Spring 2022

Incorporating Interactive Outdoor Learning Into Everyday Curricula

Haley Doty

INCORPORATING INTERACTIVE OUTDOOR LEARNING INTO EVERYDAY CURRICULA

by

Haley J. Doty

A capstone submitted in partial fulfillment of the requirements for the degree of Master of Arts in Education: Natural Science and Environmental Education

Hamline University

Saint Paul, Minnesota

December 2021

Primary Advisor: Laura Halldin

Content Expert: Missy Stubblefield

DEDICATION

To my grandmother who sparked my love for the outdoors, to my Mom and Dad for supporting my career decisions and showing me that anything is possible, and to Colbey for his continuous support.

TABLE OF CONTENTS

CHAPTER ONE

Research Question and Development of the Capstone Project

Introduction

Whether it be at an aquarium, a historic battleground, a museum, or a park, field trips are popular tools employed by educators to provide students with unique learning experiences. Referred to as informal science learning institutions (ISL institutions), these locations provide students with the opportunity to expand their scientific knowledge, practice various field science techniques and create "one-of-a-kind" experiences while developing a relationship with the resource. As an environmental educator, my mission is to foster real-world connections between my students and the environment they learn about in class. Through the use of place-based education, I am better able to form these connections.

Place-based education is defined as "learning that is rooted in what is local – the unique history, environment, culture, economy, literature, and art of a particular place" (Smith, G., & Sobel, D. 2010, p.23). This style of education relies on interactive experiences to engage students, foster a deeper connection with their local community, and inspire positive change. The goal of this capstone project is to better understand *how educational materials can be used to integrate interactive, outdoor experiences into everyday classroom curricula?* Creating these educational materials will help ensure that a student's spark of curiosity does not simply become a "flash in the pan" but instead grows into a steady flame.

Personal Background

My experiences with and within the great outdoors have evolved as I have aged. While my parents were always very supportive of my interests, they themselves were not what we would consider to be "outdoorsy" people. Instead, some of my earliest memories in nature were formed with my grandma. Every summer I would visit my grandma in the small, rural town of Cassville, Missouri. The new sights and sounds of the country amazed this city kid who spent the rest of her year living in the suburbs of Chicago. Although initially a little terrifying, the deafening sound of cicadas, the endless starry skies, and old hardwood forests became familiar to me. One of my favorite outdoor places to visit as a child was Roaring River State Park. It was here that I had my first ever camping trip, spent countless days playing in the icy creek, hiked my first trail and spent hours eagle watching.

Back in the suburbs of Chicago, my exposure to nature was significantly diminished. This lack of access to the outdoors meant that I was extra excited for school field trips and outdoor experiences that transported me back into nature. I have always loved learning about animals and spending time in the outdoors but as someone who both struggled and continues to struggle with math, I had not really given a career in the sciences much thought. Thankfully, the field trips that I attended throughout my k-12 school years helped make scientific principles more palatable, engaged me as a physical learner and inspired me to receive my undergraduate degree in the sciences.

Entering college, I was able to continue on my "hands-on" learning through an abundance of labs and field training as a Conservation Biology major at North Carolina

State University. If I was not in a forest determining a tree's diameter at breast height (DBH), I was in a lab studying different mammalian specimens, or learning how to mist net songbirds. While other individuals in my major sought careers as Game Wardens, or Wildlife Biologists, I always knew that I wanted to become an environmental educator.

While in college I had the opportunity to dip my toe into the field of environmental education while participating in two unique experiences. The first was a university internship where I worked with fellow interns to create educational materials for children living in Bhutan and Assam. The goal of these materials was to educate the children about their local flora and fauna with the hopes of reducing human-elephant conflict in the area. My second experience with environmental education occurred during a summer study abroad on Andros Island in the Bahamas. The goal of this study abroad opportunity was to research the effectiveness of the local school's environmental education program. Through analyzing the data received from surveys, we were able to identify trends such as gender preference for animals, knowledge of endemic species, and more amongst the children. These experiences reinforced my desire to become an environmental educator following graduation. By doing so, I hoped to ignite the same spark for nature and the outdoors in others that was sparked in me.

Professional Background

Following my graduation from North Carolina State University in 2016, my career has run the gamut of environmental education. My first job was with SCA New Hampshire AmeriCorps where I served as an Interpretive Ranger for nine months. During the first half of my service, I brought environmental education to local schools by acting

as a primary source of science education. I developed and taught environmental education programs to children in 3rd and 4th grade classrooms. My lesson plans, although fun, informative, and meeting required state educational standards, were completely independent from the teacher's other curriculum. During the second half of my service, I brought students to the resource. The students that I had been educating in a formal, in-school setting, came to my park for informal, environmental education in the form of a field trip. I was overjoyed to see my students get out of their comfort zone and learn about their environment through interactive activities such as ponding for macroinvertebrates and hiking trails.

Following my term with AmeriCorps, I became a Wildlife Naturalist at Osprey Wilds, a residential environmental learning center in Minnesota. In this position I provided environmental education programming to students, kindergarten thru college. Working at a residential environmental learning center afforded me with the opportunity to incorporate place-based principles while teaching students in the outdoors and providing them with unique experiences.

After my term at Osprey Wilds, I headed south to become a Park Interpreter for the Arkansas State Park system. For two years I provided interpretive programming for visitors, and school groups. As an environmental educator who has taught in a variety of settings, I know that field trips and other experiences in nature are memorable and often act as a source of inspiration for later learning. While I always noticed students having fun and learning in the moment, I was often left wondering how this experience

ultimately impacted the student and how it was later incorporated into the classroom curricula, if at all. As it turns out, I wouldn't have to wait long for my answer.

In my current position as a high school science teacher, I have finally gotten to see behind the curtain. I currently teach physical and environmental science to high school students at Spring Hill High School in Hope, Arkansas. In this new position, I am excited to have established relationships with students that last longer than just a few hours. My unique vantage point as a previous informal environmental educator and current formal educator inspired this project's research question of *how educational materials can be used to integrate interactive, outdoor experiences into everyday classroom curricula?*

Project Context and Rationale

This capstone project seeks to answer *how educational materials can be used to integrate interactive, outdoor experiences into everyday classroom curricula?* As my research question suggests, the objective of this project is to create educational materials that can be used to incorporate a student's experience at informal science learning institutions and the outdoors into everyday school curricula. While I want field trips and outdoor experiences to stand out for students, I do not want them to stand alone. Information learned during these experiences should be referenced and expounded upon in the classroom to derive more connections between the environment and other aspects of the student's education.

While ISL institutions serve as a popular destination for school field trips, there is often a lack of educational materials available for educators or students that align with classroom standards. For this capstone project I will be creating educational materials specific to my environmental science classes at Spring Hill High School. These materials will be used to connect the concepts and information learned within the classroom to interactive outdoor experiences. The goals of these materials include: adequate preparation of educators and students, the creation of engaging activities and relevance to school curriculum.

Field trips can be exciting or scary depending on the individual student attending. A student who has not spent a lot of time outside might feel less comfortable doing so for the first time. Providing educators with materials that help them prepare for their visit not only benefits them but also their students. They can make students feel more secure while also serving as an introduction to the concepts that will be covered at the ISL institution. The purpose of the educational materials used at ISL institutions will be to draw focus and encourage knowledge retention. Field trips should be fun and exciting while also being educational. Though students who are kinesthetic or visual learners may thrive during a field trip, other types of learners including auditory, reading, and writing might struggle. This project's educational materials will better help students of all learning styles stay on track and retain information in a location that is foreign to them. Finally, the conclusionary materials, meant to be used in the classroom, will help bridge the new concepts learned at the ISL institution with the educator's curriculum.

Summary

As a student who personally thrived during field trips and outdoor activities, I am a firm believer that these forms of interactive learning can leave a lasting impression. Field trips at ISL institutions provide students with interactive educational experiences, a connection with their environment, and positive memories. The place-based education approach taken by ISL staff encourages students to form a personal connection with their surroundings resulting in a more vested interest. The goal of this research project is to determine *how educational materials can be used to integrate interactive, outdoor experiences into everyday classroom curricula?* The development of these materials would: better prepare students and educators, provide students with activities relating to what they have learned in class, and transfer the newfound knowledge obtained in the field into the classroom where it can continue to be utilized.

Additional information regarding the specifics of this project will be expounded upon in the following chapters. In Chapter Two, a thorough literature review will cover several topics relating to the research question. These topics include an overview of place-based education coupled with its benefits for those who experience it, the effect that field trips play on a student's education, the different learning styles, and how we can encourage knowledge retention in students.

Information regarding the design and layout of the educational materials used by local school groups will be discussed in Chapter Three along with a timeline for the project's completion. Chapter Four will discuss the author's conclusions regarding the

creation of the educational materials including what could be improved as well as what adaptations could be made for future materials created for different groups.

CHAPTER TWO

Literature Review

Introduction

The increasing prevalence of technology in classrooms, a lack of funding and an increase in parental concern regarding child safety has resulted in the decline of experiential learning outdoors (Anderson, 2017). Often occurring in the form of field trips, experiential learning provides students with unique benefits that cannot be obtained within a traditional classroom setting. These benefits can be classified into short-term and long-term categories. Short-term benefits include an increase in academic performance and positive attitudes towards the sciences while the long-term benefits include improved socialization skills, commitments to community, and a lifetime of learning (Akbas & Cakmak, 2019; Barton, 2017; Bozdogan, 2015).

The literature reviewed within this chapter provides a thorough analysis of the information necessary to answer the research question: how *can educational materials be used to integrate interactive, outdoor experiences into everyday classroom curricula?* This research supports the creation of educational materials to be used before, during and after field trips to ISL institutions. These materials will work to effectively incorporate student's interactive learning experiences within their curriculum and traditional classroom setting. The literature reviewed in this chapter examines the role of field trips in schools, the effects of place-based education, a review of different learning styles and their relation to knowledge retention as well as guidance regarding effective curriculum

development. By having a better understanding of how field trips and place-based education can be used effectively, educators are better able to advocate for their students. The review of different learning styles coupled with effective curriculum creation helps better ensure that the knowledge obtained from these interactive experiences is incorporated back into the classroom.

Field Trips

The term "field trip" refers to a diverse set of experiences that occur when learning happens outside of a traditional classroom setting. For many students, field trips act as their initial exposure to informal science learning (Mujtaba, Lawrence, Oliver, & Reiss, 2018). Defined by Mujtaba et al. (2018), informal science learning (ISL) refers to learning activities that occur outside the school setting and are not specifically developed for school use. Those locations run by educators whose mission is to educate the public about science, such as state parks, natural history museums, and aquariums, are all considered to be examples of ISL institutions (Mutjaba et al., 2018). Unfortunately, a lack of funding, increased questioning regarding the academic effectiveness of field trips, and instructor confusion has resulted in the decline of field trips to such facilities (Barton, 2017; Bozdogan, 2015; Smith-Walters et al., 2014). This research works to inform educators of common field trip "pitfalls" while providing the associated solutions to ensure that students receive quality educational experiences. Educators who are informed and equipped to handle these complications are better able to execute field trips that have a positive and lasting impact on their students (Barton, 2017; Bozdogan, 2015; Mutjaba et al., 2018).

Field trips provide students with formative educational experiences. While these experiences can be memorable, the associated positive impacts are only achievable if they are executed correctly. Although formal educators are tasked with providing their students with interactive learning experiences, they often do not receive appropriate training on how to coordinate and execute field trips with ISL institutions (Smith-Walters et al. 2014). This lack of training can result in miscommunication, poor planning, and an overall decrease in a field trip's educational potential (Bozdogan, 2015; Mujtaba et al. 2018). To ensure a positive field trip experience, educators must avoid the pitfalls of a lack in communication, planning, and effective post-field trip assessment (Barton, 2017; Bozdogan, 2015; Mutjaba et al., 2018; Smith-Walters et al., 2014).

As with most things in life, communication is key. Most issues regarding field trips could easily be avoided if effective communication occurs between educators. When coordinating a field trip with an ISL institution, it is critical that teachers define their expectations for the experience (Mutjaba et al., 2018). Educators who work at ISL institutions frequently work with school groups and often offer programming that meets state education standards. Additionally, most of these informal educators are often willing to design and tailor programming to accommodate classroom needs. These accommodations can range from: ADA accessible activities, the review of materials previously covered in class, to the development of new skills and much more (Mutjaba et al., 2018). It is simply the educator’s job to communicate these needs and expectations to the institution’s educational staff. By doing so, miscommunication regarding the field trip experience can be avoided and the goals of educators can be met.

Although they often do not occur in a classroom setting, field trips should be considered an extension of the classroom itself (Smith-Walters et al., 2014). When planning a field trip, educators should apply the same care and thought used when crafting a new lesson plan. Proper field trip preparation requires educators to identify potential issues that might occur while concurrently preparing solutions for these issues. Communication with the ISL institution responsible for hosting the field trip can be immensely beneficial to educators. These institutions' educational staff can provide answers to logistical questions such as where and when lunch will occur, where buses can park, the location of bathrooms and a comprehensive schedule of the day's activities (Smith-Walters et al., 2014). Educators desiring additional information about the facility can also request a walk thru. These walkthroughs allow educators to explore the site, identify potential barriers, and devise ways to accommodate their students at the site (Smith-Walters et al., 2014). For example, an educator who has a student in a wheelchair can ensure this student receives their ideal field trip experience by walking the site, identifying potential obstacles, and preparing the appropriate adjustments. Once their basic needs are met, students are better able to focus on learning and have an overall more positive experience (Smith-Walters et al., 2014).

Post field trip assessments provide educators with crucial information regarding the success of a field trip. These assessments validate the time and resources used on a field trip through the documentation of student progress and the identification of future areas of improvement (Smith-Walters et al., 2014). While testing the academic effectiveness of field trips can be difficult, it is possible. Since most evaluation tools are

created for and used by formal educators, testing the effectiveness of an informal field trip requires a unique tool of its own (Mujtaba et al. 2018). To test the effectiveness of ISL experiences, the National Research Council created a framework for k-8 science learning. This framework identified six strands that capture the ISL experience (Mutjaba et al., 2018).

These six strands are as follows:

Strand 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world (this strand is of particular relevance to informal environmentalists).

Strand 2: Come to generate, understand, remember and use concepts, explanations, arguments, models, and facts related to science,

Strand 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.

Strand 4: Reflect on science as a way of knowing; on processes, concepts and institutions of science; and on their own process of learning about phenomena.

Strand 5: Participate in scientific activities and learning practices with others, using scientific language and tools.

Strand 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science (this strand is of particular relevance to informal environments). (Bell et al., 2009, p.4)

By using these strands to evaluate informal learning experiences instead of the traditional formal assessment tools, educators are better equipped to test the effectiveness of class field trips.

Field trips provide students with the opportunity to bridge academic theory with practice (Bozdogan, 2015). Away from the traditional classroom, students who participate in field trips reap significant benefits both personally, and academically (Barton, 2017; Bozdogan, 2015; Mujtaba et al. 2018). ISL institutions inspire "affective learning" within students. Defined as being "the changes in visitor's attitudes and the emotions that are created by the learning at ISL institutions" (Mujtaba et al. 2018, p.48), affective learning nurtures positive attitudes towards the sciences. These positive attitudes have even gone so far as to inspire future careers in the sciences. While interviewing museum professionals, Spock (2000) found that childhood museum learning experiences were cited as being a source of inspiration to pursue a career in the science field. The active nature of field trips has been shown to improve social skills while increasing motivation and awareness (Mujtaba et al. 2018). Although teachers and parents support the development and improvement of these skills, academic improvement continues to be a major driving factor. Research has proven that field trips do have positive effects on a students' academics. Students who participate in field trips to ISL institutions have shown a positive increase in school science performance as well as increased thinking skills (Bozdogan, 2015; Mutjaba et al., 2018). These benefits not only make a strong case for the incorporation of field trips into class curricula, but they also encourage the implementation of place-based education.

Place-Based Education

Place-based education is a form of experiential learning present within outdoor activities and field trips (Anderson, 2017). Frequently incorporated into ISL institutions, David Sobel defines place-based education as being:

> the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum. Emphasizing hands-on, real-world learning experiences, this approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens. (Sobel, 2004, p.7)

The experiential and unique nature of place-based education, described by Sobel, makes it ideal for solving interdisciplinary issues (Smith & Sobel, 2010). Composed of four parts, the learning process of place-based education occurs in local culture/the environment, focuses on local themes, content, and systems, relates to students, and gives power of change to the community (Akbas & Çakmak, 2019). Positive impacts of place-based education include a boost in student confidence, increased collaboration between classmates and community members, improved problem-solving abilities, and the emergence of new interests (Akbas & Çakmak, 2019; Anderson, 2017).

When it comes to place-based education, "place" is key. Although place can vary based on individual perspectives, this term typically refers to a location within the local

community (Eijck & Roth, 2010). This could include a state park, a school garden, a local river or even a neighborhood. Field trips to locations offering place-based educational programming work to take education out of the schools and move it into the community (Smith & Sobel, 2010). This communal aspect of place-based education makes information more palatable and results in the formation of long-lasting community relationships (Akbas & Çakmak, 2019; Smith & Sobel, 2010)

One of the major benefits of place-based education is that it reduces the occurrence of eco-phobia within students. Eco-phobia describes the general anxiety and hopelessness experienced by individuals when discussing large, abstract environmental concepts (Akbas & Çakmak, 2019). Serious subjects such as global warming, massive deforestation and animal extinctions are broken into more manageable chunks within place-based educational programming (Eijck & Roth, 2010). While some argue that place-based education encourages too much focus on local issues, in all actuality, the same problem-solving skills used to solve local problems can be utilized on a global level (Eijck & Roth, 2010). Working to solve issues within their community not only gives students a sense of ownership, it also cultivates relationships with other members of the community (Akbas & Çakmak, 2019). This improved sense of community is just one of the many positive impacts that place-based education has on students.

The students who experience place-based education are shown to benefit academically and interpersonally (Akbas & Çakmak, 2019; Anderson, 2017). The problem-solving nature of this experiential learning style ensures that students engaged in place-based education are better equipped to identify, analyze, and solve problems. When

solving these issues, students collaborate with their fellow classmates and community members resulting in an improvement in communication skills (Akbas & Çakmak, 2019; Anderson, 2017). The ability to solve local issues provides students with an increased locus of control and most importantly confidence (Akbas & Çakmak, 2019). While environmental knowledge is an important factor of pro-environmental behavior, knowledge alone will not cause change. An increased locus of control established by a student's ability to solve problems provides them with the confidence necessary to attempt other problems and make significant change (Akbas & Çakmak, 2019).

Learning Styles and Knowledge Retention

The experiential learning undergone by students on field trips and place-based education provides students with valuable new skills. Students who may traditionally struggle with concentrating and learning in a traditional classroom setting are able to flourish within these experiential learning environments. The term "learning style" refers to how an individual prefers to perceive and process information (Tanner & Allen, 2004). Despite popular belief, learning styles are not static, they can change over time. Learning styles have been studied by cognitive psychologists and there are several theories regarding how people learn. By better understanding how students learn, educators are better able to tailor their teaching styles to the needs of their students. The three frameworks examined within this section include the theory of multiple intelligences, Dimensions of Learning Styles in Science, and Visual Aural Kinesthetic (VAK).

In 1983, cognitive psychologist Howard Gardner published *Frames of Mind* where he established his theory of multiple intelligences. An individual's intellectual

competence encompasses their ability to identify, resolve and create problems. When discussed in society, the term "intelligence" most often refers to general intelligence. This form of intelligence is measured by formal IQ tests and is often used as an indicator for future success. The higher the IQ score, the higher the level of intellectual competence. Gardner established the theory of multiple intelligences in response to his belief that there is not one definition of human intelligence (Gardner, 2011; Tanner & Allen, 2004). By taking spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal intelligences into account, the cognitive capabilities of humans are portrayed more accurately (Gardner, 2011). Gardner analyzed these cognitive capabilities and defined eight intelligences. These defined intelligences are as follows:

Figure 1

Gardner's Eight Intelligences

Table 1. Howard Gardner's (1983) Multiple Intelligences Theory

The Eight Intelligences	
Intelligence	is characterized by facility with . . .
Linguistic-verbal	Words, language, reading, and writing
Logical-mathematical	Mathematics, calculations, and quantification
Visual-spatial	Three dimensions, imagery, and graphic information
Bodily-kinesthetic	Manipulation of objects, physical interaction with materials
Musical-rhythmic	Rhythm, pitch, melody, and tone
Interpersonal	Understanding of others, ability to work effectively in groups
Intrapersonal	Metacognitive ability to understand oneself, self-awareness
Naturalistic	Observation of patterns, identification, and classification

Note. Figure obtained from Tanner & Allen, 2004 (pg. 198)

When defining these new intelligences, Gardner measured them against a series of requirements. These requirements included the presence of brain localization, the presence of savants in the subject area and an evolutionary history supporting its development (Tanner & Allen, 2004). While each intelligence did not have to meet all of Gardner's requirements, they did have to meet some of them. (Gardner, 2011). Gardner advised that educators incorporating the theory of multiple intelligences into their teaching should individualize and pluralize. When individualizing, educators should attempt to teach in a way that best suits their student's identified intelligence profiles. When pluralizing, Gardner advises educators to determine important concepts and then present them in a variety of ways. This method not only reaches more students, it also better guarantees a thorough understanding of the concepts introduced by encouraging students to think about a concept in many ways (Gardner, 2011).

Established by Richard Felder and Linda Silverman, The Dimensions of Learning Style in Science is a framework designed to identify the disconnect between learning styles and the traditional teaching styles used in science classes. Felder and Silverman proposed four dimensions that best classified how students preferred to receive information. These dimensions include the type of information they receive, the modality that they receive it in, the process that they receive it, and the order that they receive it (Tanner & Allen, 2004).

As students, children consistently receive large amounts of new information daily. Felder and Silverman's Dimension One categorizes students as sensory or intuitive learners depending on how they prefer to receive information. Sensory students prefer to

receive facts, excel at memorization, and desire clear expectations and routine while learning. Intuitive students prefer to receive concepts, identify relationships between ideas, and solve problems using varied methods.

Felder and Silverman address the sensory modality in which students learn within dimension two of their framework. Students who prefer learning from demonstrations, and other visual stimuli including pictures, diagrams, and graphs are defined as visual learners. These learners suffer from the lecture heavy education often found within most classrooms. By incorporating visual stimuli into their lessons, educators can better reach their visual learning students. Those students who are not visual learners are defined as verbal learners. Verbal learners prefer to learn new information through writing, discussions with fellow learners and explaining concepts to others.

Dimension three divides students between active and reflective learners. As their name suggests, active learners do best when they are actively engaged. In a classroom active engagement includes group work, discussions, and investigations. On the opposite end of the spectrum are the reflective learners. These students learn best when they can work alone and have the ability to reflect on their newfound knowledge (Tanner & Allen, 2004).

Felder and Silverman's fourth and final dimension categorizes students based on how they build new knowledge. Sequential learners prefer to receive information in a linear fashion whereas global learners prefer to receive information in the form of large concepts. Educators who teach in a linear fashion present students with a series of small concepts that build upon each other climaxing in newfound knowledge. Global learners'

preference for large concepts puts them in direct opposition to their sequential counterparts. Starting with a large concept, global learners prefer to work backwards or "zoom in" to obtain new knowledge. Since most educators teach in a linear fashion, it is crucial that they take steps to accommodate their global learners.

Felder and Silverman's Dimensions of Learning in Science framework breaks down a student's preferred mode of learning into four dimensions. These dimensions include: the type of information they receive, the sensorial mode that they receive it best, the process by which they receive it, and the order that they receive it. Although each dimension only divides learners into two categories, it is normal for students to share qualities of each. Felder and Silverman encourage educators to teach in a manner that meets each of these learners where they excel the best (Tanner & Allen, 2004).

When discussing learning styles, it is not uncommon to hear students use phrases such as "I am a physical learner". Developed by Dunn & Dunn, the VAK framework divides learning styles into sensorial categories (Nugraha, Putri, & Sholihin, 2020; Tanner & Allen, 2004). Originally only including visual, auditory, and kinesthetic senses, this framework has been expanded to include reading and writing as well (Tanner & Allen, 2004). The VAK framework is the preferred learning framework within the educational community due to its broad perspective of student thinking, learning style and strengths (Nugraha et al., 2020). The preferred method for information processing for each category is as follows:

- Visual Learners: process information by analyzing images such as drawings and pictures. Students who identify as visual learners tend to

write what they have learned and have an easier time remembering shapes, colors, and faces (Nugraha et al., 2020).

- Auditory Learners: process information by listening to lectures and discussions. Students who identify as auditory learners speak what they learn and remember names better than faces (Nugraha et al., 2020).
- Reading/Writing Learners: process information by interacting with text curriculum.
- Kinesthetic Learners: process information through physical touch and movement. Students who identify as kinesthetic learners learn best when performing physical activities and engaging in movement (Nugraha et al., 2020).

In a typical classroom setting, only three of these categories are achievable: visual, auditory, and reading/writing. While early education often highlights the use of kinesthetic learning through the use of models and tools, this focus on physical learning declines as students age. This is unfortunate considering that research studies have found that the dominant learning style utilized by students is kinesthetic (Chetty, Handayani, Sahabudin, Ali, Hamzah, Rahman, & Kasim, 2019). Field trips at ISL institutions provide kinesthetic learners with the opportunity to thrive through the development of new skills and field work (Tanner & Allen, 2004).

Every student has a learning style that is unique as they are. Cognitive psychologists have established multiple frameworks in an attempt to understand and categorize how students learn. Howard Gardner's theory of multiple intelligences relies

on eight defined intelligences to organize learners while Felder and Silverman's Dimensions of Learning in Sciences organizes learners based on their preferences when intaking new knowledge (Tanner & Allen, 2004). The most commonly used learning framework, the VAK framework, divides learners based on their sensorial preferences. No matter which framework educators choose to use, experts suggest that they teach in a way that best meets the needs of their students. Although it is impossible to meet every need, by diversifying their teaching style, educators are able to reach more students and positively impact their student's learning and knowledge retention (Chetty et al., 2019; Tanner & Allen, 2004).

Effective Curriculum Development

Familiar to all educators, curriculum is instrumental in educating students. Defined by Giddens (1984), effective curriculum is concerned with attempts to rework conceptions of human beings and human doing, their social reproduction and social transformation. Due to the diverse nature of student learning styles, it is crucial that educators provide students with curricula featuring an array of academic experiences (Payne, 2006). The increased focus on sustainable development has impacted educational policy at the state, national and international level. The heightened prevalence of environmental education in the classroom has resulted in the need for a curriculum that improves environmental literacy while also meeting school standards (Payne, 2006).

The goal of environmental education is to produce students that are environmentally literate. The term "environmental literacy" describes an individual's knowledge and attitude towards the environment, their skills and motivations for problem

solving and an active participation in solving environmental issues (Chu, Lee, Ryung, Hee Shin, Nam Lee, Mee Min, & Hee Kang, 2007). The incorporation of environmental education into school curricula not only increases student environmental literacy, it also raises environmental consciousness and works to decrease environmental issues (Artun & Özsevgec, 2018). When designing an environmental education curriculum, educators are encouraged to educate *for* the environment. Education *for* the environment is characterized by a socially critical focus, challenges to dominant ideologies, and the promotion of personal and structural transformation (Cotton, 2006). Educators who educate *for* the environment instead of simply educating about the environment are able to inspire emotional change and action within their students. Although knowledge about the environment is important, knowledge alone is not enough to enact change (Cotton, 2006).

Inspired by other environmental education statements and objectives, a framework for environmental literacy was established by the North American Association of Environmental Education Standards Project. This framework included seven categories used to both create an environmental education curriculum as well as evaluate it. Described by Chu et. al (2007), the seven categories established within this framework include:

1. Affect: the ability of students to reflect on environmental issues and act upon them.
2. Ecological Knowledge: an understanding/comprehension of how natural systems work and interact with social systems.

3. Socio-Political Knowledge: an understanding of the relationships between beliefs, political systems, and various cultural environmental values.
4. Knowledge of Environmental Issues: an understanding of environmental issues caused by human action.
5. Skills: the development of skills allowing individuals to analyze information about environmental issues while also being equipped to create an action plan in response.
6. Potential Determinants of Environmental Responsible Behaviors: analyzes an individual's locus of control and their understanding of personal responsibility for environmental issues.
7. Actual Environmental Behaviors: an individual's active participation (legally, politically, commercially) in solving environmental issues. (Chu et al., 2006 p. 732)

Using this educational framework, educators are encouraged to produce an environmental education curriculum that incorporates the use of multiple materials, provides students with the opportunities to take environmental action, and encourages the development of skills necessary to interpret and analyze scientific information (Chu et al., 2007). The use of multiple materials increases educator flexibility. Materials such as field trips, books, and other media ensure that the environmental education curriculum is more widely received by students, no matter their learning style. Opportunities for environmental action provide students with the chance to utilize problem solving skills and increase their locus of control regarding their role in their community. Finally, the development of

skills necessary to analyze scientific information provides students with the ability to review data and make informed decisions regarding their role in the environment (Chu et al, 2007).

Like all pieces of curriculum, the environmental education curriculum is subject to standards. When it comes to educational standards regarding environmental education, there are both positive and negative aspects. When used incorrectly, externally designed standards can break down local control and decrease community impact on students. Acting in direct opposition to place-based education principles, these homogenized standards prepare students to solve global issues, not local ones. Like other subject areas, the standardization of environmental education can result in increased motivation for educators to "teach the test". This pressure for students to do well on standardized tests results in the decline of experiential learning opportunities that are deemed as extra (Jennings, Swidler & Koliba, 2005). The positive aspects of standards are that they help legitimize place-based education and environmental education and protect their presence in everyday curricula. Essentially, the creation of standards that incorporate environmental education forces educators to infuse them into their curricula (Jennings et, al. 2005).

Due to my location in southern Arkansas, the curriculum featured as my capstone project will feature Arkansas state standards. The Arkansas Department of Education has established environmental science education standards. The goal of which is to "engage students in the core ideas, scientific and engineering practices, and crosscutting concepts to support the development of knowledge that can be applied to understanding,

explaining, and improving human interactions with Earth systems and resources". (Arkansas Department of Education, 2016).

Divided into four topics, the environmental science standards covered include systems, energy, populations, and sustainability. The Arkansas Department of Education is clear to point out that these standards are not meant to be used as curriculum. Instead, they encourage educators to consider these standards as the bare "minimum" of the information required (Arkansas Department of Education, 2016). By surpassing this "bare minimum", Arkansas educators can better equip their students with the skills and attitudes necessary to make positive environmental change.

With environmental literacy and environmental education standards in mind, educators can begin to create effective curriculum. In their book, *The Understanding by Design Guide to Creating High-Quality Units*, Wiggins and McTighe outline nine questions regarding curriculum design. Intended to guide educators creating meaningful, goal driven curriculum, these nine questions include:

1. What kind of designer are you?
2. What kind of content goals will you focus on?
3. What is the scope of your unit?
4. Should a new unit be created, or an old unit be revised?
5. What areas of need might be addressed?
6. Should you start with a unit?
7. Should you start with a lesson?
8. What is the role of your textbook?

9. What is your preferred entry point? (Wiggins & McTighe, 2011, p.

These questions along with other aspects of Wiggins and McTighe's design guide, including backwards curriculum design, provide educators with valuable resources to produce quality curriculum (Wiggins & McTighe, 2011).

An increase in environmental issues has propelled environmental education into classroom curricula. With a goal to increase environmental literacy, environmental education increases positive attitudes towards the environment while also equipping students with the knowledge and skills necessary to make significant change. Effective environmental education should follow the seven standards set forth by the North American Association of Environmental Education Standards Project. Like other curriculums, environmental education is subject to state standards. While these standards can be used as a resource, they should not be used as curriculum. Keeping these educational standards in mind, educators can create effective curriculum that incorporates environmental education into their classrooms.

Summary

The literature reviewed in this chapter provided context for the research question: *how can educational materials be used to integrate interactive, outdoor experiences into everyday classroom curricula?* The chapter began by discussing the benefits of field trips, their role in creating effective learners as well as the positive academic benefits that occur when performed correctly. As forms of experiential learning, field trips incorporate place-based learning to connect students with the resource. The importance of place as

well as the positive inter- and intra-personal benefits of place-based learning was discussed. Students who may traditionally struggle in the classroom often excel on field trips and other outdoor experiential learning opportunities. The review of three learning style frameworks: the theory of multiple intelligences, Dimensions of Science Learning, and the VAK provide educators with the knowledge necessary to better educate their students. Finally, the development of post-field trip curriculum was discussed in relation to environmental education and educational standards.

The following chapter provides an in-depth overview of the capstone project created to answer the research question, *how can educational materials be used to integrate interactive, outdoor experiences into everyday classroom curricula?* . A timeline, description of the audience and setting as well as supporting research are all included in the project description.

CHAPTER 3

Project Description

Introduction

Experiences in the outdoors provide students with unique learning opportunities. As philosopher John Dewey once said, "Education is a process of living, and not a preparation for future living" (Anderson, 2017). This chapter provides a comprehensive review of the unit of curriculum developed for this capstone project. Answering the research question, *how can educational materials be used to integrate interactive, outdoor experiences into everyday classroom curricula?*. This chapter will review the project's description, audience, setting, supporting research theories and timeline.

Project Overview

Academic success occurs among students when field trip experiences are effectively incorporated into the classroom setting (Barton, 2017). The curriculum designed for this capstone project supports this integration through the use of prompts and activities that incorporate interactive outdoor experiences. Appropriately named, H_2O on the Go, this unit of curriculum provides students with an overview of the hydrosphere. Incorporating aspects of backwards curriculum design, place-based education, and developmentally appropriate practice, this curriculum is designed for high school students enrolled in environmental science classes. This project will be implemented at Spring Hill High School with students in grades tenth thru twelfth.

Project Description

I chose curriculum development for my Capstone project because all educators are familiar with curriculum design and implementation in one form or another. The accessibility and ability to be adapted based on an individual's specific needs made curriculum the ideal project subject. When teaching my students environmental science, the curriculum is largely divided amongst the four "spheres": lithosphere, biosphere, atmosphere, and hydrosphere. Serving as an introduction to the hydrosphere, the H_2O on the Go curriculum includes fifteen lesson plans that are divided into three major sections:

Intro to H_2O: students are introduced to the chemical composition of water. This section features seven lesson plans that center around water's unique properties and the impact that they have on their surrounding environment. During an interactive lab, students will discover more about these unique properties (surface tension, high specific heat, adhesion/cohesion, and solubility). Alternative to their typical lab experiences occurring in the "field", this Intro to H_2O lab provides students with additional practice perfecting lab techniques and data analysis.

The Incredible Journey: students learn about where water comes from. A series of three lesson plans re-familiarize students to the water cycle and provides more detailed information regarding the overall process. When students are first introduced to the water cycle they are often taught the most basic steps such as evaporation and precipitation. Within this curriculum, students will learn about the water cycle in more detail focusing on other steps of the water cycle such as

evapotranspiration and surface water absorption. Along with covering the water cycle in deeper detail, students will also be introduced to watersheds and learn more about the effects that human actions can have on an entire water source.

Humans and H_2O: after learning about water's structure, properties, and cycle, students will analyze the impact that humans have on water quality. Featuring five lessons, this section will cover personal water usage, what happens to water after it has been used, sources of pollution and potential pollution solutions. Student's will have the opportunity to visit a local wastewater treatment plant and see the process of water treatment in real time as part of a unique field trip opportunity.

Meant to serve as an introduction to the hydrosphere, the H_2O on the Go curriculum engages students through the use of outdoor activities, interactive labs, and a field trip. This curriculum is not intended to be the only coverage of the hydrosphere, instead it should be used as a thorough introduction. Following units can be designed to investigate other aspects of the hydrosphere such as aquatic habitats, water scarcity and the distribution of pollution.

Setting

The setting for this project is Spring Hill High School. Located just outside of Hope, Arkansas, Spring Hill is a relatively rural school. A majority of students who attend this school live in the country and have some form of livestock. With a high school enrollment of a mere 260 students, it is safe to say that Spring Hill High School is a small school. The surrounding area is characterized by pasture and deciduous forest. The field

trip scheduled within this unit of curriculum takes place within a more urban Hope, Arkansas with an estimated population of 9,768 people.

Audience

I designed this unit of curriculum for my students enrolled in environmental science classes at Spring Hill High School. In Arkansas, the order of sciences taught in high school is: physical science, biology, and then elective science such as anatomy & physiology, chemistry, physics and environmental science. Based on this order, the typical grade range of one of my environmental science students is between sophomore and senior year. Due to the elective nature of this course, a majority of the students who are enrolled in environmental science share a passion for the environment and the great outdoors.

Research Theories

The curriculum created for this Capstone project is supported by three research theories: backwards curriculum design, place-based education, and developmentally appropriate practice. In their book "*The Understanding by Design Guide to Creating High-Quality Units"*, Wiggins and McTighe instruct educators on how to design effective curriculum by working backwards. The basic tenet of backwards research design is that long-term desired effects occur when educators start with their final goal in mind and work backwards. Backward design is best organized into three stages: identification of desired results, determination of acceptable evidence and planned instruction and learning experiences. By following Wiggins and McTighe's curriculum guidelines,

educators can better avoid the “Twin Sins” of unit planning. An unfortunate occurrence in classrooms around the world, these sins are activity-oriented teaching and content coverage. Although both of these teaching styles have their benefits, if used incorrectly, they actually cause more harm than good (Wiggins and McTighe, 2011).

Students enrolled in environmental science engage in place-based learning through their participation in outdoor learning and field trips. This form of experiential learning increases knowledge retention, the development of social skills and the formation of connections between the resource, surrounding community, and student (Akbas & Çakmak, 2019; Anderson, 2017). For the purpose of this Capstone project, Spring Hill High School and the surrounding area serves as the student’s “place” of learning. The interactive learning occurring in the outdoors encourages affective learning resulting in the formation of a positive relationship between students and resources (Mujtaba et al. 2018).

Supported by research in child development and learning, developmentally appropriate practice refers to practices that “promote young children’s optimal learning and development” (Copple & Bredekamp, 2009). This research was particularly relevant when designing curriculum tailored for high school students. Knowledge of students' physical, social, emotional, and cognitive development at these ages better ensures that the curriculum designed and implemented for this project was appropriate.

Curriculum Assessment

Serving as an introduction to the hydrosphere, the curriculum H_2O on the Go works to connect students to their surrounding environment while also learning more about one of our planet's most crucial cycles, the water cycle. The unit has two formal assessments built into the curriculum, one acting as a pre-assessment and the other acting as a post assessment. Since most students have a basic understanding of the water cycle, the pre-assessment is meant to assess prior knowledge while also encouraging students to get into a hydrosphere mindset. The same assessment is offered to students again at the conclusion of the unit to assess their understanding of the curriculum. I intend on using data obtained from these pre and post assessments as well as student surveys regarding their connection to the outdoors to determine curriculum success. I believe that an increase in assessment scores and positive attitudes will indicate success and deeper understanding.

Summary

To answer the research question, *how can educational materials be used to integrate interactive, outdoor experiences into everyday classroom curricula*? I created a unit of curriculum entitled H_2O on the Go. Scaffolded around the hydrosphere, this unit of curriculum serves as an introduction to water's chemical composition, unique physical properties, it's cycle, and relationship with humans. Using the research theories of backwards curriculum design, place-based education, and developmentally appropriate practice, this curriculum includes fifteen comprehensive lesson plans to be used when

educating high school environmental science students. The following chapter will provide a comprehensive review of the project's successes, limitations, and associated literature.

\

CHAPTER FOUR

Conclusion

Introduction

Since graduating from college, I have enjoyed educating others about the environment in a variety of facets. Initially as an informal environmental educator working in state parks, this education occurred in the field. As a current high school teacher, this education now occurs primarily within the four walls of a classroom. Seeking to connect my students to their surrounding environment I asked the question: *how can educational materials be used to integrate interactive, outdoor experiences into everyday classroom curricula.* Although I am now considered a "formal" educator, I still strive to connect my students to their environment. In response to my question, I designed a unit of curriculum including three weeks worth of lesson plans to introduce students to the hydrosphere. The following chapter will review my capstone experience including: capstone outcomes, literature review highlights, project implications, potential limitations, and areas for future growth.

Capstone Outcomes

The process of completing my capstone was incredibly educational and rewarding. After years of working as an informal environmental educator, I felt that the timing of my capstone project perfectly aligned with my new career in formal education. Although I had experience writing the occasional lesson plan, this project provided me with my first major curriculum writing experiences. While completing my literature

review I found research that supported some of the pedagogical practices that I had previously used such as place-based education. I also came across literature that better informed how I used pedagogical practices such as interactive experiences within lesson plans. Like so many educators, I love incorporating interactive activities into my lesson plans. Not only are these activities engaging for the students, they are also incredibly engaging for me as the instructor. Through the process of completing my capstone I found that if done incorrectly, these interactive activities can actually hinder my students more than they help them. This new information drastically informed how I used interactive experiences within my classroom today. Instead of building lesson plans around activities, I now lead with my desired educational goals and incorporate activities only if they work in concert to achieve those goals. Another important lesson that I learned while completing my capstone is that a connection with the environment can be established anywhere. Spoiled by my previous access to a state park as a classroom, I was initially concerned that my school would not serve as an appropriate substitute. Thankfully, through the process of working with my students outside of the classroom and planning future activities for my capstone curriculum, I found that connections can still be formed between students and their environment even if it isn't as "natural" as one might hope. While I have learned a lot through the "hands-on" process of teaching as a first year educator and creating a unit of curriculum for my project, my review of relevant literature provided me with several insights into becoming a better educator.

Literature Review Highlights

Lacking a degree in the field of education, my literature review was highly informative when it came to learning more about various pedagogies and curriculum development. Although this was my first time designing an entire unit of curriculum, it was not my first time using the pedagogical practices of place-based education, interactive learning, and developmentally appropriate practices. The resources used within my literature review aided my development as an educator by providing additional context regarding these practices. Known for its positive benefits, place-based education increases community engagement, improves student confidence, and boosts academics when implemented by educators (Akbas & Çakmak, 2019; Anderson, 2017). As an environmental educator, the benefits of place-based education practices are incredibly beneficial when attempting to increase student's environmental literacy and attitudes. Vaguely familiar with the concept of varying learning styles, research into Dunn & Dunn's VAK framework as well as Felder and Silverman's Dimensions of Learning in Science better informed me about how student's learn and how I can better teach to engage all types of learners. The last portion of my literature review focused on effective curriculum development. Being the focus of my project as well as my area of least experience, it should come as no surprise that this portion of my literature review provided me with some of my most valuable information. The environmental literacy standards established by the North American Association of Environmental Education Standards Project, the environmental science standards set forth by the Arkansas Department of Education and the theories of backwards design established by Wiggins

and McTighe were crucial when developing an effective unit of curriculum. The unit of curriculum produced as a result of my research not only serves as my capstone project, but also as an actual unit of curriculum to be used with my students in real time.

Project Implications

After utilizing my project curriculum within my classroom, I hope to see change occur within my students and myself as an educator. Ideally my students will experience an increase in environmental literacy as well as a newfound connection to their local environment. The curriculum, H_2O on the Go, not only provides students with scientific information about the hydrosphere, it also provides numerous opportunities for students to form connections to their community and surrounding environments. Lesson plans such as "Watershed Discovery", "Humans and H_2O", and "Where Does it All Go?" encourage students to complete research that educates them about their local water resources. Through the process of learning more about their local resource and personal environmental impact, I hope that their sense of community and environmental stewardship will be strengthened. Although environmental education is not required by law in Arkansas, I intend on using this curriculum as well as others to ensure that my students receive a comprehensive and unbiased education regarding their environment and issues facing it. Hopefully one day in the future, Arkansas policy will change and environmental education will become a required course to graduate. Afterall, we all depend on our environment as well as impact it with our choices. This curriculum will benefit the profession of environmental education by providing other instructors with additional learning resources. In Arkansas, students are not afforded with the opportunity

to enroll in environmental science until they become upperclassmen. Although it may not be formally offered to younger students, educators can still start incorporating environmental education into their classrooms. The production of environmental science curriculum such as mine provides fellow educators with additional resources that they can modify to best fit in their classrooms. Increased exposure to environmental science at a younger age will bolster their scientific knowledge while also increasing environmental literacy.

Potential Limitations

When reviewing my capstone project, I identified a few potential limitations. At Spring Hill High School, we are lucky enough to be considered a one-to-one school. This means that each of our students is provided with a chromebook for the school year. Several of my lesson plans involve the use of technology on the student's end. Schools that do not have access to as much technology may have to modify it in regards to student activities that involve the use of technology to complete activities and or research to accommodate. At the beginning of my unit of curriculum I have several lesson plans that occur within our lab. Although I don't consider my school's science lab to be incredibly "high-tech", I do understand that not every institution may have access to a lab or certain materials. These lab lesson plans would have to be adapted by the individual educator to better meet their equipment and materials available. The last limitation that I identified was scheduling. I am very lucky in that all of my environmental science classes are stacked within my teaching schedule. This means that on days when I am interested in taking my students for a field trip, I can consolidate all three classes into one for the purpose of

scheduling field trips off campus. Educators who have classes that are not scheduled back to back will have to determine how they can accomplish the same goal of taking students off campus if they are not able to consolidate them. While this is not a current limitation of mine, it could very well become one in the future if schedules change.

Future Growth

As a first year educator, areas for future growth are endless. In regards to my capstone, I intend on taking my newfound knowledge of curriculum development and educational pedagogies and using it to create new units of curriculum for my environmental science students. Though incredibly comprehensive of certain aspects of the hydrosphere, my capstone project was more so meant to serve as an introduction to the hydrosphere. Following the completion of this unit, future units could dive deeper into the hydrosphere and discuss topics such as aquatic habitats, the ethical implications of water scarcity and the location of pollution as well as the methods used to test water quality. Once I feel like I have covered the hydrosphere, I intend on building out my curriculum to completely encase the remaining state environmental science standards as well as my own personal educational goals set for my students. Besides growing my curriculum, I hope to continue to learn more about various learning styles and educational tools that can be used to improve my skills as an educator and improve my student's overall experience.

Conclusion

As our planet's condition continues to worsen, it is crucial now more than ever that students become environmentally literate. Backed with a firm foundation in science and a connection to their environment, these students would have the ability to make informed decisions regarding our planet. Since graduating with my degree I have had the pleasure to educate students of various ages in various spaces about our environment. Seeking to connect my high school environmental science students to their surrounding environment I asked the question: *how can educational materials be used to integrate interactive, outdoor experiences into everyday classroom curricula.* For my capstone project I developed a unit of curriculum including 15 lesson plans that served as an introduction to the hydrosphere. Incorporating research completed regarding pedagogical practices such as place-based education, interactive outdoor experiences, and developmentally appropriate learning, this curriculum was my response. Using my newfound knowledge of curriculum development and learning styles I hope to continue incorporating my passion for our environment into my teaching and future curriculum development. As the Lorax once said, "unless someone like you cares a whole awful lot, nothing is going to get better. It's not." ((Dr. Seuss, 2021).

REFERENCES

Akbas, Y., & Çakmak, S. (2019). The effect of place-based education integrated project studies on students' problem-solving and social skills. *Asian Journal of Education and Training, 5*(1), 183.

Anderson, S. K. (2017). *Bringing school to life: Place-based education across the curriculum*. Rowman & Littlefield.

Arkansas Department of Education (2016). Environmental Science Arkansas K-12 Science Standards.

Artun, H., & Özsevgec, T. (2018). Influence of Environmental Education Modular Curriculum on Academic Achievement and Conceptual Understanding. International Electronic Journal of Environmental Education, 8(2), 150–.

Bell, P., Lewenstein, B., Shouse, A., & Feder, M. A. (2009). Learning science in informal environments: People, places and pursuits. Washington, DC: National Academies Press

Barton, K. (2017). Exploring the benefits of field trips in a food geography course. Journal of Geography (Houston), 116(6), 237-249. https://doi.org/10.1080/00221341.2017.1296481

Bozdogan, A. E. (2015). Determination of biology department students' past field trip experiences and examination of their self-efficacy beliefs in planning and organizing educational field trips.22(7), 31.

Chetty, N., Handayani, L., Sahabudin, N., Ali, Z., Hamzah, N., Rahman, N., & Kasim, S. (2019). Learning Styles and Teaching Styles Determine Students' Academic Performances. International Journal of Evaluation and Research in Education, 8(4), 610–.

Chu, H., Lee, E., Ryung Ko, H., Hee Shin, D., Nam Lee, M., Mee Min, B., & Hee Kang, K. (2007). Korean Year 3 Children's Environmental Literacy: A prerequisite for a Korean environmental education curriculum. International Journal of Science Education, 29(6), 731–746. https://doi.org/10.1080/09500690600823532

Copple, C., & Bredekamp, S. (2009). Developmentally appropriate practice in early childhood programs serving children from birth through age 8 (3rd ed.). National Association for the Education of Young Children.

Cotton, D. (2006). Implementing Curriculum Guidance on Environmental Education: The Importance of Teachers' Beliefs. Journal of Curriculum Studies, 38(1), 67–83. https://doi.org/10.1080/00220270500038644

Dr. Seuss. (2021). *The Lorax*. HarperCollins Children's Books.

Efird, R. (2015). Learning places and 'little volunteers': An assessment of place- and community-based education in china. Environmental Education Research, 21(8), 1143-1154. https://doi.org/10.1080/13504622.2014.976607

Eijck, v.,M.W., & Roth, W. -. (2010). Towards a chronotopic theory of "place" in place-based education. Cultural Studies of Science Education, 5(4), 869-898. https://doi.org/10.1007/s11422-010-9278-2

Gardner, H. (2011). Frames of mind the theory of multiple intelligences (3rd ed.). Basic Books.

Jennings, N., Swidler, S., Koliba, C., (2005). Place-Based Education in the Standards-Based Reform Era – Conflict or Complement? *American Journal of Education, 112*(1), 44-65. https://doi.org/10.1086/444522

Lawson, L. B., Lind, C. M., Gibson, J. W., & Höner zu Bentrup, K. (2020). Do voluntary lab-based active learning sessions impact medical student knowledge retention? *Medical Science Educator, 30*(2), 823-831. https://doi.org/10.1007/s40670-020-00956-7

Malau-Aduli, B., Lee, A. Y., Cooling, N., Catchpole, M., Jose, M., & Turner, R. (2013). Retention of knowledge and perceived relevance of basic sciences in an integrated case-based learning (CBL) curriculum. *BMC Medical Education; BMC Med Educ, 13*(1), 139. https://doi.org/10.1186/1472-6920-13-139

Mujtaba, T., Lawrence, M., Oliver, M., & Reiss, M. J. (2018). Learning and engagement through natural history museums. Studies in Science Education; Stud Sci Educ, 54(1), 41-67. https://doi.org/10.1080/03057267.2018.1442820

Nugraha, I., Putri, N., & Sholihin, H. (2020). An Analysis of the Relationship between Students' Scientific Attitude and Students' Learning Style in Junior High School. Journal of Science Learning, 3(3), 185–.

Payne, P. (2006). Environmental Education and Curriculum Theory. The Journal of Environmental Education, 37(2), 25–35. https://doi.org/10.3200/JOEE.37.2.25-35

Provost, C. L. (2012). *Effects of varying levels of physical activity on middle school students' science knowledge retention*. ProQuest Dissertations Publishing.

Smith, G. A., & Sobel, D. (2010). Place- and community-based education in schools. Routledge. https://doi.org/10.4324/9780203858530

Smith-Walters, C., Hargrove, K., & Ervin, B. (2014). Extending the classroom: Tips for planning successful field trips. (methods & strategies: Ideas and techniques to enhance your science teaching). Science and Children, 51(9), 74.

Tanner, K., & Allen, D. (2004). Approaches to biology teaching and learning: Learning styles and the problem of instructional selection--engaging all students in science courses. *Cell Biology Education; Cell Biol Educ, 3*(4), 197-201. https://doi.org/10.1187/cbe.04-07-0050

Upadhyay, B., & DeFranco, C. (2008). Elementary students' retention of environmental science knowledge: Connected science instruction versus direct instruction. *Journal of Elementary Science Education, 20*(2), 23-37. https://doi.org/10.1007/BF03173668

Wiggins, G., & McTighe, J. (2011). The understanding by design guide to creating high-quality units. ASCD.