwestern town. The aim of the study was to understand the nature of the collaboration and knowledge sharing between the two individuals along with the impact on student engagement and science learning. The participants were selected due to the fact they have a previous history of collaboration. Participant pre-and post-interviews and a series of videotaped classroom observations were the primary sources of data. Email communications, lesson plan notes, and a program brochure served as secondary sources of data. Student impact and engagement was assessed through pretest and posttest data as well as incidents of student engagement captured in the observation videos. The case study occurred across the initial planning sessions and preparations for a series of five 1-hour classroom presentations by the informal science educator. The study included student posttests and participant post interviews. The researchers' findings informed their conclusion that the preparation planning time was an important aspect of the collaboration. Together, the classroom teacher and informal science educator clearly identified their roles during the classroom presentations. These roles and the activities were designed to highlight the unique strengths and expertise of the two individuals. The informal science educator engaged the student in hands-on activities using authentic wildlife artifacts from her collection. In this way, she provided information and resources not available in the classroom. The classroom teacher provided the students with connections to previous science lessons, as

well as classroom management strategies. The student pre- and posttest results indicated students' knowledge of the science concepts explored throughout the series of the presentations increased.

Beginning in the mid-2000s, the Taiwanese government embarked on high school science curriculum reform efforts to advance scientific innovation and students' science literacy (Shein & Tsai, 2015). The High Scope Program was established as a partnership effort between high school science teachers, university scientists, and science professors. Shein and Tsai (2015) conducted mixed methods research to assess the system wide impact of the collaborative efforts in the development of a high school environmental science curriculum. The study involved eight university scientists and four high school science teachers in the design and pilot of an 18-week environmental science unit, named the High Scope Environmental (HSE) course, utilizing Shulman's pedagogical content knowledge (PCK) framework. Semi-structure interviews with university scientists and high school teachers were conducted to assess the impact on their pedagogical content knowledge. Students' scientific knowledge and scientific interests were assessed through a quasi-experimental design. The experimental and comparison groups consisted of students in two separate freshman biology classes at the same school. Students in the experimental group received the HSE course that also included coordinated guest lectures and presentations from the partnering university scientists. Student impacts were measured through pre- and post-course surveys administered to both groups. Students in the experimental group also received a series of interest surveys aligned to the particular science topics presented throughout the 18-week course.

Shein and Tsai (2015) reported that both the university scientists and high school teachers increased their pedagogical content knowledge in ways appropriate to their context. Teachers increased their knowledge of more complex science concepts, current developments in the field, and their confidence for providing complex science instruction and inquiry. Scientists improved their communication skills and instructional strategies as appropriate for high school level science. Comparative analysis of student surveys indicated the HSE program had a medium effect on students' scientific competency in the experimental group and a significant increase in their situational interest in science.

Robertson (2007) utilized an action research approach to enhance student field trip experiences by focusing on deliberate planning between the stakeholders involved. The science education community collaborative included formal educators from a local elementary school, university educators, informal science educators, and educational researchers. The field trip site was a multipurpose facility that included a bio-solids reuse facility, housed an environmental partnership organization, and a research center in a rural Texas community. Using a plan, act, observe, reflect, re-plan cycle, this qualitative case study designed included three field trips for fourth and fifth grade students at a local school that took place over the course of the school year. Multiple data sources included participant-observation of planning meetings and semi-structured participant interviews. A written document review was also conducted. Robertson (2007) reported that very quickly in the process it became apparent that the various partners held differing field trip objectives. For example, the formal K-12 educators were concerned about connecting the activities to the state science standards, whereas the informal science educator felt providing experiences that fostered student interest and excitement in science was most

important. This discovery of different aims led to a negotiation of a shared vision. However, tensions surfaced again around the curricular content in attempting to align resources at the facility to grade-level science standards and classroom lessons. The action research approach allowed for continued negotiation and shared understanding of age-appropriate science content. Teachers felt the scientists were delivering content that was designed for much higher grades. Further meetings resulted in the scientists having a better understanding of science content levels for upper elementary students, and teachers realizing the value of providing students with challenging science concepts to stretch their thinking. Robertson (2007) concluded that collaborative formal-informal science activities require adequate time for planning and developing a shared understanding of the objectives, as well as building an atmosphere of trust. In addition, each stakeholder must obtain some personal or professional benefit from the collaboration to sustain a long-term partnership.

These studies show the vast differences in the character, structure, and goals in various cross-sector science partnerships. A common factor, either implicitly or explicitly identified is the need for negotiation of practices and knowledge sharing to mitigate the potential tensions and challenges that could surface. This negotiation requires brokering across boundaries of their individual organizations to determine the most appropriate practices to integrate into the shared community.

Summary

K-12 environmental science partnerships have the potential to advance environmental literacy in students and teachers. Huxham's (2000, 2003) partnership theories and research provide a realistic view of the promises and challenges inherent in

many collaborative partnerships. Wenger's (1998) theories of social learning offer insights

into how a sense of community develops through shared practices and knowledge sharing.

Together, these theoretical foundations provide a lens through which to explore the

practices of existing K-12 school-science partnerships. Understanding how partnerships

are managed and/or negotiated in successful K-12 school-science collaborations could help

inform others interested in establishing formal-informal science partnerships. The

following chapter describes the proposed methodology that will be used in this exploratory

study.

Chapter 3: Methods

The purpose of this exploratory qualitative study was to understand the roles and practices of central figures in existing formal-informal partnerships focused on K-12 environmental education in rural Northern California. Environmental education partnerships were defined as collaborations between formal K-12 educators and informal science or environmental science professionals who design activities for the purposes of advancing environmental literacy within K-12 classrooms. For the purposes of this study, the operational definition of formal education represented any educator working at any level within the public K-12 education sector. The operational definition of informal environmental education encompassed the educational outreach of environmental science organization, environmental agency, or environmental educator networks operating outside the formal education sector. There was a high degree of variation in the types of environmental organizations that could potentially be involved in K-12 environmental education partnerships. Environmental education networks are defined as any collective group, consortia, network, or association made up of two or more organizations that meet and convene for the purposes of advancing environmental literacy in ways that include partnering with K-12 educators.

The central guiding question of this study is: *How do central figures contribute to developing and sustaining formal-informal environmental education partnerships in a rural Northern California region?* To explore this topic more fully, this study addressed the following sub-questions from the perspectives of individuals who organize, lead, and coordinate partnership activities:

1. What are the roles and practices of central figures in existing K-12 environmental education partnerships?

2. How and why are K-12 environmental education partnerships formed?

3. What strategies, practices, or processes are present in successful K-12 environmental education partnerships?

4. What are the tensions or challenges in K-12 environmental education partnerships?

Role of Researcher

The researcher in this study is an educator who holds serious concerns regarding the environmental degradation of our planet and the lack of environmental education in K-12 classrooms. The 2013 California adoption of the Next Generation Science Standards has intensified the focus on science professional development and environmental education. The researcher has a clear perception of the vision and potential of the NGSS, as well as the magnitude of challenges these new standards present, especially in elementary classrooms.

The researcher believes there is an alarming lack of science education at the elementary level and minimal environmental education across all grades in classrooms within the county. The researcher is cognizant of the difficulties and challenges in fostering change and innovation in K-12 public education. Yet the researcher also believes that the transition to the NGSS presents an opportune time to explore innovative strategies for strengthening K-12 science instruction and integrating environmental education across all grade levels. Leveraging the knowledge and skills of local environmental professionals

through collaborative partnerships could be a first step in developing environmental education programs in county districts and schools.

    Bias and reflexivity. Meaning is a process of renegotiated interpretations based on our interactions with world (Blumer, 1969; Bryman, 2016; Creswell, 2014). All researchers possess their own experiences, understandings, and interpretations of the world. Thus it is critical that the researcher adopt a reflexive stance throughout the study to minimize potential threats of researcher bias and internal study validity (Bryman, 2016; Creswell, 2014). According to Creswell (2014), a reflexive stance allows the researcher to explicitly identify their own preconceived ideas and meanings in relation to the social issue or phenomena under investigation. Bryman (2016) describes reflexivity as the researcher's ongoing self-awareness of their own construction of knowledge and interpretation of meanings conveyed by subjects throughout the study.

Research Design

    This study utilized a qualitative approach to inquiry to better understand the meaning individuals ascribe to a social problem or phenomenon (Bryman, 2016; Creswell, 2014). Qualitative studies provide for an inductive process of discovery, allowing researchers to uncover emerging themes and patterns in the meaning participants ascribed to their particular situations and contexts (Creswell, 2014; Gray, 2014). A qualitative approach affords the researcher a view into the topic from the perspective of the participants while operating in their natural setting (Creswell, 2014). This approach will be necessary to explore the roles and practices of central figures in collaborative partnerships that cross the institutional boundaries of K-12 education and environmental science organizations.

Exploratory design. This qualitative study employed an exploratory design as a means to understand the how the roles and practices of central figures play in developing and sustaining collaborative K-12 environmental education partnerships. Exploratory design is best suited when there is a lack of sufficient scientific information regarding the social issue or phenomenon, yet there is reason to believe it is worth investigating (Stebbins, 2001). Several studies on K-12 partnerships stress the importance of a central figure with the ability to traverse the boundaries of formal education and informal environmental science organizations (Lee & Roth, 2003; Waitoller & Kozleski, 2013). Yet it remained unclear how these central figures establish and sustain the partnerships. An exploratory design provided an appropriate means of discovering the characteristics of their roles and practices in successful K-12 environmental education partnerships.

In the broader field of research, exploratory studies are the initial research in a series of concatenated studies, each one building upon and referencing previous findings. The first study can be viewed as an invitation to researchers to expand upon the initial exploration in an effort to discover broader understandings or the construction of a grounded theory (Stebbins, 2001). However, the scope of this research was limited to an initial exploratory study.

Qualitative design characteristics. Characteristics of qualitative design afford the researcher holistic approaches to explore the meaning participants ascribe to a particular issue or problem (Creswell, 2014). Through direct contact and interaction with participants in their natural setting, the researcher is exposed to the environment, interactions, tools, and situated activities of participants operating within a specific context. In this way, the researcher is functioning within the world of the participants to

gain a contextual understanding of how they view and make meaning of the research issue or problem. This interactive and interpretive nature of qualitative designs call upon researchers to adopt a reflexive stance throughout the research process (Creswell, 2014; Gray, 2014). Researchers examine their preconceived assumptions, ideas, and experiences throughout the research process in an effort to separate or bracket their own biases.

Sources of Data

The target population for this study was central figures responsible for coordinating partnerships between K-12 educators and environmental science professionals in a rural Northern California region. These individuals play a leading role in the collaborative partnership by creating connections and enabling coordination of activities and learning across formal education and various environmental science organizations. This study involved the use of primary and secondary sources of data described below.

Setting of study. The majority of the research was conducted in a Northern California coastal county. The regional topography is diverse, with segments of the Northern Coast Ranges lying along the Pacific Coast and inland mountains in the central and eastern region of the county, creating unique geographical features such as valleys, plains, and ocean cliffs. Known for its Mediterranean climate, the county's distinct habitat and natural resources include redwood forests, oak woodlands, riparian forests, and seasonal wetlands. The majority of the population is concentrated along an inland urban corridor, with many small, rural unincorporated areas dotting the coast and eastern border. The county is situated within the Northern California wine country region supporting strong agriculture and hospitality industry sectors. Recent demographic data reported that 46% of the students are Hispanic or Latino, 43% are white, 3% are Asian, and

2% are Black or African American. In addition, 48% of county students qualify for free and reduced-price meals and 21% are English Learners (www.ed-data.org).

Primary data sources. Primary sources of data for this study were interviews from 16 individuals with a history of involvement in sustained K-12 environmental education partnerships. Participants were not asked to provide their age, race, or ethnicity. It is assumed that their ages ranged from late-twenties to mid-fifties and that they identified as Caucasian. Four of the subjects were elementary teachers and 12 of the subjects were environmental educators from a variety of environmental science affiliations. Two of the elementary teachers taught in the same school. The other two elementary teachers were located in a different town within the county but did not work in the same school. All four teachers are seasoned educators with a minimum of 12 years of teaching experience. The environmental educators represented organizations located throughout the county, with some providing outreach programs across other regions in Northern California.

Secondary data sources. Secondary sources of data included researcher notes and reflections generated from two separate observations. Additional secondary sources of data were artifacts presented by study participants following several interviews and both observations. These items included documents and presentation materials from an environmental educator network meeting, digital media, annual reports, as well as feedback and communication forms utilized at the outdoor education camp.

An interview and observation log was created to track responses to the initial email invitations and subsequent follow up correspondence. This document was also used to note the dates and location of scheduled interviews and observations. Referrals received from subjects were also added to this log.

Purposive sampling. Purposive sampling is a characteristic of qualitative research that identifies a target population best suited for the research questions (Bryman, 2016). This study utilized a criterion sampling method. The criteria for participation in this study were such that subjects were central figures who were actively involved in sustained collaborative partnerships activities between K-12 educators and environmental science organizations and agencies. It was anticipated that in some settings, the central figure might be the only person responsible for this coordination; in other settings there may be a team or group.

Formal-informal environmental partnerships are not common practice within K-12 education in Northern California. However, there are some examples of coordinated environmental education activities throughout the vast region of Northern California. Websites of a few K-12 educational organizations, as well as environmental organizations, highlight local collaborative environmental science projects, events, and activities. As such, the number of existing environmental education partnerships in Northern California was generously estimated to be no more than twenty. Therefore the size of the target population was not knowable, since it was an abstract population representing individuals and/or teams involved in leading or coordinating the partnership activities.

The researcher purposively narrowed the focus of this study to a Northern California area that has an active countywide environmental educator network. The mission of this collaborative network is to advance environmental literacy throughout the county by supporting environmental outreach efforts for schools and communities. Member organizations were publically available on the website of the collaborative network. A list of affiliated environmental organizations was compiled. From this list, the

researcher went to the websites of the individual environmental organizations and agencies to identify the contact information for their educational outreach personnel. Names and contact information of the individuals who coordinate or lead the educational outreach efforts were collected as potential primary data sources. An introductory email was sent to environmental educator contacts on this list with an invitation to participate in the study via an in person interview and/or observation of outreach programming. Information regarding the study, role of the researcher, criteria for participation, confidentiality of subjects, and IRB approval was included.

A second phase in the sampling process sought variation through intentional selection of individuals or groups operating from distinctive environmental science sectors. Selecting potential participants from a variety of organizations allowed the researcher to explore the perspectives of cross-sector collaborations from diverse environmental education outreach contexts. The multiple perspectives allowed for a higher degree of triangulation of the findings.

A list of potential K-12 educators was collected following several of the interviews with environmental educators. A few environmental educators were asked if they could provide contact information for teachers or principals with whom they have a history of collaborative activities. In some instances, the environmental educators initiated an introductory email between the researcher and the teacher(s). An introductory email was sent to the list of K-12 educators with an invitation to participate in an in person interview. Information regarding the study, role of the researcher, criteria for participation, confidentiality of subjects, and IRB approval was included.

Human Subjects Considerations

This study qualified for Exemption category 45 CFR 46.101(b)(2) approved by the Institutional Review Board (IRB) at Pepperdine University's Graduate School of Education and Psychology (see Appendix A). This research involved adults who were formally provided consent and whose participation poses no more risk than normal day-to-day professional activities. All necessary protocols and procedures for consideration of human subjects were followed in the study. The artifacts involved were in the public domain. The researcher's field notes were handled confidentially so that no individual person or program was placed at risk.

The researcher provided the necessary consent following IRB guidelines prior to conducting any form of data collection with human subjects. Pseudonyms were given to names of participants, interview sites, and organizational affiliations. A master list of participant names and associated pseudonyms has been maintained electronically and stored in a file folder separate from the research data. All research data has been stored on the researcher's password protected personal computer. No research data was stored on a network or Internet server. In addition, the researcher backed up the data onto a separate, password protected hard drive.

Potential participants were informed in advance of all collection, storage, and confidential coding procedures and protocols involved in the specific data collection activities. These procedures and protocols were restated to the participants at the time of the interview or observation. Participants were informed of their right to request digital recording devices be turned off at any time during the interview.

Data Collection Strategies and Procedures

Interviews and observations took place over the course of two months during Fall 2018. Several data gathering strategies were used for this study. Most interviews were conducted with individual participants, however one interview took place with two environmental educators during the full day observation at the outdoor education camp. Secondary source data included researcher field notes and reflections that were recorded following each interview and the two observations. Review of relevant artifacts collected during the course of the study also served as secondary sources of data.

Interview process and protocols. This study included 16 individuals who have a history of coordinating and participating in K-12 environmental education partnerships. All interviews were in person. Twelve of the interviews occurred at the participant's work place. The other four interviews took place at a mutually agreed upon location. Conducting research at the participant's site allowed participants to remain in their own environment and familiar surroundings. It also allowed the researcher the opportunity to converse with and observe participant behaviors in their natural setting.

With the permission and consent of the participants, all interviews were recorded on a digital voice recorder. The researcher also took occasional notes during the interview to provide additional information that was not captured in the recordings. Post-interview reflections were documented as soon as possible following the interviews.

Interviews were semi-structured to ensure the desired content was discussed. The interview questions were initially developed by the researcher considering the literature on Huxham and colleagues' (2000, 2003; Huxham & Vangen, 2005; Vangen & Huxham, 2003) partnership theories of collaborative advantage and collaborative inertia, as well as

Wenger and associates' (1998; Wenger-Trayner et al., 2015) concepts of negotiating

boundaries in communities or landscapes of practice. To ensure content validity of the

questions, a professional educational researcher reviewed the interview protocols. This

researcher has a history of studying science and environmental science educational

outreach programs and related professional development. Suggestions for the interview

questions, their sequencing, and flow were provided (see Appendix B). Following

completion of the internal validation process, a pilot interview was conducted with an

experienced environmental educator to determine appropriate time requirements and also

ensure that the interview questions elicited the desired content. The pilot interview

resulted in minor adjustments to the interview protocols, as well as the creation of slightly

modified protocols for classroom teachers (see Appendix C).

  Observations. This study included data collected from two observations. The first

observation was a full day field observation at a 200-acre experiential outdoor

environmental education camp located in a redwood forest. The second was an

observation of a monthly meeting of the countywide environmental educator network. The

intention of the observations was to view the social processes, interactions, and

negotiations between and among central figures involved in K-12 environmental education

partnerships as they engaged in collaborative activities. Firsthand observations provided

valuable insights by viewing the interactions between teachers and environmental

educators in the course of these activities. Observations also provided the researcher

opportunities to engage in informal conversations with participants before and after the

meetings. The informal conversations led to beneficial artifacts, anecdotal stories, and

connections for follow up interviews. Since the observations are secondary sources of data, face validity was sufficient for this study.

   Redwood environmental camp. This field day observation experience included a tour of the camp provided by the education programs director. Discussions with the director took place throughout the day. Time was also set aside for an individual interview. A second shorter interview took place with the director and their school programs logistics coordinator. Both interviews were recorded using a digital voice recorder and findings were coded and included in the thematic analysis.   However, no other activities or conversations during the observations were recorded electronically.

   Direct observation of their educational outreach program occurred throughout the day with a group consisting of five 6th grade teachers from the same school district, including approximately 100 students and 14 parent chaperones. Observations included a whole group welcome orientation for teachers, students, and parents, as well as a separate group meeting between the teacher naturalist staff and the five teachers. Observations of student activities occurred during the day with direct interactions with students, classroom teachers, and the teacher naturalist staff. Researcher notes were taken throughout these events with a final reflection created at the end of the day.

   Countywide environmental educator network meeting. The researcher also observed a monthly meeting of the countywide environmental educator network. The researcher was primarily a non-participant observer. However, there were occasional interactions when invited to participate in discussions. Researcher notes were taken during the meeting.

Artifact gathering. Artifacts were gathered from both observations and a few of the interviews. Artifacts included feedback forms, communication forms, annual reports, meeting handouts, and digital media. These artifacts provided additional insights into the variety of ways participants share knowledge and create meaning across organizational boundaries. They also captured the histories and events of the associated environmental organization. An artifact log was used to categorize and identify the various items collected. Print and hard copy artifacts were numbered and entered into the log with their associated organization.

Data Analysis

Some descriptive data were collected and analyzed using descriptive statistics. Comparisons within the descriptive data were made to identify similarities and/or differences in the backgrounds of the participants. Descriptive statistics help provide a summary picture of the participants in the study (Gray, 2014).

Interview data was digitally transcribed by the researcher using HyperTranscribe. An inductive qualitative data analysis process followed to identify patterns and themes emerging from the interview data. A thematic analysis process was use to recognize patterns within the responses. Themes capture important aspects of the data as they relate to the research questions (Gray, 2014).

This study used a priori and emergent codes. The researcher developed a priori codes drawing from the theoretical foundations introduced by Huxham (2000, 2003) and Wenger (1998). To identify emerging codes and themes, the researcher followed the recommendations of Bryman (2016) to look for patterns as suggested by Ryan and Berman (2003). A topical analysis process was employed to identify topics or ideas the

interviewees discuss. An iterative process was then applied to organize the 21 a priori and emergent codes into six thematic categories using the HyperRESEARCH software program. Interview transcripts, observation notes, and relevant artifacts were coded to organize and bracket chucks of data (Gray, 2014).

Means to Ensure Study Validity

Rigorous methods were applied throughout this research to ensure internal study validity. The researcher maintained a reflexive stance through the use of a journal for ongoing reflection and consideration of personal bias. Interview protocols underwent a peer review and feedback process to ensure validity of interview procedures, questions, and sequencing. A pilot interview was also conducted with an experienced environmental educator to further refine the interview protocols and determine the approximate length of an interview session. In addition, research data underwent a rigorous, iterative analysis process through peer review and feedback of the thematic categories and associated codes. To ensure the accuracy of interpretation, a thorough and rigorous thematic analysis was applied to the data from interviews, observation notes, and relevant artifacts.

Summary

The qualitative methods applied across this study were specifically identified as those most relevant to the investigation of the research questions. The researcher returned to the research questions throughout this study to ensure selected methods and procedures were appropriate for the context of this research and in accordance with the literature. In addition, the number and diversity of the participants provided a robust data set for analysis. Associated findings from this data are systematically presented in the following chapter.

Chapter 4: Findings

The purpose of this qualitative exploratory study was to understand the roles and practices of central figures in existing K-12 environmental education partnerships located in a coastal Northern California county. Central figures serve as boundary brokers who negotiate the practices of formal K-12 education and informal environmental education activities. Descriptions of the 16 participants, the countywide environmental educator network, and the two observations will provide a context for the thematic analysis that follows. A total of 21 a priori and emergent codes were grouped into six thematic categories. Each thematic category and associated codes will be presented in the thematic analysis. The following section provides background information for the 16 participants along with a brief description of their environmental outreach programs.

Participant Descriptions and Programs

The 16 participants included 12 environmental educators and four upper grade elementary teachers. One environmental educator was male and 11 were female. Two elementary teachers were male and two were female, for a total of three male participants and 13 female participants. All participants have a long history of working in K-12 environmental education partnerships and a high level of expertise in their respective fields. In person interviews were conducted in fall 2018 over the course of two months. Most of the interviews were conducted at the participant's work site however, three of the 16 interviews took place at mutually agreed upon locations. Two observations of collaborative meetings were conducted during this time. The first was a full day observation of programs at a multiday experiential outdoor education camp. The second observation was conducted at a monthly meeting of the countywide environmental

educator network. In addition, relevant artifacts were collected following many of the

interviews and both observations. The artifacts will be presented within the context of

their associated interview or observation. Table 2 shows the list of participants and their

organizational affiliations. Fictitious names and organizations will be used throughout this

discussion.

Table 2

Fictitious Names of Individual Participants and Associated Organizations

Name	Gender	Current Role	Organizational Affiliation
Program Directors or Managers			
Audrey	F	Director of Education Programs	Municipal watershed district
Marie	F	Director of Education and Resident Biologist	Environmental preserve
Diane	F	Education Director	Nature center and preserve
Blair	F	Programs Manager	Regional outdoor public lands department
Lynne	F	Education and Communications Manager	Agricultural and environmental conservation network
Rachelle	F	Director of School Programs	Experiential environmental outdoor education camp
Janice	F	Founder and Ambassador	Conservation science and habitat restoration not-for-profit
Environmental Educators or Coordinators			
Amy	F	Environmental education coordinator and trainer	Statewide environmental education network
Gail	F	Environmental education consultant and trainer	Independent consultant
Alex	M	Environmental educator	Sustainability and ecology research center
Michelle	F	Education Coordinator	Conservation science and habitat restoration not-for-profit
Mariah	F	School Programs Logistics Coordinator	Experiential environmental outdoor education camp
Elementary Teachers			
Jennifer	F	Grade 4 Teacher	K-6 elementary school
Steve	M	Grade 5 Teacher	K-6 elementary school
Shawna	F	Grade 6 Teacher	K-6 elementary school
Jeff	M	Grade 6 Teacher	K-6 elementary school

Environmental education program directors or managers. Seven of the 12 environmental educators interviewed hold leadership or management positions within their organization.   Often, these were larger environmental non-profits or agencies employing a staff of environmental educators. In smaller environmental organizations, the environmental educators assumed many of the managerial and fiscal duties.

Audrey is the education program director at a non-profit dedicated to restoration, conservation, and education of the surrounding wetlands and watershed communities. She has worked in environmental education and interpretation with an emphasis on natural history, as well as non-profit management for nearly 20 years after receiving a multiple subject teaching credential. Audrey's role includes developing and managing their school and community education programs, as well as leading the extensive docent training program. The school outreach program is designed for students in grades 2 through 4. A team of docents provides hands-on activities in the classroom prior to their scheduled fieldtrip to the environmental center. Annually, the elementary program reaches approximately 1,300 students in 50 local classrooms. Audrey also serves on the executive committee of the countywide environmental educator network and hosts most of the meetings.

As the program manager for the county regional public lands department, Blair has worked at the intersection of environmental science and education for 22 years in a variety of leadership positions at the local, regional, and state level. She also taught middle school science for several years and is the chairperson for the countywide environmental educator network. The regional public lands outdoor science programs serve approximately 20,000 elementary school students per year across the county through

experiential one-day fieldtrips. Blair was tasked with steering the countywide

environmental educator network after it was established approximately eight years ago.

She supports leadership and program development efforts in the areas of continuous

improvement through evaluation methods as well as strategies for reaching culturally

diverse audiences.

Diane started her career as a wildlife biologist and field researcher for the forest

service in Alaska. She eventually began conducting public talks regarding safety around

bears, which included leading guided hikes and developing children's activities. She began

designing educational displays for museums as well as outreach materials and programs

for K-12 schools. She later relocated to Northern California and has worked for nine years

as education director at a 3,200-acre nature center and conservation preserve. Their wide-

ranging educational outreach initiatives and programs are deeply rooted in community

involvement from Kindergarten through adult. Diane's organization offers a variety of

environmental education programs for elementary students, teens, and summer internship

opportunities for aspiring youth leaders. The elementary program serves approximately

1,000 students in grades two through five and includes hands-on classroom visits and

fieldtrips to the preserve. The five-week summer internship is available for 26 students,

ages 13 through 18. They also offer one-day fieldtrips and weekend natural history

courses for all ages. Diane is a member of the countywide environmental educator network

and serves on its executive committee.

Another participant shared a remarkable story of how a classroom project was the

catalyst of a life-changing turn of events for both the teacher and her students. Janice is the

founder of the student habitat restoration program that now operates in conjunction with a

not-for-profit conservation science organization. She was a 4th grade, project-based

learning teacher who facilitated a creek restoration project initiated by her students to help

the California freshwater shrimp in the early 1990s. It was a watershed moment that led to

a documentary film capturing the series of events in which her students spoke at a

congressional hearing on the Endangered Species Act in Washington D.C. The program

currently connects elementary classrooms to approximately 50 restoration projects each

year with 100 to 150 partner teachers. Since the program's inception, students have

planted over 46,000 trees and restored nearly 38 miles of creek beds. Janice now works as

the program ambassador, networking with partner stakeholders such as fish and wildlife

services, municipal water agencies, and private landowners.

Lynne is the environmental education and communications manager for a regional

resource conservation district. Her organization works with various stakeholders on

conservation and restoration projects with an emphasis on sustainable agriculture and

food systems. She manages an environmental education and leadership development

program for marginalized students in grades 10 through 12. The two-semester program

serves 36 students from seven different continuation high schools within the county,

focusing on understanding sustainable agriculture, personal growth and development, as

well as college and career skills. In this role, Lynne collaborates with their network of

ranchers and farmers to facilitate monthly experiential group fieldtrips to these working

lands for students to learn the different sustainable practices at the various locations.

The next participant, Marie, is the education director and resident biologist at a

1,000-acre coastal canyon nature preserve. The parent organization is an environmental

conservation, research, and education non-profit that encompasses multiple properties

across three Northern California counties. Their school outreach programs primarily serve

upper elementary students in grades 3 through 5 in schools across several San Francisco

Bay Area counties, with more intensive summer stewardship and leadership programs for

high school students. One such teen program focuses on female leadership in conservation

science. The elementary program includes an interactive hands-on classroom visit with

several docents prior to a class fieldtrip to the preserve. Marie manages the various

educational programs at the coastal canyon location and oversees their volunteer docent

network of community science educators. She has a master's degree in environmental

science and management. She also taught biology to non-science majors and credential

program students at a local university.

Rachelle is the director of school programs at a 200-acre overnight environmental

education and character development camp in the Redwoods. The experiential program

serves approximately 6,000 upper elementary to middle school students per year, designed

around a three to five-day overnight fieldtrip. The camp facility includes indoor and

outdoor science labs as well as 13 high ropes challenge courses in the redwood canopy.

Rachelle has 18 years of experience working as an environmental educator focusing on

marine science, climate change, and stewardship in a variety of settings in the U.S. and

abroad. She has a degree in environmental science and a master's degree in biology

focusing on community-based conservation and global leadership.   She is currently

working on a master's degree in business administration to balance her managerial roles

and also serves as an active member in the countywide environmental educator network.

Environmental educators and coordinators. The following five interviewees are

environmental educators, coordinators, and consultants. Collectively, they provide

outreach programs, consultation, and support to K-12 and college educators within the county and across Northern California. Their various roles and organizations provide a glimpse into the highly contextual nature of individual outreach programs operating within the county.

Alex is an environmental educator with a local non-profit conservation research ecology center and active member of the countywide environmental educator network. He provides a variety of environmental education and community outreach programs that include student internship opportunities and outdoor experiences for local schools, reaching over 1,200 students each year. Their elementary program is designed for students in grades two, four, five, and six. It includes a series of four consecutive weekly interactive classroom visits prior to a culminating class fieldtrip to one of several outdoor locations. They also offer summer day and overnight science camps as well as a high school environmental leadership internship program. Alex has a background in geography and environmental studies and first became involved in environmental education outreach as an undergraduate working with middle school students. After college, Alex focused on building sustainable communities and watershed protection through soil erosion prevention programs for homeowners in the Sierra Tahoe area.

Next is Amy, a regional consultant and trainer with a statewide environmental education network in Northern California and has served in this capacity for 20 years. She is also a member of the countywide environmental educator network and serves on its professional development committee. Prior to this role she taught middle school science and history social science at an urban San Francisco Bay Area school for eight years. She majored in environmental studies and environmental geography in college and expressed a

strong interest in cultural geography and social justice issues. She used an interdisciplinary approach to teaching these subjects through an environmental context. Amy began collaborating with local and regional environmental institutions early in her teaching career as a means to access resources and connect inner city youth to both the curriculum and the natural world. She and her students started an after school science club in collaboration with the mathematics teacher.

Gail is a retired K-12 administrator and an independent educational consultant who specializes in creating environmental education experiences by bringing together various community organizations or environmental agencies and formal K-12 or college educators. She recently relocated to the Northern California coastal area as she continues her consultation work in the central valley. She has a doctorate in educational leadership and concentrated her research on a statewide study designed to measure the existence of integrated science and history social science courses focused on sustainability. After retiring from public education, she established her consulting business as well as a countywide environmental literacy collaborative operating in the central valley. One of Gail's most recent projects involves collaboration with a central valley California university to develop environmental literacy courses and continuing education credits within their credential and pre-service teacher program.

Mariah works with Rachelle as the logistics coordinator for their K-12 education programs. She has a background in operations and environmental education and a degree in environmental resource science. Mariah's role is to coordinate planning, communications, and logistics between participating K-12 teachers, parents, and the environmental camp staff for the multiday, overnight experiential fieldtrips.

And finally, Michelle works with Janice as the education coordinator at a conservation science and habitat restoration organization primarily focused on ocean and wetland ecosystems. Their educational outreach programs coordinate classrooms with the actual restoration projects that occur on both public and private lands. Students, primarily in upper elementary grades, are directly involved in the hands-on restoration work. Michelle collaborates with the conservation science team regarding the unique nature of each restoration site and project. She then connects participating classrooms to the individual restoration sites, provides pre-restoration information and science lessons, and coordinates the culminating restoration fieldtrip. Their organization provides conservation science services throughout the Western Hemisphere and Australia. However, the K-12 educational outreach programs are centered on Northern California communities mainly in the San Francisco Bay Area. Michelle has a master's degree in environmental science and natural resources, with an emphasis on place-based education. She is an active member of the countywide environmental educator network.

Elementary teachers. Four of the sixteen subjects were elementary teachers who have a long history of partnering with local, regional, and global environmental educators and programs. All four teachers are seasoned educators with a minimum of 12 years of classroom teaching experience. Jennifer is a 4th grade teacher who has taught across 1st through 6th grades throughout her lengthy elementary teaching career. Although she does not have a background in science, Jennifer became involved in science education several years ago and participated in a professional development and leadership opportunity at the Lawrence Hall of Science at U.C. Berkeley for elementary educators. During this time, her school district was able to fund a teacher on special assignment position focused on

elementary science and worked as a district elementary science coordinator for several years. Jennifer continues to seek out numerous professional development and environmental education outreach opportunities to bring resources back to her school and classroom. She partners with various local, regional, and global environmental education programs through organizations such as the National Oceanic and Atmospheric Administration (NOAA) and the Educator Academy of the Amazon. Jennifer participates in the countywide environmental educator network when her schedule allows. In addition, she collaborates with several local environmental outreach programs including partnering with Michelle to provide hands-on habitat restoration opportunities for her students.

The next participant, Steve, is a career educator and 5th grade teacher. He has partnered with Alex for approximately five to six years on the environmental center's watershed outreach program. In addition to working with the local environmental center, Steve seeks out numerous other environmental based partnerships and grants, including the Ocean Guardian's program through the NOAA. He involves his students in community outreach endeavors and started a native plant nursery at the school gardens to be used in the restoration projects at the environmental center.

Jeff is a 6th grade teacher at an elementary school where he's taught for 14 years. He has a background in environmental studies and began integrating environmental experiences for his students early in his teaching career. Both Jeff and his partner teacher have collaborated with Michelle through the habitat restoration outreach program for well over a decade. In addition, he provides assistance and feedback to Michelle's organization on pilot programs and participates in their summer professional development for teachers. Jeff has also partnered with teachers in Mexico through Amigos Alados, an international

environmental education and global friendship program where students photograph and share pictures of migratory birds that travel between their respective locations.

The final participant, Shawna, is a 6th grade teacher at the same elementary school as Steve with a previous background and master's degree in environmental resource management. She has taught for 12 years and uses environmental education as an integrated context for learning across the curriculum and within the student service learning projects. She emphasizes the environmental connection of ancient civilizations through the 6th grade history social science curriculum. She collaborates with numerous local, regional, and global environmental education outreach programs for professional development, classroom resources, and student learning experiences. Shawna partners with Alex at the local environmental conservation research center with their grade 6 outreach program. She recently collaborated with Alex and Steve on a wildfire science ecology project to help students understand and calculate fuel load removal. She is currently working with the National Geographic Teacher Certification program, which allows her to connect her students with scientists around the world.

Observations

Two observations were conducted in the fall of 2018. The intent of both observations was to view interactions between central figures involved in K-12 environmental education partnerships. The first was a full day observation at an experiential overnight environmental education camp in the redwoods. The second was an observation of the November countywide environmental educator network meeting as a non-participant. Data gathered during these observations included field notes and reflections, as well as follow up questions with participants. Artifacts were collected during

both observations. Individual items were listed in an artifact log. Artifacts underwent a

thematic analysis and are discussed in the context of their associated subthemes. The

following is a description of the observations.

Redwood Environmental Camp. The first observation took place over the course

of a day at an experiential outdoor environmental education camp located in a 200-acre

redwood forest. The focus of the camp integrates environmental education and character

development. The facility has several classrooms and labs located throughout the camp. In

addition, there are 13 high ropes and 30 low ropes challenge courses situated in the

redwood canopy and forest floor. Well ahead of their fieldtrip, teachers identify the

specific environmental, character development, and challenge course opportunities they

preferred for the fieldtrip.

The field day observation experience included a tour of the camp provided by

Rachelle, the education programs director. Discussions with Rachelle took place

throughout the day. Time was set aside for an individual interview. A second shorter

interview took place with Rachelle and Mariah, their school programs logistics coordinator.

Both interviews were recorded using a digital voice recorder and findings were coded and

included in the thematic analysis.

Direct observation of their educational outreach programs occurred throughout the

day with a group consisting of five 6th grade teachers from the same school district,

including approximately 100 students and 14 parent chaperones. This was the first day of

their three-day, two night experiential fieldtrip. Direct observations included a whole

group welcome orientation for teachers, students, and parents. Following the orientation,

students and parent chaperones were dismissed to take part in cabin assignments and

check in. During this time, the teacher naturalist staff held a group meeting with the five teachers. Topics of discussion included specific student concerns and a thorough review of any identified special medical or social-behavioral needs as well as second language students. For example, while reviewing an identified concern on a specific student's form, a teacher naturalist asked, 'What works best for Charlie?' The teacher and the staff were able to discuss the student and the best strategies for identifying when he may be getting anxious and how best to respond.

Following specific student discussions and concerns, the teachers were asked to share what they liked best about the program and their expectations for the three-day camp fieldtrip. All the teachers have been to the camp on fieldtrips in previous years and were very familiar with the programs offered. Teachers responded that they appreciated the variety of engaging learning activities, team building, and hikes within the redwoods that created 'remarkable student experiences in nature'. They also appreciated the engaging and highly knowledgeable teacher naturalist staff that created a safe, positive learning environment.

Rachelle discussed the complexities of leading and managing an overnight outdoor environmental education program. She was hired several years prior to take over management of their struggling programs and implement internal processes and procedures. During this time she has streamlined the registration, intake, scheduling, and invoicing process with the creation of a school programs logistics coordinator position. A second short interview was conducted with Rachelle and Mariah, the school programs logistics coordinator. Both interviews were recorded. Coded passages are included in the thematic analysis.

Coordinating the communications between her organization and the schools is a process that takes place over the course of several months to an entire year. The majority of communications is managed through email and customized forms designed for each stage of the scheduling and planning process. Their organization now has a high percentage of returning teachers. Time is set aside on the last day of their fieldtrip to meet face-to-face with teachers. During this time, Rachelle solicits feedback on their experience and begins pre-scheduling for the following year.

Due to the complex nature of the programs and daily scheduling, there is very little option for teachers to request customized environmental education experiences. Teachers choose from a menu of program options during their scheduling and planning phase months earlier. The different learning modules have been developed over time and undergo continual feedback. Rachelle notes this approach and the streamlined scheduling and planning process as part of the essential changes that led to the successful turn around of their school outreach programs.

Countywide environmental educator network. The influence of the countywide environmental educator network emerged during the observation and throughout individual interviews with member participants. A thematic category, *Environmental educator network*, with five subthemes was created to capture the depth and breadth of participants' discussions involving the network. These findings are presented in detail in the Thematic Analysis section of this chapter.

The network operates as a hybrid between a community of practice and collective impact entity. The mission of the network is to 'create vibrant, innovative collaborations that increase environmental literacy in county citizens. As a network, it 'undertakes its

mission by identifying and addressing regional needs for environmental education beyond the scope of individual organizations'. It was formed nearly ten years ago through private funding to expand support for several local environmental education outreach programs. The network has evolved to include participants directly involved with environmental education outreach programs throughout the county. Monthly meetings are conducted at the same location and time for consistency in scheduling. Audrey's organization hosts the monthly meetings.

Thematic Analysis

This exploratory study resulted in 21 a priori and emergent codes that were grouped into six thematic categories. These codes were applied to the participant interviews, observation notes, and relevant artifacts collected during several interviews and both observations. The study contains a total of 1,204 coded passages. The six overarching thematic categories are listed in Table 3 along with their frequency. A description of each thematic category and associated subtheme is provided. Discussion includes direct quotes from the subjects.

Table 3

Thematic Categories in Order of Frequency

Thematic Category	Frequency
Characteristics/roles/practices of central figures	478
Characteristics of sustained partnerships	372
Tensions or challenges	154
Environmental educator network	105
Initiation of partnership	60
Description and scope of program	35
Total	1,204

Description and scope of program. Environmental educators described the scope and context of their various outreach programs. Details related to the context, grade-level, and number of students served were captured in this thematic category's only subtheme, *Context of program* (*n=*35). These findings were integrated in the individual participant descriptions at the beginning of this chapter, providing context for the environmental education programs they offer. Table 4 displays this thematic category and its subtheme.

Table 4

Theme: Description and Scope of Program Coding Results (N=35)

Description and Scope of Program	Frequency	Relative Frequency
Context of program	35	100%
Total	35	

Context of program. This subtheme, *Context of program* (*n=*35) was used to identify specific details related to the environmental education outreach programs. Findings from this subtheme were presented in the participant descriptions. Details regarding specific outreach programs are also provided throughout this chapter within the broader context of related findings.

Characteristics, roles, and practices of central figures. The most prevalent theme in this study was *Characteristics/roles/practices of central figures* with a total of 478 coded passages*.* Subthemes in this category represented data regarding the background, experiences, dispositions, beliefs, and practices participants expressed as personal or professional attributes essential for their work in environmental education partnerships. Table 5 displays the four subthemes along with their frequency and relative frequency.

Table 5

Theme: Characteristics/roles/practices of Central Figures Coding Results (N=478)

Characteristics/roles/practices	Frequency	Relative Frequency
Personal beliefs and convictions	201	42%
Foundational skills/knowledge/experiences	115	24%
Program development/promotion/communication strategies	113	24%
Professional learning/networking/growth	49	10%
Total	478	

Participants shared personal and professional attributes associated with their background, education, experiences, and careers. Two subthemes were used to represent the personal characteristics of the individual participants. They expressed *personal beliefs and convictions* regarding their convergent attitudes toward the environment, education, and empowering students through deeper learning experiences and stewardship. Subjects also shared *foundational skills, knowledge, and experiences* that included background information regarding their formal education, internship, career, and life experiences, as well as additional skill sets that contribute to their success. Together, these two subthemes identify the participants' personal characteristics.

Strategies shared regarding professional learning and program development were coded to the subthemes of *professional learning/networking/growth* and *program development/promotion/communication strategies*, respectively. These two subthemes identified the participants' professional attributes and skills. Collectively, this thematic category was used to identify the unique personal and professional characteristics of each participant.

Personal beliefs and convictions. Throughout their interviews, participants often expressed their personal beliefs, convictions, and passion for the environment and education. As a result, this was the most frequent subtheme across the study with 201 coded passages. Many views centered on a range of more nuanced notions of student empowerment and stewardship, concern for the environment, and the need for deeper learning experiences.

Connections to student empowerment and environmental stewardship. Both environmental educators and teachers presented these views based on their personal beliefs and direct environmental education experiences with students. Rachelle's experiential outdoor education camp balances a focus of exploring the natural world with personal character development. She elaborates on this connection stating:

> If kids don't understand that they have influence over the world around them, that they don't think that they can do much, then the rest of it doesn't really matter. But if they can come here and do team challenges and the high ropes and see where their locus of control is … That to me is incredibly important.

Many participants extended ideas of personal student empowerment to fostering active members of society. By connecting students to hands-on habitat restoration projects, Michelle expresses a similar belief in how actual experiences help to foster environmental stewardship noting, "I think that it's unrealistic to ask students to be contributing members of society by the time they graduate high school if they haven't been able to really practice that." Janice, a former teacher who founded this program stated, "The feeling of efficacy is really what sets it apart. … students actually moving and doing something in their community is what makes an impact on how they are, how they might be as people. "

Teachers expressed similar beliefs. As a 6th grade teacher with a background in environmental science, Jeff related his personal call to action and how it influences his teaching, stating:

> We all have to feel connected to not only the problem but also to the possibility that we can be part of the solution. … Give them the opportunity to feel like there was something they were doing in their lives to empower what can change their future. And that was really why I turned to education and with the background that I had. I wanted to do something that made a difference in the world.

Jennifer discussed the intrinsic value of connecting her 4th grade students to nature positing:

> Kids are naturally interested in finding out what's out there in nature and the natural environment. Getting them more acquainted with their local environment and teaching science that way I think is super important. That's a really good way for developing stewardship.

Environmental concerns and hopes for the planet. Underlying concerns around climate change and the environment surfaced throughout participants' discussions alongside their visions and hopes for a vital, sustainable future. Environmental educators and teachers elaborated on these concerns and the important role of environmental education to achieve the desired goal of a healthy planet and an informed citizenry. Steve shared his concerns and hopes for his 5th grade students at different times during the interview commenting:

> … it would be learning about the environment and what the threats are to our environment now. Climate change is huge. It's going to be the major issue, certainly for the next few generations. Knowing that we need to take responsibility for it and acting on it, baking that into the expectations for the kind of students you want them to be when they leave your school and go on.

He later added, "It may be with climate change, that may be the kicker. If anyone is going to save us it's going to be these kids. So maybe we better start educating them now." Steve's colleague, Shawna, teaches 6th grade at the same school and also uses the environment as

an overarching context for other subjects. She expressed similar beliefs stressing, "I think

it's of extreme importance. Math and language arts and all that can be connected to it but

the underlying theme of everything we do should be the environment."

Rekindling our connection to nature was a recurrent belief that emerged as both the

problem and the solution. Marie communicated concerns for children's lack of outdoor

experiences, which in turn, drives the activities within their environmental education

programs sharing:

> … as much as possible, give them that timeless experience that you get when you're
> out there. A lot of kids these days don't get to experience that. Really help people
> remember how to listen to more than the human world in a way that they've
> forgotten. I feel that so much of the issues that we're facing, is not only have we lost
> the stories, but we've lost the ability to even hear the stories of the things that don't
> talk to you are telling us. And that's what I want for the kids.

Deeper learning experiences. Teachers as well as environmental educators shared

their views on the value of experiential learning and deeper exploration of environmental

topics. The following participants are environmental education program founders and

directors who were previously elementary teachers. They discussed this unique

perspective that influenced their views on student learning experiences. Audrey was an

elementary teacher for a short time before her career as an environmental educator and

program director. Through this lens, she commented, "It's bringing curriculum to life. It's

not just something they're reading about in a book. When you experience something with

your body, sight, your sense of touch, then you're learning it. It's not something you

memorize to repeat back." Janice experienced the profound and life-changing impact on

her 4th grade students when she allowed them to explore a topic in depth stated, "I would

argue that you could take anything, any species, and if you went in depth you would fall in

love. Because you learn the particularities of the animal and their special talents." And

lastly, Blair shared her belief and hopes for the collective impact of on-going environmental learning experiences for students across the county, commenting:

> I think it's more about linking experiences. They did this thing with us, then they did this thing with the central watershed district, and this other thing with the regional environmental center. That's where I start thinking maybe we're making a difference.

Foundational skills, knowledge, and experiences. The second most frequent subtheme, *Foundational skills/knowledge/experiences* (*n*=115) focused on foundational characteristics participants attributed to their success in bridging the worlds between formal and informal environmental education. Participants' responses fell into two broad areas depending on their perspective and current roles as either an environmental educator or a classroom teacher. The first area related to context-specific dispositions. These attributes included background knowledge, education, experiences, and an understanding of the K-12 system. Both formal and informal educators' responses contributed to this area. The second area related to universal managerial and administrative competencies as well as soft skills necessary when working in cross-sector partnerships. In general, only participants from the informal environmental education field reported these as foundational skills relevant to their roles.

Context-specific dispositions. The knowledge, skills, and experiences participants attribute to their work are intertwined throughout their discussions. These dispositions are used in service of developing relevant and engaging environmental education programs that pragmatically address the needs and schedules of teachers. Topics included college and career backgrounds, environmental education experiences, and an understanding of the K-12 system.

Detailed background information regarding college or internship experiences was presented in the participant descriptions at the beginning of this chapter. A review of this subtheme revealed that six of the twelve (50%) of the environmental educators have graduate degrees related to aspects of environmental science and/or education and one of the four (25%) teachers has a master's degree in environmental resource management. In addition, nearly half of the participants held careers in both formal K-12 and informal environmental education. Table 6 shows the number and percent of participants with cross-sector experience through careers in both fields.

Table 6

Theme: Participants with Both Formal K-12 & Informal Environmental Education Careers

Current Career	# of Participants	% of Sector
Formal K-12 teachers with a previous background in environmental science	*n*=2 (of 4)	50%
Informal environmental educators, coordinators, program directors, or managers with a previous background in K-12 education	*n*=5 (of 12)	42%
Total participants with cross-sector careers	7 (of 16)	44%

Two of the four elementary teachers, Jeff and Shawna, have degrees and previous careers in environmental science and environmental resource management, respectively. Both teachers integrate environmental education across their curriculum in a variety of ways, viewing it as a natural and critical context for learning within the core subjects. While discussing this approach to instruction, Jeff noted, "I was an environmental studies student so that was something that was already on the horizon for me. Thinking about that as I became a teacher and got my credential."

Conversely, five of the twelve participants who are currently working in the informal environmental education field have a background in formal K-12 education. They reported their understanding of the K-12 system; especially the demands of teaching, as extremely important foundational experiences that have helped inform their outreach programs. Blair, whose county agency reaches approximately 20,000 elementary students each year remarked, "You have to have an understanding of what teachers need in terms of scheduling. That's really important." Amy shared similar views as she reflected on her previous experience as a middle school science and history social science teacher commenting:

> I had 150 kids so I brokered that whole understanding of what it took to get chaperones, bring in the materials, get the kids in and out within a 50-minute period. It was challenging. It was hard. But I've got that perspective of the challenges teachers have integrating fieldtrips with environmental education in their classrooms.

While it is essential to have an understanding of the challenges teachers face, many participants emphasized the importance of having a working knowledge of the curricular aspects of formal education. Audrey captured this idea stating:

> Having an understanding of the structure of school, curriculum standards, and having to design a lesson plan, and the culture of a school was very comfortable to me because of my experiences. … working knowledge of the curriculum, working knowledge of the content and standards. We couldn't have a successful program unless it was teaching to these content standards.

Environmental educators who do not have a background in K-12 education acquired these foundational skills and knowledge through environmental science related degrees, college or volunteer internships, direct experience, and on-going professional development. Their work as teacher naturalists, environmental interpreters, or outreach instructors provided a foundation for outdoor science education pedagogy and program

development. Michelle's environmental science and natural resources master's program

emphasized place-based teaching. She discussed the practical application of her graduate

program to her current role as an education coordinator noting:

> It is really helpful that I have a pretty good science background because I can
> understand pretty quickly the different ecological topics at the scientist level. But I
> can also know how students learn, and how to write lesson plans, and how to create
> learning goals. So I think it really does require those skills.

These context-specific environmental education competencies provided

participants with the background knowledge and skills necessary to bridge the worlds of

formal and informal environmental education. Many participants have career experience

in both sectors. Understanding of their particular field of science, outdoor education

pedagogy, and the unique needs of teachers were viewed as critical foundational

requirements for their work.

Managerial and administrative competencies and soft skills. Many participants

expressed the need for universal managerial and administrative skills, especially program

directors and managers. Their responsibilities include fiscal management and oversight of

the various programs and staff. In smaller agencies, environmental educators assume

many of these duties in addition to securing grant funding for aspects of their outreach

programs. Participants also remarked on the need for soft skills such as communication,

organization, and flexibility. Lynne, whose role requires simultaneous coordination

between agency partners, landowners, and numerous classroom teachers stated, "Being

organized and communicative are the two big ones. And that might sound very general or

generic but it is. And I have found that I have leaned on those skills a lot." The

responsibility for designing outreach programs predominantly rests on the informal

environmental educators and agencies. As such, they are the primary agents for making

the cross-sector connections and employing these skills throughout their work.

Program development, promotion, and communication strategies*.* The third

most frequent subtheme within this thematic category was *program*

development/promotion/communication strategies (*n*=113). This subtheme captured

participant descriptions of their approach to developing and promoting their

environmental education programs. It also includes communication strategies used to

initiate and coordinate partnership activities. This is another subtheme that related to the

responsibilities and roles of subjects in the informal environmental education sector.

Participants' background knowledge, experiences, and skills culminate in the service of

these actionable elements of their outreach work.

Program development. The environmental education programs are highly

contextual and vary based on the mission, function, size, location, and natural resources

associated with the organization or agency. Educational outreach efforts generally reflect

the organization's science, conservation, or research objectives. As a result, there is no

one-size-fits-all approach to program development. However, the majority of

environmental education programs are agency-led, initially developed within the

organization based on their outreach goals and capacity. The activities are then piloted

with age-appropriate grade levels and enhanced based on teacher feedback. Further

discussion of the continuum of co-created and collaborative program development is

presented in the thematic category *Characteristics of Sustained Partnerships* within the

Capacity and Level of Collaboration subtheme*.*

The development of environmental science outreach programs requires a culmination of environmental science knowledge, outdoor education pedagogy and student management, as well as a clear understanding of K-12 education including the demands on classroom teachers. Participants emphasized the need to provide relevant and engaging environmental education programs. Underlying aspects of relevancy included alignment to grade-level standards, age-appropriate activities, knowing your community and its cultural diversity, and a focus on local, place-based environmental education. Outreach programs are highly contextual and vary based on the location and mission of the organization or agency. Audrey articulated this idea in her approach to program development noting:

> So a basic understanding of what teachers are suppose to be teaching and then translating the concepts and bringing them to life based on the mission of our organization. … that creative process of developing programs, developing activities that teachers recognize as effective learning types of activities.

Cultural relevancy and related views of community and equity are reflected in program design elements. Some programs have bilingual educators and many have created materials in English and Spanish. Diane described her strategies for getting to know her new community when relocating to the Northern California area as a prerequisite for developing their outreach programs. Offering her sage advice on program development, Diane recommended, "… knowing your audience. Being really clear on your program objectives and who you want them to serve will really inform where you do your outreach efforts."

Culturally relevant programming is also a focus of the countywide environmental educator network. Members of the network recently collaborated on the creation of a list of common environmental science vocabulary terms to be translated into Spanish and serve as a living document for use within programs across the county. In addition, the

professional development committee recently facilitated a two-part workshop focused on creating culturally relevant programs.

Attention to participant feedback was also reported as an essential component for maintaining relevancy and high-quality outreach programs. Blair has expertise in evaluation development and applies it to the work within her agency as well as the countywide environmental educator network. She discussed the importance of being diligent in eliciting feedback as a means of continuous improvement, stating, "Gathering teacher feedback is important as well. To be honest, unless you dig deep the feedback is always superficial. … I think you have to ask the right questions according to what you want to do with your program." Blair is currently leading efforts for the development of a common assessment tool to be used by environmental educators within the collaborative network.

Program promotion. For the most part, individual programs experience a high percentage of teachers who return each year. This topic is examined more fully in the subthemes *Embedded in Community* and *Teacher-driven*, that are organized within the *Characteristics of Sustained Partnerships* and *Initiation of Partnership* thematic categories, respectively. However, environmental educators utilize a variety of strategic and creative promotional approaches when they wish to expand their outreach efforts to target a broader audience.

Since the decision to engage with an environmental education program largely rests with the individual teachers, many environmental educators view this unequally distributed opportunity as an equity and access issue for students. In other words, students of teachers who embrace and seek out collaborative opportunities will benefit

from these experiences, while the rest of the students are left out. Blair addressed this

issue when discussing a strategic promotional approach used by a previous employer:

> The other thing we've done at the other places I've worked, to make our reach a
> little broader and equitable, is that we've required teachers to involve everyone at
> that grade level [within the school or district]. So we knew we had everyone at that
> grade level covered if you're thinking about coverage through the whole county.
> And that was one way to embed our programming much more.

Yet, not all environmental educators agree with this approach. Janice shared the

possible unintended consequences noting:

> Whenever we get into a situation where the principal says, 'Well, if Mary and this 3rd
> grade teacher are in it, then the other two [teachers] have to do it too. That never
> gets a good result. When people are forced to do something they don't like it.

And finally, Diane provided a different take on outreach stating, "We define our reach

broader like social media, our website, our newsletter, things like that."

Other providers target schools in areas they find to be largely underrepresented or

develop programs specifically for marginalized student groups. As an example, Marie's

organization is currently piloting outreach programs for students in special education and

students new to the country. Although these targeted approaches to program promotion

vary, they are usually grounded in a commitment to broader access and equity for all

students.

Communication strategies. The majority of communication occurs between the

environmental education organizations and teachers, rather than principals or other

administrators. Experienced environmental educators realize the time constraints and

demands on classroom teachers and therefore utilize technology to streamline this process.

Environmental education programs have application requests built into their websites.

Veteran teachers know when and where to sign up online for different outreach

opportunities. In most instances, coordinating dates and times of classroom visits and

fieldtrips are managed through email. However, more complex environmental education

programs that involve overnight experiences, restoration projects, or a series of classroom

visits leading to fieldtrips do require more sophisticated online planning tools or direct

communication. Still, every effort is made to simplify this process for teachers. Most

environmental education organizations provide optional, downloadable lessons and

materials designed to prepare teachers and students for their initial experience.

Although initiating and coordinating activities mainly involves direct

communication with teachers, many organizations see the value in communicating

program information and outcomes with district and school administration. Alex's

organization provides outreach to districts in their immediate area. They enjoy the

relationships with many local teachers that have developed over the years in their

continued collaboration. He shared his organization's multi-tiered communication

approach commenting:

> I think at a district level they want to see quantifiable numbers. And so our annual
> report that we produce every year, we do a pre- and post evaluation [for students
> and teachers]… and that can show the numbers. We start off with a letter to each
> principal … letting them know about our program. … And then we reach out directly
> to teachers.

Personal learning, networking, and growth. The final subtheme in this category,

Personal learning/networking/growth (*n=*49) captures participants' statements regarding

the learning, growth, and networking opportunities they have realized through their

collaborative partnerships. Similar ideas emerged among participants within their own

sector. For example, the two teachers who did not have a science or environmental

education background reported a significant increase in their knowledge of science

concepts and revealed an enthusiasm for continual growth in this area. While discussing

his personal learning, Steve noted:

> It enhances my learning because I'm always looking for new ways to help them learn about the natural world. So I pay a lot of attention to Science Friday on NPR and read a lot. But now with my involvement in Ocean Guardians and native plants, my understanding has increased exponentially. So yes, there's a lot we get out of it.

Jennifer collaborates with local environmental education providers, including

working with Michelle on student habitat restoration projects.   She shared her personal

learning journey that took her from participation in a multi-year NGSS teacher professional

development program through the Lawrence Hall of Science at U.C. Berkeley to

participating in a 10-day experiential environmental education learning adventure in the

Caribbean Amazon, which she has done for three consecutive summers. Reflecting on

these experiences Jennifer commented:

> For me as a teacher being immersed in that – it's place-based in the Amazon. I'm engaged in these activities that I would like to have my students do. It just made it more real and tangible. … Ok, this is how you do it. This is how it feels. So I came back really motivated to do this with my kids. The inquiry piece of it, the exploratory piece of it. … So learning management strategies and lessons for taking kids outdoors.

She also discussed the networking opportunities and access to different resources available

through her environmental education contacts, which provided a rare opportunity to have

her 4th grade students present their restoration work and meet Dr. Jane Goodall at an event

in San Francisco.

Several environmental educators also shared similar beliefs regarding what

teachers learn through direct collaboration or watching as the environmental educators

lead students in outdoor activities and investigations. To this end, Diane remarked:

> Teachers have said this, and it shows up in their evaluations, that they really learn by shadowing our educators that are modeling teaching through NGSS. So they

come to me and our educators saying, 'Wow, that's a really interesting way in leading that circle. I never thought of capturing this and arguing from evidence, and hypothesizing, and asking open ended questions.' So I think there's been a little bit of passive PD happening in almost every fieldtrip.

While teachers reported increased knowledge of science concepts, management strategies for engaging students in outdoor exploration, and greater access to resources, environmental educators recounted a heightened awareness of K-12 public education from their exposure to different schools and classrooms. Several environmental educators spoke about socioeconomic aspects and the unequal distribution of resources based on the school's location. In her work with students at continuation high schools in predominately lower socioeconomic areas in the county, Lynne expressed her dismay and concern recounting:

> ... but it was also maybe a little naive thinking that they all had similar backgrounds in their education, which was not the case. And I found that out very quickly. It is not equal. It's hard to understand or wrap my mind around that established system and not providing the support to all the students. And all of them that deserve that support in a county that is a pretty amazing area and certainly have finances and support systems. So I think there's a little bit of that on a personal level. How are we doing our society justice and these students justice to just let them slip through the cracks? That was probably my biggest learning out of everything.

Alex related similar thoughts regarding an unequal distribution of resources and also discussed learning to quickly recognize different teaching styles based on classroom management and its physical set up pointing out:

> We have the luxury as informal educators being able to go into not just one classroom that a teacher is always plugged into, but I can go across the board and see every single 4th grade class in the valley. Every single style, the way tables are set up, the way the posters are on the board, their group management style. And you get a wash of every different style in the area. You can see what's successful and what schools have more resources and what schools are more deprived in resources. ... So you are constantly learning by seeing all these snapshots of all these classrooms.

Environmental educators also shared learning valuable insights regarding teachers' needs. For example, Michelle noted:

> I've learned that lots of teachers have created all sorts of their own ways about teaching about the environment that really matter to students and their school. I've learned more about all the demands that are put on teachers. Sometimes it feels there's a lack of support to make that demand a reality. … that teachers really do value learning as adult learners. Not just for the sake of what will I teach my students. I think its really important for teachers to keep their fire lit about the subject matter.

Even though the personal learning perspective is different from teachers to environmental educators, nearly every participant in the study shared a common experience regarding students' learning styles. Each interviewee shared stories of students who were either disengaged in the regular classroom or specifically identified as having behavior issues and how those students actually thrived, and even excelled, in the outdoor activities, investigations, and observations. Audrey related this insight commenting:

> I've really seen, and had first hand experience with kids going into the classroom. And the kids that are sometimes behavior issues and the problem kid in the class are the stars when they come out into the fields. They're the kids that are the most curious, the most interested, and the most engaged. Which doesn't necessarily surprise me but I think that there's a lesson in that for all of us in that it isn't necessarily a problem with the child, but with the conditions in which they're learning now.

Michelle facilitates habitat restoration projects for upper elementary students. The hands-on nature of this full day event provides a kinesthetic outlet for learning and doing. Michelle discussed the impact of this experiential learning for students and teachers stating:

> They also learn that some students just need a different experience in order to thrive. We always see that, hands down at any restoration. We can get a little bit of a warning or pulled aside about a certain student to keep an eye on them. And then they are just the one going the extra mile at the end of the day. So I think that teachers learn a little bit more about their students over the years too.

Together, the four subthemes within the *Characteristics/roles/practices of central figures* thematic category, provided insights into the formal and informal educators working across the boundaries of their respective fields.   The next thematic category, *Initiation of partnership*, pivots from a profile of the people to a focus on the partnership. In particular, participant descriptions of justification for the partnership and then how partnerships are typically initiated.

Initiation of partnership. Participants provided various rationales in support of environmental education partnerships along with how they are typically initiated. The *Initiation of partnership* thematic category (*N*=60) marked participants' descriptions of why and how these collaborations are initiated. Together, these findings illuminate factors that influence the initiation of collaborative partnership activities. There were a total of 60 coded passages across two subthemes in this thematic category.   Table 7 displays these two subthemes.

Table 7

Theme: Initiation of Partnership Coding Results (N=60)

Initiation of Partnership	Frequency	Relative Frequency
Teacher-driven	36	60%
Rationale for partnership	24	40%
Total	60	

Teacher-driven. Participants acknowledged that classroom teachers initiate the vast majority of collaborative partnership activities. Teachers control the decision and choose to reach out to environmental educators and programs for a variety of reasons. The subtheme, *Teacher-driven* (*n=36*), emerged as environmental educators described their

points of contact in the K-12 system, and as teachers discussed their desire for additional resources.

Every environmental educator stated that teachers are their main contact point. They found that direct communication with interested teachers yielded the best success for initiating and perpetuating partnership activities. Diane commented, "I quickly realized that although some principals were very able to get back to me, it had to be at a lower level. It had to be a teacher-driven initiative". Offering her advice to other environmental educators, Audrey suggested, "Encourage them to start with the teachers directly instead of going through an administrative down process". Drawing from experience, Blair stated, "You've got to get to the teachers. That's the best way to do it". On this topic, Rachelle estimated, "About 70% to 80% of our schools are public schools. And the teacher has decided they want to take their kids on this experience and they'll just do it. … I would say probably 90% of it is the teachers".

Likewise, teachers shared their motivations for initiating and engaging in environmental education partnerships. They expressed a strong desire to provide students with authentic engagement with the natural world in ways that are beyond the teacher's capacity in terms of knowledge, planning time, and material resources. The direct benefits to students are discussed in other subthemes. This subtheme captures findings regarding the incentives and supports afforded to teachers through the partnership. The teachers' desire for resources emerged as a consistent finding that drove their motivation to initiate and engage with local environmental education organizations. Amy was a former middle school teacher prior to her career as a regional environmental education coordinator.

Reflecting on her teaching experience Amy stated, "I was always looking for resources to bring into my classroom".

Teachers described resources in terms of materials, expert advice, time, and networking opportunities. Steve, an experienced teacher, shared the benefits he has realized through two local partnerships recounting:

> What Alex can come in here and do in five sessions, I could do it. I feel confident enough that I could do that. But it would blow a huge hole in the time I have to do everything else I have to do, or that any teacher would have to do. So to have that program come in, I don't have to reinvent the wheel. I can just plug that in. That's really important. … There's another group I've just started working with. They provide a lot of resources and workshops and interaction with other teachers and garden coordinators. So it's really sharing of resources and ideas.

Jennifer recounted the numerous benefits and opportunities she has enjoyed as a result of her proactive approach to partnership activities and networking, reporting:

> I was just noting that these environmental education programs have a lot of resources so I just ask. I think what I found about the environmental education providers is that it's just critical to be able to do different projects. I get resources all the time from them. One of the resource people is [provider name] who's with [organization]. So anytime she puts something up that says here's a resource, I usually follow through on it. … I would say seek out partnerships. Try to develop them because the potential support you have and can receive is huge. The bioblitz is an example. How do I get this off the ground? I've got to get these kids looking for all these species, and I'm not the expert. But I can get someone else to come in and help me. That's fantastic and such a relief.

Teaching is a second career for Shawna. She has a master's degree in environmental resource management and worked internationally in this field. She is very knowledgeable in environmental concepts yet sees many advantages to partnering with outside organizations commenting:

> Like Alex at [organization]. I can say, 'Hey, I want to do this fuel load removal thing.' And he said, 'Well, why don't we talk to so-and-so and I'll meet you up there and we'll do it'. And so he listened to what I wanted to do and he helped me get there. So that was good. … I started working with a [local university] in their teaching for sustainable communities. This summer we went to a program and they've given me

a really good framework to use here. Because I've always sort of had to design it myself.

Rationale for partnership. Subjects' views on the advantages and benefits of engaging in environmental education partnerships were coded to the *Rationale for partnership* subtheme (*n*=24). Recipients of the stated benefits included students, teachers, schools, communities, environmental educators, as well as the environment. Both teachers and environmental educators expressed connecting students to knowledgeable and enthusiastic experts in the field of environmental education as the central advantage and rationale for the partnership, which afforded many direct and indirect benefits. From a teacher's perspective Steve noted, "There's really nothing to lose. Anytime you can bring in people outside who really know their stuff and work well with kids and get them in contact with the outside natural world, it's worth it on so many levels". In a separate interview, his colleague Sheila elaborated on this central advantage stating:

> … those programs that [environmental organization] serve better, what they can do better than what a school can do. Kind of give you the WOW as opposed to the exactly how. Which is important because that's what they [students] remember more than anything.

She went on to say:

> They hear it from somebody else besides me. And they see people that are actually doing it for a living. It's not just me in this classroom. It really opens up their eyes to the possibilities when they hear it from someone else.

Jennifer added yet another teacher perspective commenting:

> Where I think the environmental education providers make the difference is the fact that you're probably connecting more with something happening locally. … And the connection that kids are going to make to their local environment is going to be greater than what you can just get out of a curriculum. … I think the connections to the environmental education providers makes it more real work and meaningful.

Environmental educators recognize their distinctive expertise, many of whom had previous careers in K-12 education which offered a unique perspective. Blair discussed the advantages of environmental educators being untethered to a curriculum or textbook and the fundamentally different approaches to teaching and learning that environmental educators provide stating, "The truth is non-formal educators understand hands on and interactive learning better than teachers do. Really. We're educators. We know how to do this better than they do. That's absolutely true. And we're bringing it to them". To this end, Audrey said:

> Knowing that having trained, qualified, enthusiastic people come into your classroom and work with your kids in a joyful way is a real bonus. It supports the teacher. Not because they get time off, but it can help them in their planning. They know it can be a central piece on which they can expand.

When asked if he thought the K-12 system could adequately address environmental education alone Alex paused, then replied:

> I don't know. I don't know if they have the financial means. I don't know if teachers have the time for that. They don't have the actual asset of the land itself. So the fact that we can bring them out to sites that they normally wouldn't have access to. So I don't think, I know some great teachers take it upon themselves to lead incredible walks and trips on their own. I think that we have the training, the resources, and the passion. And this is a very specific subject matter that we can provide a better service.

And lastly, Gail spoke to the advantages for teachers and K-12 education remarking:

> You're pedagogy, you're teaching and learning. You're not the expert on the wetlands and what's growing in the pond. You should know something about it, but your forte is the teaching and learning. Flatten out, open up and call in the expert who this is their world. Who has the database and can tell you the websites. Who comes into the classroom and explains it to the students and brings you out and comes back at the end and can do all the details. ... The schools don't have to do it by themselves.

Participants cited many other direct and indirect benefits realized through the partnership activities. They reported greater student engagement and excitement for

learning, especially for students who do not thrive in traditional classroom settings. Subjects also noted engaging in the partnerships increased instructional time for science education while it provided teachers the opportunity to build their understanding of environmental concepts and learn instructional strategies for outdoor activities. In addition, many schools enhanced their campus through gardens or habitat restoration with the assistance of the partnering organization.

The *Initiation of partnership* thematic category marked findings that illuminate how and why environmental education partnerships are formed. The next thematic category, *Characteristics of sustained partnerships*, presents findings that examine the dynamic qualities that support sustained environmental education partnerships. It was the second most frequent thematic category in this study with the greatest number of subthemes.

Characteristics of sustained partnerships. Participants discussed substantive aspects of their experiences in environmental education partnerships. These discussions were captured across six subthemes in the *Characteristics of sustained partnerships* (*N*=372) thematic category. Teachers shared their appreciation for the opportunities and resources afforded through the collaborative activities and environmental educators described their efforts to maintain teachers' confidence and trust in their programs. Topics that emerged provided insights into the interpersonal and transactional characteristics of sustained programs and partnerships. Table 8 displays the six subthemes associated with this thematic category.

Table 8

Theme: Characteristics of Sustained Partnerships Coding Results (N=372)

Characteristics of Sustained Partnerships	Frequency	Relative Frequency
Program quality/experiences/relevancy	114	31%
Rewarding outcomes and experiences	75	20%
Professional relationships	55	15%
Embedded in community	53	14%
Capacity and level of collaboration	50	13%
Characterization of partnership	25	7%
Total	372	

A discussion of the findings for this thematic category begins with participants'

descriptions of their *Characterization of the partnership* itself followed by findings around

participation in *Capacity and level of collaboration*. Together, these two subthemes provide

a contextual lens into the collaborative partnership concept. Discussion then moves to the

relational and experiential aspects of the collaborative activities, examining the subthemes

of *Professional relationships* and *Program quality/experiences/relevancy*, respectively. This

section concludes with findings from the subthemes *Embedded in community* and

Rewarding outcomes and experiences that reveal a broader context for sustained

partnerships.

Characterization of partnership. When participants were asked how they would

characterize the environmental education partnerships they were associated with, many of

them paused to consider this question.   Steve replied, "I'm not quite sure how to answer

that. I wouldn't call it a formal partnership. It's sort of they have this fantastic program, we

learned about it, they approached us, and we said 'Yeah, that's good. Let's do it." Although

this was not a frequently coded subtheme (*n*=25), the findings point to both relational and

transactional descriptions of their associations. Blair offered a succinct transactional

definition stating, "It's more of a client relationship. You provide a service and they take

advantage of that service." Audrey simply replied, "Service provider. I feel like we're a

service provider." And Alex noted, "I would say we are partners with the districts. I

wouldn't say there is any formal partnership." These responses characterize a client-

service association. Their outreach programs, like most collaborative environmental

education opportunities, are offered to teachers at no cost.

The two-semester high school environmental leadership program that Lynne

manages requires a minimal fee of less than $50 per student, with the option for a

scholarship to waive this cost for financial hardship. She described their partnership

arrangement stating:

> I wouldn't consider it a formal partnership. We do have agreements that they're
> going to bring their students out and things like that. So there is some formality to
> it. But I think within the partnership itself we are looking at it more from a
> relationship stand point.

Overnight outdoor education programs also charge a per student fee and therefore

require written agreements with the school district office. Yet Rachelle, education director

at an experiential outdoor education camp, views the essence of their partnership as

relationships between her program's environmental educators and the teachers they serve.

The relational aspect of the partnership was a strong theme expressed by many

participants.

Grant programs and certain large-scale outreach initiatives also entail contractual

agreements. Steve described his association with the NOAA Ocean Guardian grant program

as a more formal relationship, commenting, "Because you are reaching out to them it's a

more formal arrangement because of the grant and all that. But they're not embedded in the community."

Most participants characterized the partnerships as deeply revered relationships that developed over time. The following quotes are from two members of an organization that coordinate habitat restoration projects and a teacher with whom they have partnered with for over 15 years. Janice, the organization's founder stated, "I always say we work with our friends. … It's really about relationships. It's not about trees, kids, or education. It's about relationships and how to do this together." And in a separate interview, her education coordinator Michelle replied, "I would say like any relationship there are varying levels of depth and quality. Historically, we had such a small group of teachers it was a real familial kind of situation." Jeff expressed a deep connection to Janice and Michelle in appreciation of their support for facilitating annual restoration projects with his students, noting:

> I think of myself as a partner with [organization]. In that there are people there that I truly love and respect. They're just amazing human beings and I feel very connected to them in that way that they are my partners outside of this classroom. And that they're people that have this incredible motivation to change the world in a positive way, which we share at a very deep level.

Their organization has recently entered into an agreement with Jeff's school district to manage a native plant nursery at the district's high school. The partnership will allow high school students to grow native plants to be used in the habitat restoration projects with elementary students. Michelle described this arrangement as a more formal partnership between their organization and the school district office. Yet when discussing direct outreach activities, participants view their partnership associations through the lens

of community resource providers and a relational connection between the environmental

educators, teachers, and students.

    Capacity and level of collaboration*.* Numerous factors influence the degree to

which participants engage in collaborative environmental education partnerships. This

subtheme, *Capacity and level of collaboration* (*n*=50), captures findings related to these

factors. This discussion begins with a description of the various models of environmental

education programs and how their fundamental structure influences these factors. Each

outreach program is unique to the organization's mission, goals, size, location(s), and fiscal

capacities. As an example, Blair is the programs manager for a regional public lands

department that has numerous employees and locations throughout the county. Their

environmental education programs serve the highest number of elementary students of

any outreach program within the county through coordinated guided fieldtrips to various

sites and parks. These are considered 'one-touch' events designed to provide outdoor

enrichment activities for students and teachers with connections to local public lands.

Although many teachers take advantage of the fieldtrip opportunities each year, the volume

of the department's outreach efforts impacts the organization's capacity to engage with

teachers in longer term efforts. Blair spoke to this trade-off stating, "Where I think the

exciting edge is how to then, if we are thinking of ourselves as a service provider, how to

enhance the service or provide additional services so it becomes more embedded in the

classroom."

    Other outreach programs are designed around 'multi-touch' events. These

programs typically involve various configurations of a series of classroom visits with

engagement lessons and activities that culminate around a related experiential fieldtrip or

hands-on restoration project. As such, they service a limited number of classrooms, and lend themselves to deeper relationships between the environmental educators, teachers, and students as well as opportunities for collaborative input on lesson design and topics.

Major factors that influence a teacher's capacity and level of collaboration include time, program costs, district or school site support, and personal interest. Experienced environmental education providers realize the extreme time constraints on teachers and their lack of fiscal resources. To mitigate these challenges, effective environmental education programs are designed to efficiently streamline communication and coordination for teachers and most are available for free or at a very low cost. Nearly every program also offers free transportation to fieldtrips. All four teachers interviewed mentioned fiscal constraints and the necessity for free or low-cost programs. Steve addressed this issue stating, "If at all possible, have it be free so it's not a huge hurdle you have to overcome just to participate." Janice acknowledged the time constraints of teachers when discussing their free, three-day summer professional development program for partner teachers commenting, "So there's [summer program] week. That's when we get to plan and have time that they can meet. But that's only once a year. I think for most teachers they don't have any time for it at all."

Typically, environmental education programs are designed for the environmental educator to fully facilitate and lead the lessons and activities around a particular topic. However, they also accommodate the individual teacher's desire and capacity for co-planning of activities. The four teachers in this study have established strong relationships with their environmental education partners through their shared enthusiasm for environmental education and long-standing history of collaboration. As a result, they each

shared stories of higher-level involvement in co-designing, piloting, and collaboration

activities with their local partners. The teachers initiated some of the activities, while the

environmental educators initiated pilot programs, all with the goal of enhancing the

learning experiences for students.

School and district level support for teachers also influenced their ability to engage

in deeper professional learning and collaborative activities. Jennifer shared her learning

journey into environmental education that included a three-year assignment as a district

teacher on special assignment (TOSA) to coordinate and support elementary science

instruction. This allowed her to step out of the classroom to engage in professional

development programs and attend the countywide environmental educator network

meetings. Jennifer became more aware of local environmental education outreach

opportunities through her professional network with the countywide collaborative.

Professional relationships. Strong connections between environmental educators

and teachers surfaced explicitly and implicitly throughout conversations with participants.

Findings in this subtheme, *Professional relationships* (*n*=55), reflect expressions of mutual

respect, empathy, trust, and appreciation. Teachers conveyed gratitude and appreciation

for the services, resources, and opportunities for student engagement realized through the

partnership activities. They also expressed high regard and respect for the environmental

educators they work with. Many relationships have evolved over the course of long-

standing collaborations.   Jeff has coordinated student habitat restoration projects through

Janice and Michelle's organization for nearly two decades. Sharing his thoughts on this

topic Jeff stated:

> Starting with [program], which is to me that's been the most influential program
> that I've worked with and had the opportunity to have a continuing relationship

with for my entire teaching career so far. ... I continue over the years to foster that relationship and keep that going because they've been the most amazing partners. ... I feel indebted to them to a certain level.

Likewise, environmental educators emphasized the importance of their professional relationships with teachers that are borne out of empathy, respect, and understanding of the pressing demands on their daily schedules. Janice voiced her organization's position and personal feelings commenting:

Incredible respect. ... We have to treat them with the utmost respect. So I would say that is so important. Mostly respect. Empathy and respect. ... And teachers relate to us differently because they know that we understand.

Alex articulated similar views noting:

Get to know your teachers well as people. Know how challenging it is for them. And empathy. I think empathy is a huge thing.

Findings from this subtheme encompassed aspects of the interpersonal nature of sustained partnership activities. The discussion now turns to expectations of high-quality environmental education programs and providers. The following subtheme was used to capture these expectations.

Program quality, experiences, and relevancy. The most frequent subtheme in this thematic category was *Program quality/experiences/relevancy* (*n=*114). Environmental educators spoke to their efforts to provide high-quality, engaging student experiences from an equally knowledgeable and skilled staff. Teachers shared their expectations for relevant environmental education programs, reliability of the organization, and engaging program providers. Similar aspects were reflected in the *Program development/promotion/communication strategies* subtheme in the previous thematic category of *Characteristics/roles/practices of central figures*. However, this current subtheme captures the expectations of quality programming and providers. Passages were

coded to this subtheme based on stated examples of actual experiences as they relate to

essential elements of sustained partnership activities.

Aspects of high-quality environmental education programs included their alignment

to grade-level standards, opportunities for authentic hands-on outdoor exploration

activities, connections to local environment, and whenever possible, materials and

instruction with Spanish translations. Collectively, these features provide enrichment

experiences for students to increase their knowledge of and appreciation for the

environment. Jennifer articulated this expectation noting:

> I think first and foremost are that the programs are going to help meet the academic requirements. That's super important to teachers. The other would be to instill that love of nature in students. To share with them potential careers so that they can be good decision makers in the future, environmental stewards.

Sharing similar views regarding impactful student experiences, Jeff commented:

> I would say the quality of environmental education program and the level of student engagement. If it's a high-quality, the students will be glued to it and they love it. It's an amazing thing that they really want to keep coming back to.

Shawna stressed the importance of alignment to her curriculum and also spoke to

the subjective idea of quality while addressing the importance of student engagement

stating, "Quality is hard to judge. So I think that goes along with how engaged they get

students."

The expectation for high-quality programs runs parallel with the need for engaging

and enthusiastic environmental educators who are knowledgeable in their focus areas.

Shawna elaborated on this point remarking:

> Like the lion scientists. They're so passionate when they talk about the lion, you can't help but feel 'Oh my gosh, that lion needs to be saved!' So that's really good, they're just really passionate about what they do and the kids pick up on that.

Steve and Alex have collaborated together for approximately six years. Steve

expressed his appreciation for the experiential student learning experiences this

partnership brings noting:

> What I like about Alex's work is it's hands-on. There's activities that students are involved in. It's not just a bunch of concepts and theories, not top down just passing on information or knowledge. So they get involved in the experiential experience to learn with, rather than the abstract. That's the key for me. A lot of it gets them directly engaged with the natural world, out on the trail looking at leaves, looking at whatever.

Alex shared his views on the importance of balancing a positive student experience

with strict adherence to grade-level standards commenting:

> That's honestly, we always try and ensure that there's standards being met. But if I feel like it's just not being heard, I'll switch to just make sure the fieldtrip is a success in that they had an appreciation for the outdoors. That they enjoyed the aspect of nature, the aspect of fresh air and hiking and being in the woodlands. ... I don't want to be the preacher and take away from the fact that I just want them to fall in love with this park.

All participants discussed the value of providing outdoor experiences for students,

especially for children who may not otherwise have those opportunities. Environmental

education programs center on these experiential learning activities as an engaging means

to connect students to science concepts and their local environment. In addition,

participants acknowledged the importance of aligning to grade-level science standards.

Since the California state adoption of the NGSS, environmental education organizations

have invested significant time and resources into staff professional development to

understand these standards and realign their programs as needed. Findings from

interviews, observation of the countywide environmental educator network meeting, and

related artifacts show the ongoing training efforts focused on the NGSS as well as the

EP&Cs, California's educational focus on environmental principles and concepts. The

featured topic of the observed meeting was an interactive presentation of the EP&Cs. In addition, discussion included announcement and registration for an upcoming two-part environmental educator workshop centered on integrating culturally relevant programming within the NGSS.

Environmental educators emphasized this ultimate attention to the student experience in their discussions. They realize these experiences are dependent upon a combination of quality programming and an engaging, highly skilled staff and are critical to sustaining long-standing partnerships with formal K-12 educators. The final two subthemes in this thematic category present additional findings of characteristics of sustained partnerships.

Embedded in community. A notable aspect of sustained partnerships that emerged in discussions with each environmental educator was that of teacher continuity. Participants reported a very high percentage of returning teachers, many returning over several consecutive years to decades. The subtheme *Embedded in community* (*n*=53), was an emergent code used to identify sustainable partnerships attributed to long-standing associations with teachers, students, schools, districts, or connections to the broader community. Michelle spoke to this phenomenon asserting, "We do have our teachers, and I could give you more specific numbers, but we do have our teachers who have been with us 15 to 20 plus years." Jeff is an example of one of their veteran teachers who has partnered with her organization for 13 years adding that his colleague "has been doing that for close to 20 years."

Diane shared similar examples stating, "I would say that about 70% of our participants are teachers that have come, or they retired and they passed along the

knowledge and connections to their successors. And that's how we've kind of kept the

community going." Many other environmental educators shared similar stories about

veteran teachers who established a classroom tradition or legacy around the partnership

that continues with their replacements. Similarly, veteran teachers who move to a new

school often continue the program partnership and thus establish a new school connection

for the providers. Rachelle spoke to this tradition commenting:

> I think that the relationship has established over years. … It's just because they come back year after year. Which is a large part where if they then move schools, they get that new school to come here as well.

Some environmental education programs are also embedded into the school culture

and local community, serving students across numerous grade levels. Students get to know

the environmental educators over the span of several years. Alex talked about the benefits

of providing outreach programs for multiple grades at a school site remarking:

> Most of the kids I see, that I will be seeing in 6th grade, I've known them from the beginning of 4th grade all the way through 6th grade. I see them in the community. I see them at events and it's like 'Mr. Alex, the Science Guy'! I get to come in and I get to really know these youth.

Many environmental organizations are involved in their local community and bring

unique aspects to their programs. Audrey's organization utilizes trained community

volunteers, typically retired teachers or scientists, to provide their outreach programs. She

spoke to the many benefits of this model stating:

> Because we're teaching community members to teach it we're getting that impact. With community members who are going to go out and talk about [program] and talk about things they've learned in their training course. … I like our model of involving the community in it. I think it just has multiple benefits for the community members. We're providing a service for all those people who want to volunteer and contribute to society and their community.

Marie also related similar positive community outcomes of her program realized by parent chaperones commenting, "And his father was the chaperone when he came and he's bringing his father again. And the ability for kids that get excited when they're here to bring their family back and get to be the expert."

_Rewarding outcomes and experiences__. The final subtheme of this thematic category, _Rewarding outcomes and experiences_ (_n_=75) marked the stated benefits and rewards participants attributed to their shared partnership activities. Finer grained subtopics in this area included direct benefits for students, the environment, teacher learning, and positive future-centered ideas. The fundamental mission and rationale for the partnerships is to educate and inspire students with a love of nature and to become responsible, environmental stewards. Positive student experiences play a central role in this mission.

Student-centered outcomes. Rewarding student-centered outcomes involved student learning, growth, and empowerment as well as equity and access for all students, especially marginalized groups, and also connections to their local environment. Teachers shared numerous stories of students initiating recycling campaigns, presenting environmental projects to local community members, creating native plant nurseries, and understanding their local watershed as a result of guided hikes and classroom lessons. Michelle talked about students in Jeff's sixth grade classroom who were empowered by their restoration experiences and took ownership of their own project idea:

> Last spring one of our schools was so excited about it that they wanted to plant plants on their own school after the restoration. They mapped out and planned and organized with the support of our interns who really connected with the program. And I was almost able to step back and witness and see how that unfolded. They designed and planned and planted on their own school campus.

Coincidentally, in a separate interview, Jeff elaborated on his students' project:

> But it becomes something where kids feel empowered and they can do something about it when it's in their own backyard. ... And when you can actually offer solutions that they've come up with, it becomes extremely empowering because they see their choices. They see their actions actually making that difference and right in their own backyard. ... Last year we, on our own campus planted over 20 native species. And that was part of what we looked at, could we build in a restoration day here. ... It had been a long time kind of vision of mine to do that. That we would have students starting to leave behind a legacy of something that they had done on this campus to create a place. ... That's something that has power. When you get people who really enjoy working together you can create that. You'll get teachers who are willing to put in that time, even if you're not getting paid outside and stuff. It's worth it because it's a legacy that you're creating and it's more precious than anything being paid for.

> Lynne discussed the importance and rewards of connecting today's children to

nature, sharing:

> When you hear a 5th grader say that they've never been to a farm before. And how do you expect them to know where their milk comes from. And where there are apples and bees and why should we protect pollinators. We're asking them to do something that they have no connection with ultimately. And so at least there's that introduction. And there's those light bulbs. And a student ask me why I do this work. And that was such a thoughtful question and she said 'You inspire me'. You're providing more than just that experience. It impacts their life forever.

Speaking of the intrinsic value of environmental education for students, Shawna remarked,

"I think it's more. It's almost more of an appreciation and an understanding of something

bigger than themselves."

Many environmental educators shared stories of students who returned to work as

student interns or even staff members. Others received letters from students many years

after their environmental education experiences. Janice, a former fourth grade teacher

who founded the habitat restoration program, relayed this story of a student in her class

the year of the initial student-led restoration project that changed the course of Janice's life:

> And then another girl who was nine and very shy and new to my class said, 'I never thought that kids could do anything. I always thought kids meant nothing. And this

project showed me that we're not just a bunch of little dots'. And it's interesting. She's in graduate school now and she just wrote me and said, 'Remember me? I still remember my 4th grade experience and I hope graduate school will be as good as that.' So it sticks to you.

Environmental outcomes. Environmental educators, teachers, and students involved in reusable materials projects, school campus landscaping, native plant gardens, and habitat restoration projects are able to bear witness to the positive environmental impacts of these coordinated activities. Janice reflected on the collective impacts of their years of local wetlands and creek restoration projects saying:

> We've had a carbon sequestration research project done on our projects. And I don't remember the stats but it's like 50 cars off the road for a year or something. It's substantial. Carbon sequestration children are providing by doing this project. And it's cool. The tree goes in, it provides it [carbon sequestration] and provides it every year. … 46,000 trees so far. Isn't that wonderful! We have 35 to 38 miles of creek beds restored so far. The birds return. We know that. It goes from five species of birds to 28 species of birds at a single site. And otters return. Restoration works! Nature is a good partner.

Teacher-centered rewards. Findings around teacher-centered rewarding outcomes included enhanced understanding of science concepts, inspiration from partners and students, and greater job satisfaction. Many of their previous quotes allude to these positive outcomes. Michelle reflected on teacher's feedback following their annual three-day summer professional development workshops stating:

> A lot of teachers note in their feedback on our professional development that this is where they get a lot of their science information. Especially for elementary [teachers]. … At the end of each [summer program] I'm inspired by the teacher's feedback. They really feel like that made a difference for them in their teaching career. I've even had teachers write like 'I'm on the brink of wanting to quit and this really inspired me'.

Jennifer shared her experience seeing the level of excitement and engagement in her young students reflecting:

I think the first time I started playing around with project-based learning was a schoolyard habitat unit with 1st graders. So after you are exploring your own environment, what could live here, do we have the right resources, how do we support habitat for some of the wildlife that we do want here. It was the first time that I saw 1st graders go out during their recess time with a clipboard and go find stuff on their own. And then come back so excited. And the first time that I would hear from parents 'Oh yeah, he's building a lizard habitat at home'. So I think that says a lot.

Future-centered rewards. Participants also expressed future-centered rewarding

outcomes for both their students and the planet. Alex discussed the inspirational rewards

of 'the long-term investment you make' in students and the environment commenting:

For the first time last year I had students in my high school internship that were the first students that I taught in 5th grade. And they stayed on and they remember. They tell me their memories of when I came in. For them that's such a huge growth time in their life that it seems like ancient past five years ago. But for me, it's like seeing these kids that were four foot tall, little 5th graders with their lunch box grow into high school kids driving cars. And instead being students in the classroom, they're employees and essentially adults that are working under me. And basically, carrying on that pathway into the next set of their roles in society. And so that's the idea of a pathway that can lead them into hopefully a desired passion. If not profession, a personal level to preserve our land, air, and water, our local ecology. That is the most fulfilling thing that I get out of it.

And lastly, Marie spoke to this topic in her reflection regarding their conservation science

residential program led by female scientists:

The thing that's amazing to me about the summer program for young high school girls. I think that all of us in this field have moments of despair. And the three years that we've done that program, every adult woman that's been involved has said 'Thank you'. I feel so much better about the world now.

Collectively, these six subthemes *Characterization of partnership, Capacity and level*

of collaboration, Professional relationships, Program quality/experiences/relevancy,

Embedded in community, and *Rewarding outcomes and experiences* capture participants'

views on essential elements for sustained environmental education partnerships. Findings

presented thus far have characterized the central figures involved in the partnership

activities, how those partnerships are established, and necessary aspects of sustained collaborative engagement. The next thematic category turns to a discussion of the countywide environmental educator network.

Environmental educator network. The Northern California location of this study has an active countywide environmental educator network. Nearly each of the environmental educator participants is a member of the collaborative network, with several of them serving in leadership roles. The thematic category, *Environmental educator network* (*N*=105) captured participants' explicit references to their involvement in the collaborative. Data for this category was collected during individual participant interviews, an observation of a network meeting, and related artifacts gathered. The artifacts were collected following an interview with the network's chairperson and the separate meeting observation. Table 9 displays the five subthemes within this thematic category.

Table 9

Theme: Environmental Educator Network Coding Results (N=105)

Environmental Educator Network	Frequency	Relative Frequency
Learning and knowledge sharing	34	32%
Belonging and relationships within network	22	21%
Collaborative activities	22	21%
Effective governance	15	14%
Challenges within network	12	11%
Total	105	

Ten of the twelve environmental educators interviewed were members of the countywide environmental educator network, with several holding leadership positions within the collaborative. The stated mission of the network is 'to create vibrant, innovative collaborations that increase environmental literacy in [county] citizens'. The countywide

environmental educator network meets monthly to implement culturally relevant outdoor

events, share best practices, maintain connections between participating organizations,

and provide communication to the broader community regarding outdoor activities and

events.   The network of participating organizations serves the community and views

schools as a vital link in their outreach efforts. It can be described as a hybrid between a

community of practice and collective impact entity.

     Belonging or relationships within network. Participants, particularly

environmental educators, expressed a strong connection to the collaborative network and

colleagues. The subtheme, *Belonging or relationships within network* (*n*=22) was used to

mark participants' references to a sense of connectedness or belonging to the network.

Many discussed the value of networking with like-minded professionals who share a

purpose and passion for environmental education.   Alex conveyed his appreciation for the

collaborative network noting:

> The collaborative is incredible. It's one of my favorite days of the month to go to
> that meeting. You see other people, they're equally passionate and it's just, it's just
> so uplifting to see that community around you that everyone's doing their part.

Audrey shared similar views on the personal and professional value of the network

commenting, "The collaborative has helped me feel like I'm part of a greater team. I have

an even greater purpose. I have an even greater level of accountability. So I think it really

elevates our profession to have a collaborative". The network's chairperson, Blair,

discussed the value of belonging to a professional community relating:

> I think our work as a learning community and the connections that we've made,
> both through our formal PD and the individual connections has been the best piece.
> I think we are becoming a real learning community where we are calling on each
> other for co-mentoring and support – big time. I can't accomplish my job without
> my partners. My partners help make it happen. That's what I would say is the
> biggest. It's beyond networking. Working for me, that word isn't strong enough.

It's co-support, it's co-mentoring. To me it's my professional community. That's what it is.

Participants discussed the evolution of the network and their commitment to a shared purpose that has resulted in a collegial rather than competitive environment. Lynne spoke to the impact of having shared purpose stating, "I think [network] is probably the best example. ... Because we are sharing. And we've moved away from working in our spaces. And seeing a common goal. The common goal is environmental literacy and an informed citizenry in [county]".

The concept of trust among participants surfaced as a result of having a common goal and shared purpose. Most environmental education programs are operating at full capacity, eliminating the need to compete for school or teacher participation. Diane discussed the value of a broader shared mission to serve students across the region and its effect on building trust across the network commenting:

> I think that one of the things that people are scared of is the perceived scarcity of funding. And so if you work together, if you show your cards too much maybe somebody else will get the funding. And I think because [county] is so big and we have two great agencies that have free programming, the water agency and the regional parks, they see almost every child in [county]. So that kind of takes the pressure off the rest of us to focus on areas that they're not serving. And there are plenty of kids to serve. I think it's more collaborative and less competitive here.

Audrey also credits the network and their shared commitment to serving students across the county as a foundation for trust among the members noting, "Before we started this collaborative there was more of a competitive competition. We were competing for dollars, we were competing for students. But now it's just dissolved all of that. It's this feeling that we're all working together for the kids and parents".

Learning and knowledge sharing. The network's commitment to sharing best practices surfaced during discussions with individual participants and were observed

during their monthly meeting. The subtheme, *Learning and knowledge sharing (n=34)*, was

used to code references to personal and professional growth as realized through the

network. Learning and knowledge sharing experiences are embedded into each monthly

meeting. In addition, the network facilitates professional development workshops

designed to enrich the professional learning of the group.

Blair is the network's chairperson. During the interview regarding her agency's

outreach efforts, Blair also discussed the countywide environmental educator network and

its collective impact reflecting, "I think our work as a learning community and the

connections that we've made, both through our formal PD and the individual connections

has been the best piece". She later added:

> I do think we moved the work forward by these workshops we've put on. I do think
> people are learning stuff that they can apply to their own teaching that brings up the
> quality of environmental education in [county]. I think that's been really awesome.

Lynne spoke to the professional learning of the network stating, "I think it's helped

all of us with the professional development component of that collaborative as well. That

we're all in this to improve ourselves as educators. It's a multifaceted collaboration and it's

been a wonderful tool for us to utilize and to lean on each other". Alex shared his

appreciation for the professional learning opportunities commenting:

> When you mentioned partnership, it made me think more of the collaborative we
> have. I think that's so important. Being an isolated non-profit working on your own
> can be really challenging and overwhelming. And meeting with other partners and
> forming professional development, or getting updated curriculum, or getting
> techniques, it definitely helps create a foundation to support you in your work.

And lastly, Amy a member of the group's professional development committee noted,

"They're going to dive into practice and learn what those practices look like and share their

practices with one another. And so it's like a continuum I guess of moving them closer to what formal education needs".

Observation notes of a monthly meeting of the countywide environmental educator network included annotations of a discussion on the NGSS and the EP&Cs. Together, the Next Generation Science Standards and the Environmental Principles and Concepts detail the grade-level science concepts and associated focus on environmental connections for California K-12 science instruction. The EP&Cs are a California enhancement to science instruction that 'highlight the deep relationship to humans and the natural world'. Since the NGSS state adoption in 2013, K-12 educators and the informal science community have been engaged in professional development to realign instruction to reflect the more dynamic and authentic approach to science instruction these standards elicit. The countywide environmental educator network has facilitated an on-going focus on these standards through monthly meeting topics, professional development workshops, and bringing outside experts to raise the collective awareness and capacity of its members. This allows the individual environmental education organizations to maintain relevancy in the support for K-12 teachers. During the meeting, participants shared their understanding of the EP&Cs and their natural connection to their outreach programs. Gail shared copies of reference guides for the NGSS and the EP&Cs that were specifically developed for informal environmental educators. The professional learning topic of the meeting was centered on an exploration of the EP&Cs, presented by Amy. The planned interactive activities involved participants going outside to find evidence of how humans have changed the local environment. However, this meeting occurred less than one week after the major

wildfire in Butte County, covering the region with smoke. Due to extremely unhealthy air quality across Northern California, the activities had to be adapted and conducted indoors.

Collaborative activities. Members of the countywide environmental educator network work together on shared activities, events, and projects. The *Collaborative activities* (*n=* 22) subtheme was used to code participants' discussions of the various shared activities, events, and projects. The collaborative action focuses on serving the broader community, identifying areas where gaps in service may exist, and leveraging the collective resources of the group to create culturally relevant programming.

The mission of the network is to improve environmental literacy for all students in the county. The Pathways to Environmental Literacy project, commonly referred to as 'Learning Pathways' is one such collaborative effort involving each of the partnering environmental education organizations and agencies. The goal is to address program outreach gaps that exist across the county by first identifying the grade level(s) and school district area(s) currently being served by each organization. Environmental educators looking to expand their outreach efforts can then design and promote programs specifically for students in the underserved grades and locations. The project is a work in progress. One product of this project is a compilation of current K-12 environmental education programs on the network's website. These programs are listed by grade level with direct links to the individual organizations' program description. Lynne shared how she was able to target an underserved school as a result of the Learning Pathways project noting:

> And when we [network] started that research and cataloging, that fall we [her organization] were just starting another site with our teen programming and I went through that list and selected the schools that were the least served. So it works and we have all been applying that.

Another example of collaborative activities is the groups' efforts to translate program materials into Spanish. Observation notes from the countywide environmental educator network meeting included the group discussion of this topic as well as a collaborative activity. Participants discussed the need for professional translators to review previously translated Spanish materials for accuracy and clarity. One activity during the meeting, participants compiled a list of the top environmental education vocabulary words to have translated into Spanish. The goal was to create a living document of translated environmental education terms that will be shared across the network. This group activity was the first step in this process.

Effective governance. Functioning and governance of the countywide environmental educator network has evolved over time. The subtheme *Effective governance* (*n*=15) was used to code references to the leadership and policies of the network. Blair serves as the network's chairperson. Several years ago, she was given the task to reshape the network about three years after its initial inception. She is largely credited with its successful evolution due to her efforts and the support of other leaders within the network. Blair reflected on the changes that have led to effective functioning of the group recounting:

> We started putting out a regular agenda, formed committees, had some visioning sessions and really tried to make it be - it's kind of a hybrid between a learning community and collective action group. I'd say more on the learning community side but we do some collective stuff so that we can have some things we accomplish together.

There is shared governance between the steering committee and the participatory involvement of all members. Blair emphasized the purposeful nature of their meetings and the expectation to begin and end on time. Members share the responsibilities for

administrative and logistic tasks during the meetings. Observation notes of the meeting included a group discussion regarding information sharing on social media. A Facebook group was created the previous year to get out information during the local wildfires. Further discussion ensued as to the Facebook group norms.

Challenges within network. The subtheme, *Challenges within network* (*n*=12) was used to code expressed tensions or challenges within the countywide environmental educator network. Topics that emerged included a desire for more direct involvement from K-12 education leaders within the county. One challenge for teachers is that the monthly meetings are held during the workday from 10 a.m. to noon, preventing full time classroom teachers from participating. However, the meetings are open for county, district, and school site leaders but are not regularly attended by K-12 administrators.

Balancing the responsibilities of leadership roles within the network can create challenges for individuals with demanding work schedules. Most local environmental organizations and agencies that have an educational outreach component support their staff member's participation in the network. However, responsibilities and tasks associated with the network are added to an often full and demanding work schedule of the individual. Blair discussed these challenges suggesting, "So getting it into managers' and directors' job descriptions to be part of this collaborative. … it's the collective action thinking. And how we move forward together is by getting these things done." Diane spoke to this issue as well commenting, "It kind of falls apart because it's an extra thing for most people to be part of a collaborative."

This thematic category was used to report findings regarding the countywide environmental educator network. Subjects credited much of their professional learning

and growth to their participation in the network. They expressed a shared commitment to its mission of increasing environmental literacy for all students in the county. The next and final thematic category presents findings regarding tensions and challenges participants associated with their work in environmental education partnerships.

Tensions or challenges. Participants expressed challenges inherent in K-12 environmental education partnerships. The thematic category, *Tensions or challenges* (*N*=156) contains two subthemes used to code obstacles or frustrations described by the individuals. These subthemes distinguish between challenges associated with inherent constraints in the K-12 system or the capacity of the environmental organization. A third subtheme emerged during the study, *Environmental urgency/wildfires*. Participants made numerous references to environmental threats, including the wildfires that severely impacted the community a year prior to this study. It should also be noted that during the time interviews were conducted in the fall of 2018, the area was again directly affected by Northern California wildfires. This third subtheme was used to code participants' references to these environmental threats and challenges. Table 10 displays the three subthemes associated with this thematic category.

Table 10

Theme: Tensions or Challenges Coding Results (N=154)

Tensions or Challenges	Frequency	Relative Frequency
Constraints/challenges in K-12 system	66	43%
Capacity of environmental organization	62	40%
Environmental urgency/wildfire impact	26	17%
Total	154	

Constraints and challenges in the K-12 system*.* Teachers as well as environmental educators voiced frustration and concern for the systemic lack of science and environmental education occurring in K-12 classrooms, especially in the elementary grades. Similar issues surfaced regarding the lack of administrative support, changes in leadership, and the inherent challenges for partnering with middle and high school teachers. The *Constraints/challenges in K-12 system* (*n=66*) subtheme was used to code participants' discussion of these topics.

Subjects conveyed consternation regarding the sporadic occurrence of environmental education in most classrooms, resulting in an unequal distribution of student access to these unique learning opportunities. Similarly, many participants mentioned the overall lack of elementary science education. This reality creates an even greater burden for the few teachers committed to integrating environmental education into their classrooms. Steve relayed his concerns stating:

> I think that's the biggest frustration is the lack of continuity. If you go to any school, there's probably only one teacher, or maybe two. And that's where it's happening. And they're doing their best. That's too much of a burden to put on a few teachers or grade levels. And you can't realistically do all the things that need to be taught.

Steve's colleague Sheila discussed the general uneven distribution of environmental education. She went on to note the challenges associated with her desire to foster environmental literacy in her students within the limited course of one school year commenting:

> It's just so random what school you're in – what environmental education the kids are getting. I'm not sure why teachers don't take more of it on but I think teachers already feel a little overwhelmed. And it's kind of interesting how little science background a lot of elementary education teachers have. … I want them [students] to know so much so fast. Maybe that's my challenge. I'm like 'You have to learn this now and care'. So maybe that's my biggest challenge.

Steve and Sheila are also working to increase environmental awareness at their

school and encourage colleagues to integrate environmental education at the lower grade

levels. Sheila discussed the challenges of implementing a school wide focus stating:

> We have a climate action plan at this school. And that doesn't really mean anything at this point. But that's what we're working on to get the students to make it mean something. ...So I think there's a lot of work to be done. And everybody in the staff would have to buy in and they don't yet. And I don't know how you can change that either. I really don't.

Environmental educators voiced similar dismay regarding the lack of science and

environmental education they believe is happening in classrooms. To this end, Lynne

noted:

> We used to get one teacher who's kind of the lead teacher, the really inspired one who's going to get their kids out onto the fieldtrip giving them these experiences. And other classes within that grade were possibly missing out.

Environmental educators recognize the time constraints and many demands on

teachers and apply a system's perspective to these issues. Audrey addressed this topic

stating:

> I kind of look at schools as a unifier as a system. As a way to sort of make citizens. And I know when those boats get big like they are, and a system with so much tradition and history, that changing them or creating new ways, I think it's really hard. Especially when it's coming top down.

Blair shared similar notions as they relate to the consequences for science and

environmental education commenting:

> Guess what, we're kind of all the science that is happening in some of these classrooms. So it's not that much of a surprise to me because frankly they're not teaching science. They're not meeting the standards. To me, they're not meeting their professional obligation. But that's the way they're set up in those schools. It gets pushed off.

Participants discussed the potential impact of administrative support, or lack

thereof, for environmental education. Jennifer shared her appreciation of a supportive

principal and offered a pragmatic view of this overall issue stating, "I landed back at the site

where someone was very amenable to that. And the principal was very interested in

having that creek restored and opened up for student activities".   However, she added, "We

have a different principal now". She then went on to say:

> But you always have to remember that science and environmental literacy is not the
> be all and end all for administrators. They've got all kinds of other things to do, but
> it's frustrating for those of us who know that you can integrate so many things.

Many environmental educators discussed the quandary of reaching out to

superintendents and principals in efforts to establish a school-wide or district-wide

partnership. Blair shared her direct experience as a science teacher when her principal

questioned the use of experiential fieldtrips and activities in Blair's science program

stating, "And so very easily, just by her view could have really shaken up my whole

program. So I only saw her involvement as detrimental." Jeff, a veteran teacher who has

experienced several administrative changes, commented:

> We've had different administrators and different principals. It's never been a school
> priority. It's never been something that's ever taken legs at a large school scale. Our
> administrators, I had everything from administrators who've made time to come out
> to see what the kids are doing on a restoration day, to ones that were kind of
> oblivious.

Gail, an environmental education consultant who has experience in K-12 education,

expressed her disappointment in the status quo of the system. Citing its overall inattention

to environmental concerns and environmental literacy she stated, "I'm surprised and

disappointed how inflexible, and that leadership, K-12 administration and leadership is.

And in all fairness, we probably have no reason to expect it to be more open because their

whole careers have gone that way". Lastly, Janice a former teacher discussed the impact an

administrator can have on instruction at their school noting:

> The administrators are the ones who can really make project-based learning or this kind of education happen or they can stop it. Because they really set the culture of the school. The teachers are really hobbled if they have an administrator that is going to say 'Everyone is on page 91 this week'.

Participants also mentioned the challenges associated with coordinating collaborative activities with middle and high school teachers. The schedule structure of secondary schools with shorter class periods as well as separate courses and instructors are not conducive to experiential fieldtrips and off campus outdoor activities. Some organizations have created internship opportunities for high school students. However, they are limited in their outreach efforts for most middle and high schools. Alex's organization is in the process of establishing a program with a local middle school. He addressed this issue stating:

> Middle school is challenging. We are just starting to do that. Because it is pulling them out of other subjects that are tested, their subject matter classes. And so they're a little bit more weary of that, being removed from school.

Capacity of environmental organization. Environmental educators discussed challenges they face in serving the mission of environmental education for K-12 students in the region. The subtheme, *Capacity of environmental organization* (*n*=62) was used to code participants' views on this subject. Funding, especially for smaller organizations, was the most common issue surrounding the capacity of individual and collective organizations to serve their educational outreach missions. Commonly, these organizations are non-profits, local or regional government agencies, 501(c)(3) not-for-profit environmental organizations, or municipal resource districts or agencies. Nearly all of the environmental educators stated their outreach programs were operating at full capacity with waitlists of teachers who want to participate. Many felt funding challenges limited their ability to expand staff to meet this demand.

Participants conveyed a strong desire to collectively serve all students across the county. Lynne's two–semester high school program specifically targets outreach efforts to continuation schools in lower socioeconomic areas. She expressed her concerns stating:

> We're at capacity. But when we look at how many we are actually serving there are still gaps. I feel like sometimes I know we're doing a lot with the programs we have and the students we serve. But I find some challenge in being able to fulfill some of those overall statistics of students not being served.

Most environmental education programs, with the exception of overnight experiential camps, are provided at very low or no cost to the school district or teachers. In addition, many of these programs also cover the transportation costs of fieldtrips through district reimbursements for this expense. Audrey addressed the funding challenges that she and many other similar organizations experience noting:

> Funding is hard. Writing grants and trying to find time for all that. But everything we do is related to resources and having staffing and having finances to pay for that. Because it is supported by the community and you have to get grants and donations to run what we do. … If we did get funding from schools we could have more services. It just really comes down to that.

Alex works at a local conservation science and research center. Elaborating on the ongoing funding challenges for educational outreach he articulated:

> So it's a portfolio of small grants. Education is extremely difficult to find. Generally, the budgets for the two other pillars for our organization are well funded. And in education anything over a $20,000 grant for environmental education is hard to come by. So we usually kind of have to piecemeal it together and do smaller grants to keep us going.

He went on to add, "The funding is one thing. If they [schools] were to eat the cost of bussing that would definitely help us out. But they are financially challenged themselves though." In addition to limited financial resources, other commonly reported challenges included the number of school days, amount of time participants had to work with

students, rescheduling due to unforeseen circumstances or extreme weather conditions, and staff turnover.

The challenges of assessing student learning were topics of concern. Many programs that involve a series of lessons and field experiences provide pre and post-assessments to evaluate learning and attitudes toward environmental experiences. For some, this issue reaches a philosophical realm when considering immediate evaluation of student learning in relation to the immeasurable benefits of interacting with nature. Jennifer conveyed her thoughts regarding the challenges of assessing her students' learning while acknowledging the value of their experience:

> There are a lot of great things that happen on these field trips and then sometimes I wonder how do I assess what kids have actually learned. Because very often they are in separate groups and what they learned depends on who their docent is. And there are things that happen during the day that are super important as well. Sometimes there's room for improvement in that area.

Michelle discussed an inherent challenge in the amount of time they have to work with students to build deeper learning experiences noting, "We wish students had more time to engage with us. So students could plan where the plants go and things like that." As a classroom teacher, Jeff provided a different perspective on driving deeper learning commenting:

> To be honest, there are years when I feel better about the environmental education that I've offered to my own students. And other years where I don't because I had a really tough group of kids that came in with a really low set of skills that I wasn't able to push as far as I wanted to. We weren't able to take a look back and explore what ancient ecologies have done.

Participants discussed challenges unique to their organizations and programs. As an example, Rachelle is the director of school programs for an experiential overnight outdoor education camp located in the redwoods that focuses on environmental education

and character development. The 200-acre facility has several high ropes challenge courses

and ziplines through the redwood canopy. She discussed her successful turn-around of the

previously struggling environmental camp, along with the dynamic nature of her role at

various times during her interview and the day-long observation of their programs. The

complexities of overseeing budgets, establishing new policies and procedures, maintaining

facilities, staffing, and ensuring the safety of the students, teachers, and parent chaperones

present 'lots of layers' to her role. Discussing these responsibilities Rachelle noted:

> The business part of it was very new and different. And trying to figure that out.
> And so I think in this role, more than other roles I've been in, it has been as much
> about, it's a non-profit as well as a business. And if you're not running it well, it's
> gonna shut down. … So that's been very interesting to me and what led me to why
> I'm getting an MBA now.

Environmental education programs that involve coordination with various

community partners also present extra layers of complexity. The student habitat

restoration projects require a high level of planning between the restoration science team

and the landowners, ranchers, or other responsible parties associated with the restoration

site. Michelle talked about the challenges inherent in their unique program commenting:

> There are only so many school days and so any restoration projects. And the
> planting window in the winter is almost over until March or April. And most weeks
> in March and April have two to four restorations per week. … I think other
> challenges for us are that our restoration sites are new each year and that we spend
> so much of our time in the spring and summer trying to make connections and find
> different restoration projects. And sometimes we have restoration projects that are
> just not in an area even remotely close to a school that we have been working with.
> And that gets really complicated to figure out if they can drive an hour to the site.
> Often times, contracts don't get signed in time for teachers. They love to know what
> fieldtrips they are going on in September. We often have to tell teachers we need to
> wait until November to figure out what they'll be doing. Really, that flexibility is key.
> But we don't like having to put our teachers in that situation.

Environmental urgency/wildfires. This final subtheme, _Environmental

urgency/wildfires_ (_n=_26), emerged as participants expressed concerns over a sense of

urgency to respond as a nation or community to the increasing environmental threats

brought on by climate change, pollution, or waste. This area was one of several Northern

California counties directly impacted by massive wildfires in 2017 and extremely

unhealthy air quality the following year. Several of the environmental organizations

experienced destruction of facilities and habitat loss. Many students in the communities

they serve lost homes and schools.

Sheila touched on several of these topics during her interview, at which time the

entire area was engulfed in a dense smoke from the 2018 wildfire in Butte County causing

schools to close and keeping people indoors. Addressing her concerns, she stated:

> We've talked about people using fires, native people using fires to help the
> environment instead of suppressing. Which is a little tricky because many of these
> kids lost their homes last year. … The underlying theme of everything we do should
> be the environment. Because otherwise we can't live a healthy life, as is evidenced.
> And it's pretty scary that we're just getting masks and filters and nobody is really
> talking about why it's happening and what we can do about it. Because there is no
> going back and these kids are already going to have to live a different life than other
> generations. So I feel an urgency.

Diane's organization is a 3,200-acre preserve that lost many structures and habitat

destruction from the 2017 wildfires. Fortunately, their main facility of stone and concrete

remained intact. During the interview conducted outside, a staff member was leading a

class of visiting fifth grade students on a nature exploration and hike. Diane commented

about the group noting:

> The 5th graders from [school], down at the bottom of the hill kind of by Starbucks.
> They've [the school] been coming here for 7 years. A lot of the kids lost their homes
> in the fire. They were impacted by the fire a lot. So it's good for them to come back
> here and see the post fire recovery, and the trees, and that nature rebounds.

Marie talked about the wildfire's impact on her organization's inland preserve and

the educational programs stating:

> One of the issues they're having there now of course all the buildings burnt down and we can't use some of the trails. They're actually working with less schools, half the number of schools because they can only accommodate one school per day, or one class per day instead of two classes per day. … And the trails still have hazardous trees. So that's really the thing that's limiting the number of classes that can come.

Janice discussed the regenerative power of restoration projects in conjunction with the local effect of climate change. Relating these topics to their work she said:

> We're waiting for the wave. You know, climate change. I mean when people realize climate change is real and wonder what can we do, this is a proven model. It works, it does. Restoration works. People are hungry to do this kind of work. People feel the call that the earth needs help and they want to help.

And lastly, to this end, Amy simply stated, "Climate change is happening faster than we thought. We're not prepared for it".

Summary

A summary of findings along with conclusions and implications are discussed in the following chapter. Characteristics and practices of the central figures involved in sustained K-12 environmental education partnerships will be presented. The dynamic communities of learning and knowledge sharing fostered through partnership activities will also be explored along with recommendations for further research.

Chapter 5: Conclusions

The research into partnerships between formal educators and informal science organizations reports that this practice has failed to institutionalize, noting that such partnerships are sporadic and temporary (Bevan et al., 2010). This study supports Bevan et al.'s (2010) conclusion and attempts to provide further insights into this phenomenon by examining conditions found in existing K-12 environmental education partnerships. An understanding of the central figures and practices in successful, sustained partnerships could help inform relevant stakeholders who seek to advance environmental education opportunities in K-12 classrooms.

Summary of Conceptual and Theoretical Foundations

This study explored the conceptual foundations of environmental education and environmental literacy. Broadly defined, environmental education is the many ways a person comes to understand the complex interdependent relationships of the natural world and the human impact upon them (Hollweg et al., 2011; Stapp et al., 1969). Environmental literacy is the summation of knowledge and dispositions acquired over a person's lifetime through their experiences and interactions with the natural world. As such, it is the ultimate goal of environmental education (Roth, 1992).

The theoretical foundations of partnership theory and social learning among communities were used as a lens to explore environmental education partnerships. Huxham and colleagues present the complexities of partnerships through their dual theories of collaborative advantage and collaborative inertia (Huxham, 2000, 2003; Huxham & Vangen, 2005; Vangen & Huxham, 2003). Learning and knowledge sharing among the central figures in environmental education partnerships was examined through

Wenger's (1998) theories on communities of practice as well as Wenger-Trayner et al.'s

(2015) landscapes of practice. Together, these theoretical foundations provided a view of

partnerships as structure (Huxham, 2000, 2003; Huxham & Vangen, 2005; Vangen &

Huxham, 2003) along with a lens to understand the dynamic social interactions of learning

and knowledge sharing among the participants (Wenger, 1998; Wenger-Trayner et al.,

2015).

Summary of Methods

Central figures engaged in collaborative K-12 environmental education partnerships

were interviewed to explore how such partnerships are initiated and sustained.

Participants included 12 environmental educators and 4 elementary teachers located in a

rural Northern California region. This region was selected due to the presence of a

countywide environmental educator network. Semi-structured, in person interviews were

designed to capture the breadth of the roles and practices of individuals engaged in

environmental education partnerships. Two observations were conducted in this study.

The first was a full day observation of programs at an experiential outdoor education camp

located in the redwoods. The second observation focused on a monthly meeting of the

countywide environmental educator network to gain further insights into the practices of

environmental educators who partner with local teachers. Relevant artifacts were

collected during both observations and following a few of the interviews. Thematic

analysis was applied to the interview transcripts, observation notes, and relevant artifacts

using a priori and emergent codes. These codes were grouped by thematic categories to

organize associated subthemes.

Summary of Findings

The section presents the key findings of this study in relation to the research questions. A summary of these essential findings provides insights into the central figures involved in K-12 environmental education partnerships as well as how such partnerships are initiated and sustained in a rural Northern California region. Key findings associated with the challenges in K-12 environmental education partnerships are integrated into this discussion.

The findings clearly indicate that environmental education partnerships are primarily teacher-driven initiatives. The elementary teachers in this study are highly motivated and passionate about integrating environmental education into their instruction and they do so by choice. Most districts and schools provide few supports and minimal funding in this area. Teachers with a strong environmental education orientation access free or low cost resources and supports through their collaborations with local, regional, and global partnerships. Regardless of whether teachers had a background in environmental science, they continually expand their knowledge of environmental concepts through their enthusiasm for this topic, partnership activities, and related professional development opportunities.

Environmental educators and teachers involved in this study shared deeply held beliefs and convictions about the health of our planet and the need to educate and prepare our youth to be fully functioning, environmentally literate citizens. Participants feel a sense of urgency due to growing threats of climate change as well as the local and regional impacts from recurring wildfires in Northern California. They believe all students deserve

access to high-quality environmental education and are dismayed by its unequal distribution across most K-12 classrooms. Furthermore, environmental organizations operating at capacity could expand their educational outreach if districts and schools would be willing to help share the costs these efforts.

Guiding students through learner-centered investigations of the natural world requires a unique pedagogical approach far different from teacher-centered, textbook-based, direct instructional practices. This study found that environmental education professionals are highly skilled in their fields with unique expertise in student-centered outdoor education pedagogy. They hold undergraduate degrees in the environmental sciences and several have graduate degrees in environmental resources and/or environmental education. In addition, many had a previous career in K-12 education. Their foundational backgrounds in environmental science, outdoor education, and an understanding of K-12 education serve as they bridge the worlds of formal and informal science education.

Lastly, this study found that the participating teachers have established long-standing, positive relationships with their environmental education partners. They greatly appreciate the resources and support afforded through these collaborative activities. Teachers are able to provide their students with enrichment activities they could not otherwise arrange. Thus, partnership activities are sustained over time through respect, appreciation, positive relationships, and mutually rewarding outcomes.

Significance of Findings

This study contributes to our understanding of sustained environmental education partnerships in a Northern California region. The insights gained from this research may

be of assistance to California educational leaders working to advance policy and practices

that support environmental literacy for all K-12 students. This research provides an

understanding of the central figures and partnership characteristics necessary for

sustainability at the classroom level of the educational system. These findings would also

be valuable for environmental organizations and agencies interested in designing and

delivering outreach programs for California teachers and students.

Study Conclusions

This study found that elementary students' access to high-quality environmental

education is highly dependent upon the motivation of their classroom teacher. Individuals

with strong personal beliefs and convictions drive environmental education partnerships.

They share deep concerns for the future of our planet and the quality of life in the face of

growing environmental threats. Teachers engaged in collaborative activities with

environmental educators reach out as a means to access needed resources and support to

offer these unique activities. Engagement in environmental education partnerships allows

teachers to provide students with authentic learning experiences led by knowledgeable

and skilled environmental professionals.

Conclusion 1: Environmental education partnerships are driven by people

with strong, shared personal beliefs and convictions. All participants expressed strong

personal beliefs and convictions regarding the health and stewardship of our planet.

They viewed K-12 environmental education as a critical component necessary to foster an

environmentally literate citizenry. Their shared goals are in direct alignment with the

literature, which notes that environmental literacy is the ultimate goal of environmental

education (Roth, 1992).

Participants' shared personal beliefs and convictions serve as a uniting purpose for central figures involved in environmental education partnerships. Janice spoke to the mutual dedication of environmental education partners stating:

> Most of the teachers who work with us have a personal dedication or commitment that really pushes them forward to spend the extra time to do this. And yes, they see that it does integrate subjects, it does many things well. I think that is something that we all have in common. We want to help the planet and we want to do it physically.

Motivated by a personal calling, Jeff transitioned into teaching nearly 15 years ago as a more purposeful outlet for his environmental studies background. Relating his story Jeff commented:

> We all have to feel connected to not only the problem but also to the possibility that we can be part of the solution. … Give them the opportunity to feel like there was something they were doing in their lives to empower what can change their future. And that was really why I turned to education and with the background that I had. I wanted to do something that made a difference in the world.

Participants' collective concerns for the future and quality of life on our planet are intertwined with hopes for empowering our youth to be action-oriented, informed participants in society. Environmental literacy is viewed as a continuum from environmental knowledge to stewardship and thus defined across cognitive, affective, and behavioral domains (Hollweg et al., 2011; Roth, 1992). Environmental education partners realize that environmental literacy is acquired across a person's lifetime through a variety of formal and informal learning experiences (Bevan et al., 2010; Coyle, 2005; Hollweg et al., 2011). Participants feel a shared responsibility to nurture environmental literacy development in the students they serve. Environmental educators see their programs as an essential student experience along that continuum. Rachelle expressed this view commenting:

It's about their own personal experience and how they've grown and are a different person by the time they leave. Whether because they look at the world in a different way, ask questions, they've become curious, or because they recognize the role they play within their community. ... we are just helping move them along the spectrum to become responsible environmental local citizens.

Participants hold strong convictions regarding issues of equity and students' access to environmental education experiences. They believe that all students should have access to educational experiences connecting them to the environment, as expressed by Amy when she stated, "There are social justice issues being attended to. That everyone gets access to all of this. ... It's their right to a healthy environment." In addition, environmental educators realize that students will not acquire the fundamental knowledge and dispositions of environmental literacy through a textbook alone. Environmental literacy and student empowerment are borne out of direct interactions with nature and opportunities to have a positive impact (Hungerford & Volk, 1990; Louv, 2008; Roth, 1992). Michelle asserted this point stating, "I think it is unrealistic to ask students to be contributing members of society by the time they graduate high school if they haven't been able to really practice it."

Several subjects characterized the partnerships as relational rather than contractual. This is evidenced in participants' expressions of mutual respect and empathy. Jeff conveyed this deep connection stating:

I think of myself as a partner with [organization]. In that they are people there that I truly love and respect. They're just amazing human beings and I feel very connected to them in that way that they are my partners outside of this classroom. And they're people that have this incredible motivation to change the world in a positive way, which we share at a very deep level.

Participants bear witness to the empowering effects of authentic environmental education activities on students and stress the importance of providing these opportunities

for all children. Janice discussed the enduring impact habitat restorations can have on

some students commenting:

> We see through the years, we have students that were 5th graders coming back as 20
> year olds interns. We see for some people that day can be life changing. It has that
> possibility. Obviously, it doesn't for everyone. It's exciting to know that it has that
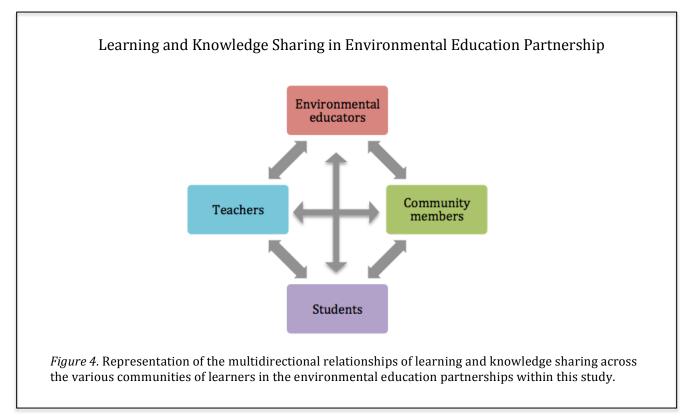> possibility for some people.

Their shared convictions and professional relationships, combined with rewarding

outcomes, create a positive incentive for central figures to maintain partnership activities.

Participants are committed to fostering an environmentally literate citizenry. They

understand that environmental literacy is developed over a person's lifetime and view

their contributions as an important link in a child's overall growth.

The shared activities and purpose-driven beliefs create deep bonds and professional

relationships. Wenger's theories of communities and landscapes of practice provide a

foundation for understanding how relationships are developed among and across

participants operating within a social community (Wenger, 1998; Wenger-Trayner et al.,

2015). According to Wenger and his colleagues, relationships emerge from the joint

activities and shared practices that create connections and histories among the individuals.

Engaging in shared, meaningful environmental education activities for students cultivates

deep personal connections and relationships among the participants.

Huxham's collective research on partnership theory focused more on leading or

managing the partnership entity (Huxham, 2000, 2003; Huxham & Vangen 2005; Vangen &

Huxham, 2003).   Many of her key findings are not applicable due to the largely voluntary

nature of teacher participation. However, a few concepts provide insights into the

environmental education partnerships and reinforce Wenger's position on shared activities

(Wenger, 1998; Wenger-Trayner et al., 2015). Huxham posits that progress toward

collective action or activities are means to avoid collaborative inertia within the partnership (Huxham, 2000, 2003; Huxham & Vangen 2005; Vangen & Huxham, 2003). The focus on shared activities and action are central in both Wenger's and Huxham's theoretical frameworks.

 Implications. Many environmental education partnerships are built upon shared personal beliefs and convictions of the individual teachers and environmental professionals. The majority of partnerships are characterized as relational rather than contractual and sustained by choice over several years to a few decades. In addition, environmental education partnership activities are more favorable in elementary settings where flexible schedules are conducive to fieldtrips and outdoor learning excursions.

 Conclusion 2: Partnerships in this region produced dynamic communities of learning and knowledge sharing. Environmental education partnership activities yield multiple communities of multidirectional learning and knowledge sharing. The subjects of this study were environmental educators and teachers involved in environmental education partnerships. Through their engagement in the partnership activities, participants cross the boundaries of their own institutions and learn from the expertise of others. Wenger-Trayner et al. (2015) apply the metaphor, landscapes of practice, to characterize an individual's expansion of professional learning, meaning, and identity across related specialties, each specialty its own community. The term knowledgeability describes the level of knowledge a person acquires across related communities within the landscape of his or her own practice. Participants engaged in K-12 environmental education partnerships expand their professional knowledgeability and expertise through cross-sector interaction and joint activities.

While the central figures in environmental education partnerships were the focus of this study, learning and knowledge sharing was identified across several communities of learners. The learning is shared across the communities through multidirectional, dynamic configurations. Although Wenger's theory of landscapes of practice is directed at professional learning and knowledge sharing, students are also learners within environmental education partnerships (Wenger-Trayner et al., 2015). As such, they are included in this discussion to illuminate the learning and knowledge sharing as a result of the partnership activities. Figure 4 displays the dynamic relationships of learning across these communities.

Learning and Knowledge Sharing in Environmental Education Partnership

Figure 4. Representation of the multidirectional relationships of learning and knowledge sharing across the various communities of learners in the environmental education partnerships within this study.

Teachers learning from environmental educators. Environmental educators possess a unique knowledge and pedagogical expertise that supports hands-on learning and inquiry around environmental topics. Integrating environmental education activities

requires an understanding of related science concepts as well as student management

skills for inquiry and outdoor activities. Environmental education professionals are highly

educated and prepared for this work. Through these partnership activities, classroom

teachers acquire knowledge specific to the environmental concepts under investigation.

Teachers are also exposed to the unique pedagogical and group management practices

modeled by environmental educators as they lead students through experiential learning

activities. Teachers expand their knowledgeability and expertise as they integrate the

practices of environmental professionals into their own pedagogical repertoire. Jennifer

acquired inquiry strategies for guiding her students in outdoor investigations that she

learned through specific workshops put on by environmental educators. Discussing her

learning journey into environmental education Jennifer commented:

> The trainings that I went to that they were giving to each other, those were huge for
> me. Particularly techniques for how to take kids outside. The inquiry piece of it, the
> exploration piece of it. And then the other important piece is the dialogue you get to
> have. Constructing explanations. What is this? Why is it? How do you think it
> functions?

Environmental educators learning from teachers*.* Conversely, environmental

educators learn aspects of K-12 education to ensure their programs are age-appropriate

and relevant to the grade level learning objectives. Environmental education professionals

also gain valuable insights into the demands of classroom teachers and the unequal

distribution of resources across schools in their region. Alex provides a series of hands-on

classroom lessons in the weeks leading up to a culminating fieldtrip. He shared what he

has learned over the years through these classroom experiences noting:

> But I can go across the board and see every single fourth grade class in [county],
> every single style, the way tables are set up, the way the posters are on the board,
> their group management style. And so you get a wash of every different style in the
> area. You can see what's successful and what schools have more resources and

what schools are more deprived in resources. … reflecting on that and so you feed that back to yourself and see that your presence in front of a classroom dictates the energy of the students themselves. So you are constantly learning by seeing all these snapshots of all these classrooms.

In both examples, participants are stretching beyond their own institutional boundaries in the acquisition of new knowledge and practices. Wenger's (1998) community of practice theory describes boundary brokering as the negotiation of new elements, practices, and meaning between individuals in a community and the outside world. Connections are established through joint enterprises and shared activities across the participants. The collective theories of brokering within communities and landscapes of practice provided a framework to examine the learning and knowledge sharing between environmental educators and teachers engaged in partnership activities (Wenger, 1998; Wenger-Trayner et al., 2015).

Teachers and environmental educators learning from students. Teachers and their environmental education partners learn from the students through these experiences. Every participant shared similar stories regarding the change in behavior for students identified as having behavior or attention issues within the traditional classroom setting. Teachers, as well as environmental educators stated that these are the students who excel in the hands-on, outdoor learning experiences. To this topic, Audrey commented:

> I've really seen, and had first hand experience with kids going into the classroom. And the kids that are sometimes behavioral issues and the problem kid in the class are the stars when they come out into the field. They're the kids that are the most curious, the most interested, and the most engaged. Which doesn't necessarily surprise me but I think that there's a lesson in that for all of us in that it isn't necessarily a problem with the child, but with the conditions in which they're learning now.

Student learning through partnership activities. Students benefit from authentic experiential learning activities led by a variety of enthusiastic, knowledgeable educators.

The impacts on student learning were not within the boundaries of this study. However, participants shared anecdotal stories of student outcomes such as taking ownership of local stewardship projects, leading sustainability campaigns, and returning to the environmental organizations as student interns. Students learn from both the environmental educators as well as their teachers as a result of partnership activities. Students also learn from community members in programs, such as Audrey's and Marie's, that utilized trained docents.

The community learning from students. Students also share their learning with the larger community in a variety of ways. Jeff's sixth grades students initiated and conducted a restoration project on their school campus, planting over 20 native plants including trees to enhance the landscape for future generations. Teachers also shared examples of students' community service projects and presentations to various audiences including the local Rotary Club, Parent-Teacher Association (PTA), and in San Francisco at a Dr. Jane Goodall's Roots and Shoots Institute. Teachers directly attributed these extended student activities to their involvement in environmental education partnerships.

Implications. Environmental education partnerships expand learning opportunities beyond the classroom providing benefits to the adults, students, community, and the environment. Such partnerships help foster greater environmental awareness and stewardship for all participants involved in the collaborative activities. These dynamic communities of learning can serve to expand the impact of environmental education partnerships beyond the classroom to the broader community.

Conclusion 3: The countywide environmental educator network is a highly effectual collaborative entity. The countywide environmental educator network is a

regional consortium dedicated to advancing environmental literacy for all citizens throughout the county. The group is comprised of educational outreach professionals from environmental organizations and agencies, land trusts, municipal resource agencies, and open to participation from local school districts. The network functions as a hybrid between a community of practice and collective action entity in service of their mission to identify and address regional environmental education needs beyond the scope of any individual organization.

The collaborative network maximizes the collective impact of the individual environmental education organizations through joint projects, community events, and sustained professional learning and growth of its members. They identify underserved areas across the county and design programs to meet those needs. Participants work together to strengthen their outreach programs through ongoing professional development, peer feedback, and sharing best practices.

The countywide environmental educator network has evolved over the past six years through effective leadership, highly purposeful meetings, and shared responsibilities. Environmental educators attribute the quality and expansion of outreach programs to their participation in the collaborative network. They also credit the leadership of the network for its success and high level of functioning.

Nearly all of the environmental educators who participated in this study are members of the collaborative network, with several serving in leadership roles. These participants expressed a strong sense of connectedness to the network and attribute much of their professional growth to their participation within the collaborative. Environmental educators share a deep personal commitment to advancing environmental literacy. The

network evolved into a highly functioning consortium through effective leadership and the shared belief that advancing environmental literacy across the county requires the collective action of its members.

Wenger's (1998) community of practice theory provides a sociocultural perspective on learning, identity, and knowledge sharing among participants within a community. He identifies the following four integrated components of social learning theory. Wenger's components of social learning theory serve as a foundation to frame the interpersonal connections across members of the community.

- Meaning - learning as experience

- Community - learning as belonging

- Practice - learning as doing

- Identity - learning as becoming

These aspects of community surfaced throughout the study during participant interviews and observation of the countywide collaborative network. Connections between Wenger's (1998) theoretical foundation and participants' expressed views are presented below.

Meaning: Learning as experience. Wenger (1998) associates meaning as a person's negotiation of relevance to everyday life and how it translates into practice. Meaning and practice are not static; rather they are continually negotiated through our experiences with the world. Participants expressed a connection to serving a mission much greater than the scope of their individual organizations. Audrey, who serves on the executive team and hosts the monthly meetings, conveyed this connection to a higher purpose stating, "The collaborative has helped me feel like I'm part of a greater team. I have an even greater purpose. I have an even greater level of accountability. So I think it

really elevates our profession to have a collaborative." The experiences of working as a

collaborative gave rise to renegotiated meaning and purpose to their collective mission of

advancing environmental literacy.

Community: Learning as belonging. Participants expressed a strong sense of

belonging within the network and personal connections to their fellow environmental

educators. The collaborative serves as a professional support network, founded upon the

strong professional relationships among its members. They view the network as their

learning community and appreciate the opportunity to connect with like-minded

professionals. Alex stated:

> The collaborative is incredible. It's one of my favorite days of the month to go to
> that meeting. You see other people, they're equally passionate and it's just, it's so
> uplifting to see that community around you that everyone's doing their part.

Wenger (1998) discusses the relationship between community and a sense of

purposeful belonging. In professional communities, this component is intricately

connected with a person's identity and sense of competence within their practice. For

environmental educators, participating in a learning community specifically established to

advance their work and grow their professional practice, fostered a shared sense of

belonging.

Practice: Learning as doing. Wenger (1998) broadly describes practice as the

ways in which humans engage in various enterprises through social interactions with

others pursuing similar aims. Practice is learning by doing as a means to sustain mutual

engagement through action. The collaborative network engages in professional learning

opportunities, countywide community events, and numerous joint projects designed to

maximize their impact across the county and strengthen their individual outreach programs.

Monthly network meetings focus on the professional growth and learning of its members. As an example, network resources are leveraged to sponsor ongoing professional development around the new science standards. It would be difficult for individual environmental educators, especially those from smaller organizations, to pursue the same level of professional learning on their own. Alex expressed his appreciation for the professional learning opportunities offered through the network stating:

> Being an isolated non-profit working on your own can be really challenging and overwhelming. And meeting with other partners and forming professional development, or getting updated curriculum, or getting techniques. It definitely helps create a foundation to support you in your work.

Blair shared similar thoughts on the value of their professional growth and learning noting, "I think it's helped all of us with the professional development component of that collaborative as well. That we're all in this to improve ourselves as educators."

Identity: Learning as becoming. Wenger (1998) defines identity within a community as a way of understanding how learning changes the individual. Participation in the community influences an individual's personal or professional identity as a result. Their identity as part of the community further strengthens their association to the shared social enterprise. Blair spoke to the idea of learning as becoming commenting, "I think we are becoming a real learning community where we are calling on each other for co-mentoring and support – big time." Later adding, "To me it's my professional community."

Environmental educators are deeply committed to the work they do in service of creating a healthier planet and informed citizenry. They view their participation in the

network as a vital means to advance their efforts while working toward a common goal.

Lynne conveyed this stating:

> I think for [network] is probably the best example. And I'm assuming that has come up. Because we are sharing. And we've moved away from working in our own spaces and seeing a common goal. The common goal being environmental literacy and an informed citizenry in [county].

Huxham's collective theories on partnerships provide alternative perspectives in which to view the countywide environmental educator network (Huxham 2000, 2003; Huxham & Vangen, 2005; Vangen & Huxham, 2003). The theory of collaborative advantage presents aspects that support the creation and sustainability of a partnership. Huxham notes that most public sector partnerships are generally founded upon a moral imperative or large social issues (Huxham, 2000, 2003; Huxham & Vangen, 2005; Vangen & Huxham, 2003). Common rationale for many public sector partnerships or community consortiums is that the issue is too complex for any one organization to tackle alone. Considering the complexities of advancing environmental literacy across a county, this rationale aligns with this aspect of Huxham's theory of collaborative advantage.

Huxham's theories on collaborative inertia provide insights into the common challenges within partnerships that lead to inaction or dissolution of the network (Huxham, 2000, 2003; Huxham & Vangen, 2005; Vangen & Huxham, 2003). Effective leadership combined with collective actions help avoid collaborative inertia. Several participants discussed the evolution of the collaborative network, crediting its turn around to Blair's leadership and collective action agenda.

The countywide environmental educator network is both a consortium and a community of practice. Both Huxham and Wenger emphasize the importance of collective action and shared activities (Huxham, 2000, 2003; Huxham & Vangen, 2005; Vangen &

Huxham, 2003; Wenger, 1998). Together these theoretical frameworks provide multiple

perspectives for analysis of the collaborative network.

Implications. Local or regional environmental educator networks can serve to

maximize the outreach efforts of individual environmental science organizations and

agencies, benefiting schools and communities. Environmental educators, especially from

smaller agencies, benefit from participation in a professional learning and support

network. A shared mission and vision that is beyond the scope of any single organization

helps to build trust among the members and reduce internal competition of programs.

Such networks require effective leadership and shared activities designed to advance their

collective mission.

Conclusion 4: Student access to environmental education is dependent upon

highly motivated teachers. Classroom teachers initiate the vast majority of the

collaborative partnerships. Teachers who reach out to environmental educators are highly

motivated to provide these experiences for their students. Their motivation is driven by

personal beliefs and convictions regarding concern for the environment and educating the

next generation of children. Science instruction has not been given high priority across the

K-12 education system. Elementary teachers who choose to focus on science and

environmental concepts do so on their own volition. Speaking as both a parent and

environmental educator, Blair asserted:

> I've been in this game so long. Guess what, we're kind of all the science that is
> happening in some of these classrooms. So it's not that much of a surprise to me
> because frankly they're not teaching science. They're not meeting the standards. To
> me they're not meeting their professional obligation. But that's the way they're set
> up in those schools. It gets pushed off.

Teachers are left up to their own devices to learn environmental concepts and locate material resources. They engage in environmental education partnerships to access needed support in the form of resources, related professional development, and interaction with like-minded professionals. Most importantly, partnering with environmental educators allows teachers to provide unique student learning experiences they could not otherwise offer. Steve established a garden club at his school and expanded his network of environmental education partners to support these efforts. Discussing this project he noted:

> There's another group I've just started with, the [town name] Garden Network. And it's more like the [organization] they provide a lot of resources and workshops, and interactions with other teachers and garden coordinators. So it's really sharing of resources and ideas.

However, students in most elementary classrooms are not provided these opportunities. Participants expressed consternation and dismay regarding the unequal access to elementary science and environmental education. To this topic, Sheila commented, "Depending on what school you're in, it's just so random what school you're in what environmental education the kids are getting."

Implications. Student access to environmental education experiences can be viewed as an equity issue. High-quality environmental education requires opportunities for experiential learning activities beyond what is available in conventional science textbooks. Environmental education partnerships offer unique opportunities for authentic student engagement, usually within the context of the local area. The decision to address environmental education and to engage in supporting partnership activities largely rests on the individual teacher. As a result, students are more likely to be exposed to

environmental education if their teacher has access to the necessary resources, the desire

to pursue these activities, and the ability to support these efforts.

Recommendations

Conclusions from this exploratory study resulted in implications for formal K-12

and informal environmental education as well as collaborations across these organizations.

The following section provides recommendations in support of cross-sector partnerships.

It also presents recommendations within the context of the individual institutions.

Recommendations for community-school partnership development. It is

imperative to raise awareness, enthusiasm, and demand for high-quality environmental

education in K-12 schools. However, most schools and teachers are not equipped to do this

alone. Local schools serve their communities in a variety of ways. In many rural areas,

public schools serve as vehicles for establishing community networks by bringing together

stakeholders in efforts to promote the education, health, and well being of students and

families. Many such coalitions focus on physical and mental health issues, cultural

awareness, college and career development, sports and recreational activities, community

fund raising, and student enrichment programs. Expanding these efforts to include

communitywide environmental literacy action campaigns could support partnerships with

local environmental organizations. Currently, the financial burden for these programs

primarily rests on the partnering environmental organizations, limiting their educational

outreach capacity. Schools and communities would realize the benefits for their students,

community members, and their local environment. In this way, communities and schools

could leverage their local resources and share equally in the responsibility to advance

environmental literacy in their students and citizens.

Recommendations for K-12 districts and schools. Districts and schools could harness the passion and enthusiasm of individual teachers who are interested in environmental education. Providing enthusiastic teachers opportunities to share their experiences and student outcomes with a broader audience may help to fuel excitement across the school or district. These teachers could also lead efforts to share best practices and help support their colleagues as they begin to build a foundation for integrating environmental education.

An alternative approach for elementary schools would be to support subject-specific specializations. For example, an elementary teacher with a passion for environmental education could teach science and environmental education across several classrooms or grade levels, while colleagues with strong interests in history or mathematics would be responsible for their respective subjects. This approach allows elementary teachers to focus on fewer subjects and gravitate to their interests or strengths.

Lastly, districts and schools committed to expanding these opportunities to all students would need to recognize that teachers require encouragement and support in their efforts. Professional development focused on student-centered learning strategies, such as inquiry and project-based learning, would help teachers build on the environmental education experiences students gained through the partnership activities. Veteran teachers devoted to providing these opportunities would not be working in isolation or small groups within their schools. This would also serve to lessen the burden on those few teachers who choose to integrate environmental education in their own instruction.

Recommendations for elementary teachers. Partnering with local and regional environmental education organizations can provide many positive benefits for teachers as well as their students. Such partnerships allow teachers opportunities to expand the learning experiences of their students, often within the context of local environmental features and resources. Teachers also increase their personal knowledge of environmental concepts and awareness of local natural resources and agencies.

Elementary students are capable of initiating and carrying out meaningful projects with the guidance of environmental educators who have access to the necessary resources. These activities offer many students, especially those who struggle in traditional classroom structures, a positive outlet and opportunities for successful learning experiences. Furthermore, providing students with opportunities to contribute to society helps prepare them to become active, engaged citizens.

Recommendations for environmental education organizations. Environmental educators require unique student engagement skills along with an understanding of the teachers and communities they serve. Participation in a local or regional collaborative allows environmental education professionals to share best practices and maximize their outreach impact. Therefore, it is recommended that environmental educators establish, or participate in, a professional learning and support network to help advance their programs and outreach efforts.

Suggestions for Further Research

Exploratory studies can serve as a catalyst for continued research focused on a particular issue or phenomenon. The following section provides suggestions for further research into environmental education and the potential of formal-informal partnerships.

These suggestions are not an exhaustive list. Rather, they present potential next steps in an effort to mitigate challenges and leverage possibilities for advancing environmental literacy for California students.

Suggestions for K-12 environmental education research. Direct implementation for standards and instruction occurs at the classroom level, but also requires school and district supports. The California K-12 educational community would benefit by further research that focuses on systemic barriers at the local implementation levels that contribute to the lack of science and environmental science education, especially in elementary classrooms. A specific systems-oriented focus on science and environmental education research at the local levels could help inform educators of the current implementation barriers and elevate its importance across the district, its schools, and classrooms. These findings would be extremely insightful given the State's focus on fostering environmental literacy in all students (see Chapter 1).

Research suggestions for teacher perceptions of environmental education. This study found that most environmental education partnerships are teacher-driven. These informal collaborations are sustained through the positive relationships, shared passions, and the teachers' desire for resources. However, K-12 participants in this study were limited to teachers who have been engaged in ongoing environmental education partnerships. The K-12 educational community would benefit from investigating perceptions and attitudes of teachers who have not participated in such partnerships, especially elementary teachers. Further research into teachers' perceptions, attitudes, and identities as teachers of science and environmental education could provide valuable

insights into needed supports for those who may be reluctant or intimidated by the subject matter.

Research suggestions for formal-informal environmental education partnerships. Research into the nature of local formal-informal environmental education partnerships could provide valuable insights into the essential characteristics that support ongoing, sustainable collaborations. In addition, informal science organizations would benefit from further research into student outcomes and the development of evaluation tools appropriate for unique outreach contexts. These findings could, in turn, encourage broader recognition of their value across the formal K-12 education community.

This research would be especially helpful for rural areas that lack proximity to science-rich institutions. Many rural areas are situated in environmentally diverse locations with associated environmental resource agencies. Understanding best practices for initiating, developing, and sustaining environmental education partnerships could help advance environmental literacy efforts regardless of the school's location.

Limitations and Internal Study Validity

The sample population of this study involved individuals in sustained environmental education partnerships located within a rural Northern California region. Elementary teachers who participated in the interviews and observation have been engaged in longstanding environmental education partnerships. The environmental education professionals in this study operate in environmental resource and science organizations with well-established educational outreach programs. All findings in this study are limited to this context and not generalizable to other populations or regions.

Rigorous methods were applied throughout this research to ensure internal study validity. Interview protocols underwent a peer review and feedback process to ensure validity of interview procedures and questions. A pilot interview was also conducted to further refine the interview protocols. As a reflexive practice, the researcher maintained a journal for ongoing reflection and consideration of personal bias. In addition, research data underwent a rigorous, iterative analysis process through peer review and feedback of the thematic categories and associated codes. A thorough thematic analysis was applied to the data from interviews, observation notes, and relevant artifacts.

Closing Comments

California state leaders in government and the public education system have demonstrated a strong commitment to science and environmental education through the adoption of related standards, policy, and publications (see Chapter 1). State level frameworks and supports are critical for advancing environmental literacy for all California students. Statewide assessment of science instruction aligned to the NGSS will be fully operational in spring 2019, testing students in grades 5, 8, and once in high school. As of the completion of this study, it has not been announced when the new science assessment results will be integrated into the accountability metrics for California schools and how science will be weighted with ELA and mathematics within the academic measurements. However, the impact of these events has yet to result in significant changes in instruction at the classroom level across all California public schools, especially for elementary students. There remains a distressing lack of science and environmental science education in many elementary classrooms throughout California.

The simple response is to cast a critical eye upon the teachers. However, a broader view of this phenomenon supports the popular idea that every system is perfectly designed for the results it gets. Throughout this study, participants eluded to many aspects of the K-12 public education system that present challenges and barriers to high-quality environmental education in elementary and secondary classrooms. These challenges include the pressing demands of teachers, their lack of resources, supports, and time, scheduling at the secondary level, as well as the reality of what constitutes high-quality environmental education. Thus, effective environmental education outreach programs have evolved to be accessible to teachers given these inherent constraints.

Innovation theory presents a systems and sociocultural perspective of this issue (Rogers, 2003). Aspects of innovation theory provide a lens to consider the actionable response needed to fulfill the vision of fostering an environmentally literate citizenry. Adoption of new science standards and accompanying California focus on environmental principles and concepts are no guarantee of effective implementation at the school and classroom levels. Rogers (2003) posits that diffusion of innovations is complex, yet highly dependent on the innovation's compatibility within the sociocultural context of the individuals involved at the implementation level. In other words, the capacity of classroom teachers to integrate environmental education will largely determine its impact.

The challenge is having this message heard above the cacophony of competing initiatives and the renewed focus on academic accountability metrics that, at the time of this study, do not include science. In the 2018 Intergovernmental Panel on Climate Change (IPCC) Special Report, global climate scientists state that serious reductions in greenhouse gas emissions need to occur by 2030 to prevent the precarious 1.5°C threshold increase in

global temperatures. The high school graduating class of 2030 are now in first grade.

Currently, it is a matter of chance whether these students will be exposed to high-quality

environmental education.

There are many passionate individuals and organizations dedicated to elevating the

status of science and environmental education throughout the State. Yet, it is unreasonable

to assume the California K-12 public education system has the capacity and flexibility to

rise to the demands of integrating high-quality environmental education alone.   Partnering

with local and regional environmental science professionals provides needed resources

and supports for implementation at the district, school or classroom levels. Given the

critical urgency and importance of fostering an environmentally literate citizenry, such

partnerships hold the potential for the most immediate and effective response.

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APPENDIX A

IRB Notice of Approval

PEPPERDINE

NOTICE OF APPROVAL FOR HUMAN RESEARCH

Date: September 14, 2018

Protocol Investigator Name: Theresa House

Protocol #: 16-10-409

Project Title: The Role of Boundary Brokers in K-12 Environmental Education Partnerships: An Exploratory Study

School: Graduate School of Education and Psychology

Dear Theresa House:

Thank you for submitting your application for exempt review to Pepperdine University's Institutional Review Board (IRB). We appreciate the work you have done on your proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. Upon review, the IRB has determined that the above entitled project meets the requirements for exemption under the federal regulations 45 CFR 46.101 that govern the protections of human subjects.

Your research must be conducted according to the proposal that was submitted to the IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an amendment to the IRB. Since your study falls under exemption, there is no requirement for continuing IRB review of your project. Please be aware that changes to your protocol may prevent the research from qualifying for exemption from 45 CFR 46.101 and require submission of a new IRB application or other materials to the IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite the best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the IRB as soon as possible. We will ask for a complete written explanation of the event and your written response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the IRB and documenting the adverse event can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* at community.pepperdine.edu/irb.

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval. Should you have additional questions or require clarification of the contents of this letter, please contact the IRB Office. On behalf of the IRB, I wish you success in this scholarly pursuit.

Sincerely,

Judy Ho, Ph.D., IRB Chair

APPENDIX B

Interview Protocols for Environmental Educators

Individual's background

How, why, and when did you become involved in environmental education?

What roles have you played in that area or field?

Collaborative partnerships with K-12 schools

In your role, whom do you work most directly with in the formal education system – administrators, teachers, students, etc.?

How would you characterize or describe your collaboration/partnership(s) with schools?

How did you learn to bridge the worlds of formal and informal environmental education?

What skills and tasks are required to balance these worlds?

What are the most essential elements of your collaboration/partnerships?

Coordination and program design

How are collaborative activities planned, carried out, and refined?

How do you think the K-12 and EE providers involved in the collaboration/partnership think similarly about the work? How do you think they think differently about the work?

What are your greatest challenges?

What strategies have helped overcome them?

Learning

What have you learned from the K-12 world as a result of your participation in the collaboration/partnerships?

What have you learned about managing collaborative activities through this experience?

Has anything surprised you in this learning experience?

What do you K-12 educators have learned from you?

Outcomes

What would you consider are the greatest accomplishments of this work?

What did it take to make this happen?

What does your organization do particularly well?

What are the 'next steps' for your educational programming?

Sage advice

What advice would you have for other environmental organizations interested in providing educational programming with K-12 schools?

What do you think the field of K-12 education should know about programs such as yours?

Vision

What is your highest vision for K-12 environmental education partnerships?

Conclusion

Is there anything else you would like say regarding partnership activities with K-12 educators?

APPENDIX C

Interview Protocols for Classroom Teachers

Background Information

How, why, and when did you begin partnering with a local environmental education program?

Collaborative Activities and Communication

How would you characterize the collaborations/partnerships between your school and the local environmental education program?

Can you tell me about the process, structure, and timeline for the environmental education program activities?

What are the most important factors you considering when partnering with an environmental educator or agency?

What are your expectations of the environmental education providers/programs you collaborate with?

To what degree to you prefer to collaboration on designing the lessons and activities?

Approximately how much time to you spend on communication between yourself and the environmental education provider?

Learning

From a K-12 perspective, could you share your thoughts on the learning experiences this program provides to students?

How has this collaboration enhanced your learning?

Has anything surprised you in this learning experience?

What do you think environmental educators have learned from these experiences?

Budget/challenges

Do you have an annual classroom or school budget for environmental education activities?

What are the greatest challenges you experience when partnering with an environmental educator or agency?

Outcomes

What would you consider are the greatest accomplishments of this work?

What did it take to make this happen?

Sage Advice

What advice would you give to environmental educators who want to create K-12 outreach programs?

What would you like to say to other K-12 teachers or administrators about partnering with an environmental educator, agency, or program?

When you think about the dynamic experiences and complexities of environmental education, do you think K-12 education can do this alone?

Vision

What is your highest vision for K-12 environmental education partnerships?

Conclusion

Is there anything else you would like say regarding partnership activities with environmental educators?