

Hamline University

DigitalCommons@Hamline

School of Education and Leadership Student
Capstone Projects

School of Education and Leadership

Summer 2020

Incorporating Traditional Ecological Knowledge to Support Critical Thinking in Environmental Education

Nicholas Koerbitz

Follow this and additional works at: https://digitalcommons.hamline.edu/hse_cp



Part of the [Education Commons](#)

Recommended Citation

Koerbitz, Nicholas, "Incorporating Traditional Ecological Knowledge to Support Critical Thinking in Environmental Education" (2020). *School of Education and Leadership Student Capstone Projects*. 549. https://digitalcommons.hamline.edu/hse_cp/549

This Capstone Project is brought to you for free and open access by the School of Education and Leadership at DigitalCommons@Hamline. It has been accepted for inclusion in School of Education and Leadership Student Capstone Projects by an authorized administrator of DigitalCommons@Hamline. For more information, please contact digitalcommons@hamline.edu.

INCORPORATING TRADITIONAL ECOLOGICAL KNOWLEDGE TO SUPPORT
CRITICAL THINKING IN ENVIRONMENTAL EDUCATION

By

Nicholas Koerbitz

A capstone project 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

August, 2020

Primary Advisor: Patty Born
Content Advisor: Tess Drotts

TABLE OF CONTENTS

CHAPTER ONE: Introduction

Introduction.....	4
Lack of Culture in Youth Experiences.....	6
Experiencing Cultural Knowledge in College.....	7
Experiencing Culture in the Education Program.....	9
Experiencing the Culture I was Never Aware of in the Workplace.....	10
Definitions and Terminology.....	13
Summary.....	14

CHAPTER TWO: Literature Review

Introduction.....	16
Native American Cultural Knowledge.....	19
Native American Cultural History.....	21
Native American history after European colonization.....	23
Modern day erasure of Native American culture in society.....	24
Cultural Implementation.....	27
Teacher responsibility in cultural implementation.....	28
Implementation of Native American values in science.....	30
Environmental Education Pedagogy.....	32
Connecting other science topics to environmental education.....	34

Inquiry based learning in environmental education.....	35
Conclusion.....	37
CHAPTER THREE: Project Description	
Introduction.....	39
Context.....	40
Intended Audience.....	41
Project Components.....	42
Rationale.....	43
Curriculum Framework.....	44
Summary.....	45
CHAPTER FOUR: Conclusion	
Introduction.....	46
Revisiting the Literature Review.....	47
Project Implications.....	51
Project Limitations.....	53
Future Work and Recommendations.....	54
Communicating and Using Results.....	55
Benefits to Teachers and Students.....	56
Summary.....	57
REFERENCES.....	58

CHAPTER ONE

Introduction

Introduction

There are common phrases that can be used in most environments, such as, “don’t make things more complicated than they need to be”, and “use the resources already available”. These sayings are as relevant in education today as they have ever been with the constant increase of duties administrators and teachers continue to take on. Yet, with nearly unlimited educational resources with today’s technology, many still make their jobs more difficult than they need to be. In my personal background in science, I find this especially the case with teachers in environmental education. The focus for most classes is based on current practices and developments, along with a few important names and dates in our nation’s history. The United States Environmental Protection Agency defines environmental education as “a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment” (2019). While this topic is gaining popularity, people are obsessing in exploring new ideas rather than focusing on cultures that have valued taking care of the earth for thousands of years. Native American people have always viewed their relationship with the earth as an important part of life, and western science is only now catching up to traditional ways. The absence of this connection in environmental education provides the question that

drives my project, “*How can traditional ecological knowledge be implemented in environmental education?*”

While the connections between Native teachings and environmental education are strong, most people, my younger self included, in the public school system don't have the background to know there is a connection in the first place. According to the Next Generation Science Standards Website, there is never mention of any group of Indigenous people in the High School Life Science sections (2019). According to the Minnesota Department of Education, in the High School Life Science portion of the Minnesota Science Standards there is only one mention of “Minnesota American Indian tribes” (2009). With this lack of focus in the standards for public schools, there is an overall absence of awareness regarding the ties to Native people and environmental education. In this chapter, I discuss how there is no reason someone with my upbringing should not have been exposed to this information. With the entirety of my childhood spent in northern Minnesota, and near multiple Indian reservations, I discuss how I had never been exposed to different cultures in my own area. I also stress that it took extensive research in my graduate program along with personal experiences to eventually make connections with traditional ecological knowledge and environmental education. Having lived most of my life in close proximity to multiple Native American Indian reservations, along with my science background, these connections should have been obvious much earlier. While reflecting on my upbringing and experiences, I focus on how my absence of culture contributed to long journeys just to make connections that should have been already obvious.

Lack of Culture in Youth Experiences

I was born and raised in a small town in northern Minnesota in an upper middle class household. My father had a good job at the local paper mill, and my mother stayed home with my two sisters and me. With mom at home, everything we did was on a schedule. This mostly included school, church, and playdates with other kids our age. While we had a very active childhood consisting of a variety of daily activities, I'd never had any reason to notice that every person I'd ever connected with was White. My parents weren't trying to shelter me on purpose. The fact is that it was, and still is, very rare to see someone who isn't White in my hometown. I simply didn't know anything different. I had no reason to believe that anywhere else in the world was any different from what I was experiencing everyday. I hadn't a clue there were different cultures from what I was experiencing, or even that I only lived 15 minutes from an Indian reservation. My world would begin and end with my everyday experiences.

When it was time to start at the Catholic elementary school, I was again surrounded by people similar to me. My friends shared the same hobbies and values as I did, and fitting in never seemed to be an issue. While I can't specifically remember the first time we studied anything about other groups of people in school, it was undoubtedly during American History. Naturally, different groups of people were studied in greater detail as we progressed through school, yet they seemed worlds away. My elementary teachers never had to worry about connecting different ways of life to our own, as one example would be able to connect to the whole class who had similar upbringings.

The first time I was ever introduced to someone from a different culture was after elementary school, and in our town's only public middle school. The only reason this was a possibility was because a family hosted a foreign exchange student. While we would constantly ask him questions about what it was like at his home in Guatemala, we were hardly expanding our culture other than confirming that there were other places in the world where things were done much differently than where we lived. In high school, I started to become more inquisitive about other places in the world and other cultures. From taking German as a foreign language, to taking several history classes, and becoming close friends with multiple foreign exchange students, I tried to learn all that I could. While I was fascinated by cultural education, I was ignorant enough to believe that I needed to leave the country to observe this. As I travelled around the state playing hockey and soccer, I came to the unconscious conclusion that Minnesota was simply full of White people who had similar values and upbringings. Never did I think of urban areas, or even the small school down the road whose enrollment consisted of half Native American students, let alone the Indian reservation itself. As I ventured through high school and participated in a variety of activities, I assumed that my upbringing was typical, as I had yet to be exposed to anything else.

Experiencing Cultural Knowledge in College

Leaving home for a college that was only three hours away opened my eyes rather quickly regarding how sheltered my experiences were growing up. I had of course studied different cultures and groups of people in high school, but I had assumed that I would never witness this while I was still in Minnesota at a small, liberal arts school. The

choice to play college soccer exposed me to more worldview learning than what I had experienced in school growing up. I was lucky enough to have teammates from all over the world who would share stories in the dining halls and during long bus rides. In addition, I found that for the first time in my life, I was the one who had to figure out how to fit into the group being that I was the only one who was from a rural area. I can distinctly remember my two teammates, one from Rwanda and one from Burundi, telling me about their experiences growing up while we were eating lunch one day. I was unable to move in my chair, as I was shocked when they filled me in on what life was like as young kids during the Rwandan Genocide, and how they had to travel all over the place for safety. They provided me with an education that I could have never learned out of a book.

One of my best friends from college and roommate for three years was originally from Nigeria, where he lived through middle school. While a Black Nigerian and White American from rural Minnesota might seem like a strange combination, we had more similarities than most would think as he went to high school in Canada. As we grew closer through the years, I gained insight on how different our childhood experiences were from each other. I often wondered how two such people could become so close almost instantly. While we had many similarities in personality and interests, our past experiences and the way we were brought up couldn't have been more different. When we travelled to my hometown one weekend, he acted like the rural area was in a different world, and he couldn't believe I had grown up in such a secluded place. What I had

always considered to be a normal upbringing was completely foreign to one of the closest people in my life.

Experiencing Culture in the Education Program

My sophomore year in college was when I started taking education classes, with aspirations of becoming a teacher. I approached these classes with great excitement, as I had pictured myself being a high school teacher for most of my life. The coursework was interesting to me, but what I was really looking forward to was travelling to local schools and observing real classroom situations. The first classroom experience that students in the program were exposed to was an English Language Learners (ELL) classroom. This was a completely new concept to me, as my nearly all White high school had no such program. Never having heard of ELL, I had assumed that I was being placed in some sort of remedial English class for my observations. I never thought much about the title of the classroom I was going to be placed in, as I was determined to succeed in any setting. My younger self had the arrogant viewpoint that I was ready for anything, and I was going to be a pleasant addition to any classroom. As I walked down the hallway to the classroom I was being assigned to, the bell rang signaling the end of the current period. Without thinking, I stopped to look around in the hallway, as I quickly realized that for the first time in my life, I was the only White person in a hallway full of nearly 200 people. When I reached my classroom, I quickly came to realize that I would be working with students who were learning the English language for the first time as high school students. I immediately felt guilty inside about the incorrect pre-assumptions of my situation. It was in that moment that I realized from a professional viewpoint, I had to start over in regards

to how I viewed our education system, as my own experiences didn't represent what I was currently working in.

As I progressed through my clinical observations in urban areas, I learned that diversity in personalities and cultures amongst students was something that I really valued about my experiences. I enjoyed the fact that I was making connections with many students with fascinating backgrounds, and I was finally starting to break through the stereotypes that had unintentionally been instilled in me since a young age. By the time I had reached student teaching in my last semester of college, I at least had the understanding that personal relationships with students were something that took time to develop, and I wouldn't be able to immediately connect with every student based on the diverse student body I was dealing with. During the twelve weeks, I learned how valuable these connections are in education, especially when it comes to helping students understand classroom material in a way that is relatable to them. It was truly an experience where I learned more from my students than they learned from me. More importantly, it gave me the understanding that every student comes from their own unique situation, and the importance of forming relationships and making connections with them is a recurring theme that needs to exist in a productive classroom.

Experiencing the Culture I Was Never Aware of in the Workplace.

Right out of college, I got a job at a high school 15 miles from where I grew up and on the edge of a Native American Indian reservation. Based on my experiences in college, I entered with a mindset that there would undoubtedly be a tremendous learning curve, and I would need to enter with an open mind everyday, willing to learn from my

successes and failures. Yet, there was also a sense of comfort that I was going to be near my hometown with kids who I thought would have similar backgrounds to me. In many cases, I couldn't have been more wrong. I could never have imagined that my seemingly all White high school a short distance away could be vastly different than my current school that sits one mile from the reservation. Even now, in my fourth year of teaching, all four of which have been at the same school, I wonder how I could have grown up paying only the slightest attention to the immensely different culture in my own area of the state. I have often felt embarrassed that as I grew more curious about different places and people in the world throughout high school and college, it had never occurred to me that I could find this in the same county where I had lived all my life.

As different as my current school is from the high school in my hometown, I never worried about adapting to my situation; I had already done that multiple times in my clinical and student teaching experiences in college. Learning about the hobbies and interests of my new students was something that I enjoyed a great deal, as I finally had my own students. Particularly, I have felt that my Native students had the most interesting stories to tell, as many of their traditions and hobbies were different from anything I had ever heard of. Furthermore, our Anishinaabe Education Department has also taught me an incredible amount of information through activities they have provided for students and staff. While this continuous learning is something I enjoy, I still find myself asking quite often why none of this was exposed to me in any of my experiences before my employment in my current school district.

While I had much to learn about my students, I had always felt my knowledge in this content area was a personal strength. In most branches of biology, I still feel that to be true today. I personally believe that I excel in directing academic conversations where students are able to express their opinions in a respectable manner regarding scientific issues. The topic I enjoy teaching the most is climate change and its contributing factors, as I have studied environmental education extensively during both my undergraduate and graduate courses. However, through workshops focused on Native American cultures and practices taken both through work and by personal decision, I arrived at the realization that I still had many pieces missing from the history of environmental education. I had always perceived environmental education and conservation as relatively new areas of study in an attempt to compensate for unsustainable practices since the industrial revolution. Through my findings in working with Native people, very few of the values emphasized in environmental education are new. The holistic approach that everything is connected and worth protecting has been practiced by many groups of Native Americans for thousands of years. A majority of important dates emphasized in environmental education classes at any level likely have to do with the United States government. There is little acknowledgement that these acts have been practiced for thousands of years by certain groups of people.

These experiences lead me to believe that there is a great injustice in the history of environmental education, as there are many Native American cultures that still value these same practices today. Failing to incorporate Native American culture while teaching environmental education is ignoring easily accessible resources that are

constantly left out. As someone who was born and raised near an Indian reservation and pursued a biology degree in college, I have still had to find most of this information from my own inquiry despite the fact that it has been accessible for most of my life without my knowledge. If local high schools near Indian reservations are leaving out traditional ecological knowledge, other schools who are not in proximity are extremely unlikely to incorporate these teachings. With the connections that Native American values bring to environmental education, there should be specific mention of these ties in science standards nationwide, along with curriculum to incorporate these ideas in a public school classroom.

Definitions and Terminology

Through my personal experiences, I have learned the importance of being culturally aware and sensitive to all situations in an educational setting. For this reason, I feel it prudent to first clarify what I mean by traditional ecological knowledge. As I explain in chapter two, Native Americans have valued being connected to the earth both physically and spiritually, and have lived in harmony with the earth by taking only the resources they needed for many generations. By viewing themselves as only a small part of the earth's natural cycle and taking care of the environment, otherwise referred to in this paper as ecocentrism, Native Americans have been advanced in environmentalism compared to Western civilization for generations. In this paper and project, I define traditional ecological knowledge as cultural teachings from Native Americans and Indigenous peoples that support taking care of the earth's resources, along with having practiced these values long before environmental education was recognized as a branch

of science. The sources used in this paper include holistic ways of thinking, which I define as understanding there is a connectedness between all living and nonliving things on earth, along with understanding that the actions of a single species can disrupt the balance of the earth's resources and energy. It is because of these rich histories of ecocentrism and holistic thinking in Native American cultures that I strongly support traditional ecological knowledge being incorporated in an environmental education unit.

It must also be recognized that Native American, American Indian, and Indigenous peoples are all used when describing or referring to sources that consist of traditional ecological knowledge. It is of extreme importance to understand that these terms are not necessarily interchangeable. However, all of these terms are used in attempts to be consistent with what appears in the cited sources throughout the paper, therefore, each appearing frequently. None of the listed terms are a single culture, as there are many different cultures across North America used in this paper referencing Native American people, American Indian People, and Indigenous people. Subsequently Native teachings refer to one or more Native American culture, American Indian teachings refer to one or more American Indian culture, and Indigenous teachings refer to one or more Indigenous culture.

Summary

Chapter one has explained the reasoning for the guiding question of this project, "*How can traditional ecological knowledge be implemented in environmental education?*" I have based the justification for this project from my youth, collegiate, and professional experiences, and described the long journey it took to get to my current

understanding of the topic. The work of this project will steer my own journey of incorporating these values in a classroom, along with the goal of shortening the journey for others to see the value in incorporating traditional ecological knowledge in environmental education.

In chapter two, I examine different sources of literature, where I outline Native American foundations that already exist in the forms of past research, along with connecting different sources containing both Native American culture and environmental practices. In chapter three, research methods are explained along with the justification as to why these methods are included in the introduction of the project. Chapter four will be the conclusion of the project, and will discuss implementation of the curriculum.

CHAPTER TWO:

Literature Review

Introduction

In this chapter, I review many sources of literature to emphasize the benefits from understanding general principles in traditional ecological knowledge, and I use these principles to provide insight on key components of designing an environmental education curriculum in a public school setting. It is immensely important to understand that Native American cultural knowledge is a very broad topic that needs to be broken down extensively. As there are many different groups of Indigenous people throughout North America, it must be understood that differences do exist, and it is neither correct nor appropriate to put all of the different groups under the same umbrella. The literature referenced in this chapter supports that effective educators teaching environmental education will benefit from obtaining certain skills, including understanding Native American culture and values, knowing how to implement this culture into a classroom, and applying Native teachings into modern day environmental issues. The literature referenced in this chapter also supports tribal communities benefiting by referencing cultural beliefs and ways of knowing that governments and societies of the past have tried to eradicate. In this chapter, I support the idea that these skills will increase student understanding in the classroom, along with developing skills they will use later in life to make informed decisions as citizens.

Native American cultural knowledge has been long overlooked in our public school systems. Curriculum for national and state standards seldom include minority groups, and when these groups are included, they are often a side note to aid a history lesson from a White perspective. Frequently, the views that are most often misrepresented are those from the many different groups of Native Americans. While these groups are mentioned in many history curriculums, they are referred to out of the United States government's viewpoint from that time period, and are seen as violent as they are most often mentioned in battles and wars throughout our nation's history. The way of life, traditions, and cultures that have been passed on to Native American people are studied by few today, and are not included in most school's curriculum. Furthermore, environmental racism and misconceptions of cultures have driven traditional science out of most curricula despite that many studies support traditional ecological knowledge being far more successful for student understanding and retention than non cultural examples (Huntington, 2000). Yet, in a society that is looking to reduce greenhouse gases, become more mindful of how our actions are affecting others, and become more environmentally efficient, a lack of exposure to Native ways of life that have centered around relationships with the earth is ignoring resources that are readily accessible. Native American culture and values are thousands of years ahead of many aspects of our current society, and valuing these teachings by incorporating them into environmental education will add to our resources as we look to establish conservation efforts.

Cultural implementation in a classroom can be challenging, yet, it is an important tool when teaching traditional ecological knowledge. Even teachers with extensive

knowledge in Native American culture and history meet challenges consisting of when and where to incorporate cultural examples into a science curriculum. With national and state standards driving the curriculum in public school systems, finding ways to incorporate Native teachings can be challenging. Not only does the teacher's background knowledge need to be adequate, the art of introducing these ideas to students needs to be intentional. Teachers need to be intentional in what connections they make between Native American cultures and their students, which will vary based on the demographics of the classroom. This will also require teachers to be intentional that Native American cultures are represented accurately and appropriately, as well as respected as a way of life that can be learned from. The implementation of these sources of information and teachings into a classroom is as important as acquiring the information itself.

Effective educational strategies are needed to ensure that students are comprehending the appropriate connections that Native teachings have with environmental education. With many students in today's public school systems having never been exposed to these Native teachings, many connections will have to be made to ensure student understanding. For these connections to be made, teachers must acquire efficient environmental education pedagogy by first educating themselves about the resources they will be using in the classroom. With many sources available pertaining to Native Americans and their relationship to the earth, a challenge that remains is applying them while living in a society that is constantly changing. For educators and citizens, being adaptable while studying environmental education is a necessity why? With legislation, regulations, and technologies constantly changing, environmental education is

a topic that requires staying up to date with current events such as changing policies and economic impact. Without effective educational strategies and efficient pedagogy in environmental education, we cannot properly connect the knowledge from existing Native teachings to the current issues we face today.

How then, as environmental educators, do we know exactly what aspects of Native American culture to familiarize ourselves with? How do we implement a culture in appropriate ways without having been taught these values ourselves? What connections should we be making to emphasize that these values are still practiced today, and directly relate to present day time? How do we adjust to an ever changing path that environmental education leads us on? To address these questions, we look to research that has focused on one or more of these topics. Past research of introducing Native American content in a classroom, along with student-centered learning, has outlined benefits and effective ways to answer these questions. In order to answer this project's research question, "*How can traditional ecological knowledge be implemented in environmental education?*", the scientific research along with modern practices in environmental education will be connected through the review of literature. While the combination of these concepts is a relatively unexplored area, the review of literature in this chapter will make connections to provide clarity on how Native American culture and environmental education can and should coexist.

Native American Cultural Knowledge

As mentioned before, Native American cultural knowledge is a very broad topic, and it is imperative to understand that each of the many groups of Native Americans have

their own unique cultural history and beliefs. It is also very important to understand that when Native American culture is mentioned in this project, being highlighted are the general similarities of the many different cultures that exist in the different groups of Indigenous people in North America. In a study by Chang, the main principles to answer the research question that will be taken from Native American cultures are the general ideas of a holistic and ecocentric approach, which are shared amongst most groups of Native people (2015).

When incorporating Native American culture into a classroom setting, it is of extreme importance not to generalize all groups of Native people into one single culture. When aligning cultural values with the Minnesota State Science Standards, these connections come from Anishinaabe or Dakota backgrounds, as the Anishinaabe and Dakota people are most prevalent in the state. However, most other areas of the United States would have closer ties to other groups of Native Americans, which would require examples used from their cultures rather than the Anishinaabe and Dakota cultures of Minnesota. Research has supported the idea that cultural literacy establishes a sense of belonging to all students in a classroom setting, and can help students better connect different ideas (Gilliard and Moore, 2006). As studies in this paper address the traditional ecological knowledge that is appropriate to relate to environmental education, I am primarily including concepts that are shared in most Indigenous cultures to be inclusive of the needs of educators across North America, such as ecocentrism, holistic ways of thinking, and connections between science and community. What are these concepts? Make a short list to help ground the rest of this chapter.

Native American cultural history. Native American people have resided in North America for thousands of years living in harmony with the earth by taking care of its resources, and altering lifestyles as necessary with the seasons. The values of today's capitalistic society do not align with the ecocentric lifestyles that Native people have valued for generations. In addition, our current competitive society does not emulate the idea that humans are not outside of nature, but rather a part of it (Cochran and Gelier, 2002). As stated by Rosier,

Dialogue between the vibrant subfields of American Indian history and environmental history can deepen our understanding of the relationship between political sovereignty and environment, the interplay of symbolic space and real place, the role of historical ideas in shaping public discourse about environmental crises, and the roots and range of the environmental justice movement (2013, p. 714).

The idea that humans are not in control over the earth is an ancient idea that has been lost in mainstream society today. Native Americans have historically viewed people as a part of the earth's natural cycle, but as a participant rather than a master, which directly aligns with traditional ecological knowledge, as a human life is viewed as incomplete if it is not embraced as a factor in a balanced environment (Chang, 2015). The interconnectedness between humans and not only the earth, but all of its resources, is at the very core of Native American cultures.

Native Americans have practiced ecocentrism for thousands of years before European colonization of North America. While an ecocentric view is a staple in these

cultures, maintaining spirature balance and community health are also important values. In Native American cultures, the circle is an important reminder that all things have spiritual energy and are interconnected. The circle is used to show a “sacred relationship we share with all living beings in this world, and of our responsibility as a helper and contributor to the flow of the Circle of Life by living in harmony and balance with all our relations” (Portman and Garrett, 2006, p. 457). The ecocentrism and balance that have been prevalent in Native American cultures for many generations is still practiced by many Indigenous people residing on the continent today. These practices are applied to a lifestyle, rather than a branch of science. In this culture, every living being has a spirit, and all of the spiritual and physical beings should treat all of these living beings with respect (Chang, 2015). These values, however, are not recognized by many driving forces in environmental education today. Even Native Americans with advanced science degrees may experience trouble accepting Western science, as it doesn’t address community needs through a holistic way of thinking (Cajete, 2020). The United States Environmental Protection Agency defines environmental education as, “a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment” (United States Environmental Protection Agency, 2018). While this definition addresses future practices, there is no mention of using past histories to aid our understandings. A key resource for environmental education itself is the available literature on Native American cultures and values. Information from literature describing how Indigenous people lived with a symbiotic relationship with the earth for thousands of years are resources that are seldom used, yet readily available.

Native American history after European colonization. The arrival of Europeans with aspirations to make a life in North America brought many more complications than simply different looking people with an unfamiliar language. The most damaging and permanent prospect of what Europeans brought was their culture and their way of life, which is still practiced in mainstream society today. Native American cultural values consist of a collectivistic approach where a worldview is taken into consideration, compared to an individualistic approach in a European centered culture, which is one of the key fundamentals of capitalism (Hain-Jamall, 2013). The purpose of this review of literature is not to support nor discourage capitalism itself; however, it must be noted that competition and production in our capitalistic society have accounted for much of the environmental situation we are currently in. With a lack of environmental regulations in place, there is nothing to prevent industries from exploiting resources for financial profit.

The holistic values that have been suppressed in groups of Native Americans have led to historical trauma in many categories, including the relationships between individuals and the earth. Nicolai and Saus claim,

For many Indigenous peoples, the traumatic history of colonization still hangs heavy in the air, with contemporary living disparities connecting the past and the present in salient ways. The concepts of historical trauma and historical trauma response may contribute to understanding the difficulties facing some Indigenous groups, and for many researchers and professionals, linking the past and present is only natural (2013, p. 56).

With multiple generations of Native people who were taught that their culture was standing in the way of progress, individuals today are still recovering from the lost cultures and connections their people had taken from them (Bruchac, 2005). As many groups of Native people work today to re-establish the culture that the United States government had tried to suppress, the earth which people try to connect with is different than it was before the industrial revolution. With much of earth's natural resources destroyed and depleted for settlement, mining, and farming, the earth itself has not only been taken from, but many other living species who relied on those taken resources have also suffered the consequences (Nyberg, 1993). While literature sources are beneficial to understanding ancient Native American ways of life, it is also important to acknowledge the different state of the earth that Native Americans look to connect with today compared to the earth hundreds of years ago. The consistent values of Native American cultures in regard to the earth, despite its severely damaged state, are still practiced by these same groups of people today. While Native cultures have adapted over time, many core values have withstood challenging times for Indigenous people, and can provide resources to any person or group of people looking to reevaluate their relationship with the earth.

Modern day erasure of Native American culture in society. Today, we view and study environmental education as a constant changing subject for many reasons. One reason is that as a society, we have progressively advanced our knowledge on this topic in general. Another key factor as to why constant change is necessary, is technology and production are constantly improving, which has resulted in both progress and decline in

conservation depending how the technology is used. While we live in an ever changing society today, changes have been necessary for environmental education to keep up. While the world we live in changes, the core values of Native American cultures regarding our relationship to the earth have stayed the same. Recording and speaking of observations from the natural world has always been a value, yet observing the natural world has a different meaning for Native people today than it did hundreds of years ago, as our climate continues to change. In Minnesota, traditional ecological knowledge is used to manage forests as it is recognized that the communities are being negatively impacted by the environmental destruction that has occurred over past decades (Bussey, Davenport, Emery, and Carrol, 2016). Noticable changes in hunting and gathering trends were recorded by Alaskan Natives as early as the 1970s (Cochran and Gelier, 2002). These animal population trends were amongst the first recorded to be altered by global actions rather than local actions. As the changing of the seasons have always held importance with Native American cultures, recorded changes in phenology patterns have aided the research in environmental education, and in many cases have been ahead of Western science.

As connections from natural observations by Native Americans have corresponded to scientific research, it is becoming more common to refer to recorded Native literature to look for studies that explain our environment today (Chang, 2015). As studying Native American literature pertaining to the natural world has increased in popularity, it has become apparent that these groups of people were ahead of their time in documenting changes in the earth's patterns before environmental education gained the

popularity it has today. As Western science catches up with these findings, traditional ecological knowledge has been explored by more people as an effective tool, as “Traditional knowledge can provide scientists with more accurate and timely hypotheses to use in their search for the causes of declines in wildlife, saving time, money, and any delay in action” (Cochran and Gelier, 2002, p. 1407). As past recordings by Native Americans continue to be validated today, we must not only ask ourselves what more can be learned from looking at the earth from this point of view regarding past studies, but also how can we implement this today in our modern approach to environmental education?

As environmental educators learn from literature how Indigenous values express a healthy relationship with the earth through connectedness, we must be conscious of what can be learned from the successes and failures of our past. Likewise, we must also take those lessons and apply them to our future in environmental education. Educators need to grasp the concept that the earth should be treated with tenderness, and that our actions leave a mark on the earth that takes time to heal (Nyberg, 1993). The ecocentric views that are valued in the cultures of Native Americans are ideas that many modern day environmentalists are looking to reinvent rather than learn traditions that have been centered around the well-being of the earth for generations. However, while environmental education has undoubtedly been advanced in recent years, there are still key principles that are missing that can be found in traditional ecological knowledge. “The Native American eco-activist point of view is less compromising than that of the mainstream environmental groups, who by now are used to trade-offs—this tract of forest

for that, this set of emissions standards for another” (Pennybacker, 2000, p. 30). Any missing concept disrupts the balance between humans and the earth. While connecting with the earth is seen as good medicine, any action compromising this relationship with the earth and being out of sync can also be viewed as bad medicine (Portman and Garrett, 2006). As we continue to access and apply Native American literature that is available, we must ask which core values can be applied to modern day society, and how can we incorporate them without compromise. In order to apply traditional ecological values in environmental education, the fundamental values and teachings of Indigenous cultures must be understood by educators in order to introduce them in a classroom setting.

Cultural Implementation

For many years, it has been accepted in education that instructional methods and relationships with students can drastically change a student’s learning both positively and negatively. While this can be applied in any subject, this especially applies when bringing a cultural component into classroom material. While including different cultures in a classroom can be extremely challenging for teachers, finding common ground for students to relate to is of vast importance. In a study done by Helin and Sandstrom, developing a universal code in a business setting through storytelling can set a common ground, and increase production and compatibility with people of different cultures (2008). When introducing any culture in the form of supplemental content, the attitudes of educators and students must be of an open mindset, and ready to appreciate all new cultures as ways to expand on our existing knowledge and ideas. When incorporating cultural values in any form of education, it is important to take care of and respect the

studied culture, and not present it as something that can be exploited or disrespected (Capurso, 2010). While mindset and respect are an important base in incorporating cultural values in a classroom, there are also sets of skills that both teachers and students should consistently work to improve upon, such as, encouraging different views, being mindful of other opinions, and avoiding the stereotypes that may exist in studying cultural diversity (Yang et al., 2014).

Teacher responsibility in cultural implementation. To understand how to appropriately apply traditional ecological knowledge in environmental education, non-Native students must first have to be open to receiving information from different cultures in order to think of concepts different from their typical ways of thinking, along with Native students being open to learning from their own cultural histories. In order to both create a classroom with this mindset and apply the scientific material in this context, effort and mindfulness from the teacher are required. A challenge that must be addressed is the pressure of teacher accountability, as this type of learning environment requires a teacher to adapt to this style that differs from what most educators are accustomed to. A teacher must provide inclusive material that forces students to think critically, develop decision making skills from a holistic point of view, and have an understanding of the Native American culture where these skills are practiced (Kim, 2017). The ability to comprehend this material requires teachers to create a classroom mindset that must be established before the core principles of environmental education are introduced. Extensive research has supported that students' ability to comprehend cross-cultural references increases critical thinking skills (Yang et al., 2014). Naturally, many educators

have little experience teaching units from a different cultural perspective than their own. It is not only a challenge to become educated on multiple cultures, but most teachers are not trained to work with other cultures different than their own, or even evaluate their own cultural literacy by speculating how their own viewpoints affect how the provided material is being received (Gilliard and Moore, 2006). While cross-cultural connections aid student learning, the national and state standards still don't require teachers to instill these values in their classrooms. This project looks to provide ideas for Native American cultural incorporation as limited sources for this topic are provided to most educators.

Portraying Native American culture as teachings that can provide scientific information is a critical skill for a teacher, as many misconceptions exist that these Indigenous teachings aren't considered as accepted science (Kim, 2017). When Indigenous teachings are appreciated and respected by students, they are more likely to comprehend the intended values and apply them appropriately (Wilcox, 2015). The goal of this portrayal is to give students the skills to critically think how actions affect the well being of the earth (Rich, 2012), and assess how political decisions can directly and indirectly contribute to the well being of the earth (Saito, 2014). Native teachings are used to understand how the well-being of land, water, and the sky are not only of importance, but a part of the cultural identity (Unsworth, Riggs, and Chavez, 2012). Once students are open to Native American cultures and teachings, many natural connections will be made with environmental education. These connections will be better understood than a typical educational setting where many people don't see material that involves culture.

Implementation of Native American values in science. Productively incorporating Native American values into environmental education includes both teachers and students understanding which values from different cultures aid the understanding of the material. Many practices have proven to be successful in using these values to aid student understanding. When possible, applying culture to local examples can help with students making connections. In a British Columbia study, a project was put in place to include community members being involved in teaching students the practice of local methods of problem solving in the form of hunting, problem solving, and decision making as citizens (Kim, 2017). These skills that include the local culture provide a broader outlook on how to apply the material than a typical classroom setting would, which rarely incorporates hands-on cultural examples. Community based learning, in this sense, views that the cognitive and social elements will be developed through different types of inquiry (Yang, et al., 2014). While this type of inclusive learning is believed to help students of all cultures make better connections, many educators are also hesitant to include this, as it doesn't match the standardized test format (Kim, 2017).

To appropriately incorporate Native American cultures in any branch of science, including environmental education, it is important to understand the common goals in Western science compared to those in Indigenous science. Western science generally has the outcome of using scientific observations to come up with ideas and theories that explain the results, while Indigenous science looks to take those observations and apply it to their culture to see how they can use it to improve life in a communal sense (Dupuis

and Abrams, 2016). The goal of introducing this mindset in a classroom is getting students to discover the mysteries about the earth to further understand it, and work to protect the earth rather than to accomplish it and use the knowledge to exploit its resources. Indigenous science shares many of the same ideas that environmental education bases its principles on in regard to treatment of the earth. However, Native teachings are based from a point of view that allows people to connect to the earth at a more sincere level than environmental science from a Western point of view. Indigenous science and traditions view humans as a part of the circle, not in charge of it, and value the level of interdependence of all species (Rich, 2012). While environmental education may incorporate these values when convenient and seemingly applicable, Native American cultures never break away from these concepts as their core values, regardless of the situation.

Logic-based research regarding the geological history of the earth has been used productively as a natural connection in historical events to current topics connecting Native American history and modern day goals in science. According to a study by Nam, Karahan, and Roehrig, “Logic-based research focuses more on probing students’ cognitive ability or logical thinking involved in the transformation of geological events into correct time series” (2016, p. 487). Logically thinking about the interconnectedness of not just life on earth, but the formation of the earth from a Native American perspective, is a foundation that naturally leads into many topics of environmental education. In order to connect humanity with the living and physical aspects of the world, these topics are natural segues into Native American cultures and environmental

education, provided that the attitudes towards exploring new cultures are established when learning about the physical world (Breening et al., 1971). As educators, using resources available can be a great assistance in connecting traditional ecological knowledge to environmental education. Through online collaboration or connecting to available local resources, working with people who have worked in Indigenous Education programs provide great insight, as a common goal of these departments have been to revitalize the attitudes of students and teachers regarding the connectedness of life on earth, and the earth itself (Capurso, 2010). Using resources and connections to understand the approach and mindset of Native American cultures are important aspects in creating a classroom environment before incorporating these values in environmental education. To address this project's question, "*How can traditional ecological knowledge be implemented in environmental education?*", educators must make conscious efforts to ensure students have the attitude and desire to be culturally literate, and have the ability to think of the interconnectedness of all beings on earth from a holistic mindset.

Environmental Education Pedagogy

To address the research question, incorporating Native American cultures and values will have minimal use in addressing today's environmental challenges if students don't have the skills to apply it to today's issues in environmental education. In addition to staying caught up with environmental education, adhering to the modern policies and standards in place in our public school systems are a constant challenge to teachers who are often teaching to a standardized test. An unfortunate reality is that many teachers spend a significant amount of class time establishing test taking skills and preparing

students for a test rather than focusing on science-based material itself (Johnson, 2006). However, while standardized tests are undoubtedly important in schools, they add a tremendous amount of pressure on teachers across the country, and students miss out on other real-world skills when they are being taught to these tests.

From an instructional perspective, most national and state standards do not require that students make connections to real world implications they may be faced with in the future, such as global environmental challenges, social justice issues, and cultural changes in society (Blenkinsop and Ford, 2018). These challenges that students will undoubtedly be facing as adults are not addressed in standardized tests, which are dictating many educators' teaching methods. What this means for teachers, is that to be effective, they must use current issues to build decision making skills which students will use when they are adults in society, all while tying these skills into topics addressed on state and national standardized tests. Today, most adults are aware of environmental issues that we face as a society, yet they lack the skills to address challenges such as climate change, biodiversity loss, and pollution, by taking any type of action on even an individual level (Johns and Pontes, 2019). While teaching environmental education, the Indigenous value of connecting to the earth and all of its living things, must be introduced and presented in a format that allows students to be able to apply this value to current challenges. This requires students to be connected learners, who "demonstrate attentiveness, knowledge, respect and care, thinking, and agency/action." (Thomas, 2018, p. 178). To instill these types of values in students, this must include a curriculum which requires students to use skills that will help them transform into connected learners. To

solve the problems that environmental education imposes on society today, a classroom curriculum needs to use a bottom-up approach that requires students to think critically. The goal of this approach is for students to come up with strategies as a society to solve these problems, help people see the earth from a holistic view in which everything is connected, and understand that humans are a part of this connection rather than outside of it (Misiaszek, 2016). Student responsibility is crucial when preparing students for the understanding of environmental issues, and teachers can use traditional ecological knowledge from resources that are available to aid them in guiding students to think of themselves as part of the solution to these challenges.

Connecting other science topics to environmental education. Environmental education is a unique topic, as we can't predict future situations that society will be facing. With this in mind, a common question teachers may have is what key principles and facts should they have as a foundation to build a unit around? The biological background that is necessary for teaching environmental education largely consists of the basic principles of ecology, particularly connecting key events in both life and earth sciences and their effects on ecosystems (Johns and Pontes, 2019). Immediately following the study of ecosystems in a classroom is a natural place to introduce environmental education in a science curriculum at any level, as many key ideas here will be applicable in this unit. Ecosystems are also a natural place to introduce traditional ecological knowledge regarding the connectedness of the earth and all of its living species. If cultural literacy has already been instilled as a value in the classroom during an ecology unit, students can enter the topic of environmental education with a mindset

that allows them to use Indigenous knowledge to think critically about how their actions, both individually and as a society, will have an effect on all of the living systems on the earth.

While the ecology background of teachers and students can undoubtedly aid the principles of environmental education, the critical thinking skills that students develop are of greater importance than any introduction of material, as environmental education will continue to evolve as society continues to advance in technology. Teachers can create an environment where these types of skills are valued in a student centered classroom. A student centered classroom requires students to lead discussions, projects, and become responsible for meeting goals provided by the teacher, rather than the teacher controlling the material and methods of learning that would be found in a teacher-centered classroom (Quay and Jensen, 2018). While student responsibility will be recognized in this project's curriculum, a connected teacher, who can "apply an ethic of care that reflects respect for self, others, and place; are curious relational thinkers; are passionate about the inner and outer work of sustainability; and respect Indigenous wisdom" (Thomas, 2018, p. 178), is required for the monitoring of the learning taking place. The desired outcomes in this situation are to create students who learn to self-manage their learning, can use these skills in environmental education to become active in their communities, ask challenging questions, and have the ability to self reflect (Blenkinsop and Ford, 2018).

Inquiry based learning in environmental education. While promoting students to become in charge of their own learning has proven to be extremely effective, it still

requires a transition for teachers whose classroom routine hasn't included this style of learning. A transition tool, which can be used by teachers who are seeking to move to a student centered classroom, is presenting new material in the form of a story where students are able to form their own opinions. Open ended stories of historical events leave room for interpretation by students, especially in environmental education with its political implications (Thomas, 2018). The skill of holistic thinking can also be developed here by examining the environmental injustices Native Americans have faced in the past and present (Lynch and Stretesky, n.d.). Students who get in the habit of interpreting material into their own opinions will be prepared for future participation as citizens deciding on issues inside and outside the realm of environmental education.

According to a study done by Johnson,

Students who participate in an inquiry-based science program ask questions, plan and conduct their own investigations, use appropriate tools and techniques to gather data, think critically and logically about the relationships between evidence and explanations, construct and analyze alternative explanations, and communicate findings in the form of scientific arguments (2016, p. 150).

Building these skills in today's students will ensure the future decisions regarding environmental education are in prepared hands. When addressing the research question, *"How can traditional ecological knowledge be implemented in environmental education?"*, students must be able to explore and interpret material through inquiry to acquire a mindset that will allow them to make connections from Native American cultures and values to environmental education, and use multiple perspectives to see

these connections. Once these skills are instilled amongst the students, they will be able to use the Native philosophies that focus around ecocentric values to provide the required insight to take on current and future issues in environmental education.

Conclusion

The existing literature identified in this section describes the connections between Native American cultures and values, developing cultural literacy in a classroom, incorporating these cultures and values in environmental education, and teacher strategies to be put in place to use cultural connections to address environmental issues in society. A common principle in any branch of environmental education is that we are faced with challenges as a society, and not just as individual citizens. Our actions affect each other in all parts of the world, not just ourselves. Traditional ecological knowledge is far ahead of western science in this regard, as the belief that everything and everyone are interconnected has been practiced for thousands of years. With their methods of managing resources, many different groups of Native Americans have been practicing conservation long before the term environmental education was coined, and they provide many generations worth of productive mindsets and scientific methods to take care of the earth. Collaboration between all citizens to use traditional ecological knowledge to better understand environmental education will prepare society when facing current and future environmental challenges.

To show how traditional ecological knowledge can be applied in a public school science classroom, I develop a high school curriculum that provides a series of lesson plans that includes the preparation of students to think from a holistic and ecocentric

point of view, along with inquiry based learning to allow students to apply the lessons from Native American teachings to today's issues in environmental education. My goal is that this bridges the gap between the readily available information from Indigenous ways of life, to the many similar values that environmentalists share today. I hope to share this curriculum with my own community to support the idea that Native American cultural knowledge can be integrated into the Minnesota State Science Standards. As previously stated, there are many Native American cultures across North America. This project will focus on Anishinaabe culture, as that is most prevalent in my area of northern Minnesota. However, the lesson plans are designed so other Indigenous sources can be substituted for the Anishinaabe sources, as my goal for this curriculum is that it can be used in any area. While generalized ideas will be incorporated into lesson plans to apply this to as many people as possible, teachers are encouraged to incorporate local Indigenous history that is relevant to their own areas.

Chapter Three will include the development of this project, along with the reasoning and justification for the methods used. Also, the target audience will be identified along with the roles of students and teachers.

CHAPTER THREE

Project Description

Introduction

In this chapter, I describe my research question: *How can traditional ecological knowledge be implemented in environmental education?* The goal of this project is to provide connections from Indigenous cultures to aid educators who are teaching environmental education in a public school setting. In chapter one, I described my lack of cultural exposure despite growing up in an area that is rich in Native American history. Chapter two referred to Native American history referring to examples of Native people's relationship to the earth through holistic values, explained practices to incorporate cultural teachings in a classroom setting, and identified how educators with sufficient environmental education pedagogy can apply Native cultures and teachings to modern day environmental education. In this chapter, I will identify the context for the project itself, identify the target audience, describe the detailed steps of the project, identify and explain the chosen framework to be applied to my work, provide a timeline for the research to be completed, and provide rationale for Native teachings being applied in environmental education.

Context

This project will introduce educators and students to a new way of thinking about modern day environmental education. With many current environmental challenges existing, a common theme all of these challenges have is they are constantly changing as technology improves. Environmental education and conservation efforts will rely on new ideas and technologies to combat many of these issues in the future. In addition, the United States Environmental Protection Agency acknowledges problem solving in the future when defining environmental education (2019). While a progressive mindset is necessary in combating current and future global environmental issues, key ideas and beliefs that have existed for thousands of years can serve as a foundation of environmental education if applied appropriately. As we currently face global climate change, habitat destruction, and multiple forms of pollution, it is impossible to address these issues without viewing humans in an environmental context where everything is connected (Chang, 2015). While humans are perceived by many as being separate from nature and its many ecosystems, many Native American cultures' core principles revolve around human relationships with the earth and provide an effective and alternative way of taking care of the earth compared to many western viewpoints.

This project serves to demonstrate how traditional ecological knowledge can be efficiently referred to in environmental education by using core values to approach modern day challenges. Specific connections will be identified in this project, but equally as important are the critical thinking skills that will be developed, as teachers and students will practice viewing the earth from a holistic point of view, which will be new

to many individuals. Activities in lessons deriving from Native teachings, such as those that will be used in this project, will help students develop skills to critically think about socio-environmental issues and how actions can have global effects (Misiaszek, 2016). Through my lesson plans in this project, I will make connections from Native American cultures to the current Minnesota State Science Standards. I will later be able to measure if establishing these connections with both educators and students will result in a better understanding of key environmental concepts, along with improving critical thinking skills to apply ideas and principles to current and future environmental issues in society.

On a local scale, this will impact my current school in our science curriculum by using local examples of Indigenous history. For many students, it will introduce content from their own cultures in a science class and will provide a different way of looking at science compared to other courses in our school. In addition, it will provide students of all backgrounds with chances to look at current issues in environmental education from various perspectives. This project will provide students in my school opportunities to use local history to serve as their foundation for understanding key concepts in environmental education.

Intended Audience

The intended audience will be 10th grade students in the high school biology classes I will be teaching during this project. Lessons in this project, however, may also be applied to other grades studying similar material, as students may take biology at a different grade level depending on which state they live in. According to the Minnesota Department of Education (2019), out of the 449 students at the high school where I will

conduct my project, the ethnic backgrounds represented by percent are: White, 53%, American Indian or Alaska Native, 29.2%, two or more races, 13.8%, Hispanic or Latino, 3.6%, Asian, 0.2%, and Black or African-American, 0.2%. However, nearly all students who identify as two or more races are also Native American. Native students make up about 43% of our school's population when American Indian or Alaska Native and two or more races are combined.

This project will use the Minnesota State Science Standards provided by the Minnesota Department of Education. My current school district uses the Minnesota standards, but the standards used in this project can easily be replaced with similar Next Generation Science Standards (NGSS) that cover the same topics. The Minnesota State Science Standards have been in effect since 2009 (Minnesota Department of Education, 2019), and according to the NGSS website, these standards have been in effect since 2013 (2019). If COVID-19 restrictions for public schools are lifted, this project is on schedule to take place from September to October during the 2020-2021 school year.

Project Components

There will be a variety of lessons used in this project: lessons that include traditional ecological knowledge along with lessons that don't use any cultural examples. This project will take place over 4 weeks in the fall. The entire project will be developed in 2020, as the development of lesson plans started in January. The lessons will be taught in the classroom from September to October and the data analysis from the assessments will be reviewed in November and December. Each of the four units will be designed for five instructional days consisting of 50 minute class periods, including at least one review

day per unit. Units of this project that will include traditional ecological knowledge to aid environmental education are:

1. Ecology
2. Natural Resources
3. Climate Change
4. Current Environmental Challenges

Each of these units were selected as there are not only vast amounts of traditional ecological knowledge resources pertaining to these four topics, but also because these topics are strongly tied together. A significant amount of crossover in concepts and terminology between these four topics already exist, and for that reason, I have already taught these units in succession in years past. As the four units in this project will tie in with each other naturally, it will promote the use of holistic thinking that is emphasized in traditional ecological knowledge.

Rationale

My decision to incorporate traditional ecological knowledge in environmental education derived from the amount of unexplored connections that exist between many Indigenous values and the goals of environmental education. This project aims to develop critical thinking skills in students by introducing them to traditional ecological knowledge and the different perspectives offered by these teachings. I will conduct this project in my own classroom and will measure the effectiveness of introducing this content in a 10th grade biology classroom by using formative and summative assessments. These assessments will be used to determine the percentage of students who

are proficient in applying information from the units to environmental issues. These assessments will be modified and utilized at a later date when students are deemed safe to return to school due to the current pandemic. Scores from each of the three class periods will be recorded and further categorized by comparing scores from Native students to non-Native students.

Lessons in these units will include sections where Native American cultures are included and sections where these cultures aren't included. The purpose of this will be to assess how students perform during different types of lessons. Assessments will measure comprehension of information, along with applying the information to present day environmental issues, through critical thinking. The framework during this project will be supported by the Minnesota State Science Standards, be relatable to NGSS, and will provide connections to these standards through the lessons in each unit.

Curriculum Framework

The lessons in this project will be developed using the Understanding by Design (UbD) framework. This framework will be used and many of its key tenets are shared with the goals of environmental education, such as: students autonomously make sense of learning, curriculum is planned backwards, and teachers are coaches of understanding (Mctighe & Wiggins, 2012). The developed curriculum will be designed to educate the whole person, along with requiring students to apply what they learn to real world examples. When addressing long term environmental issues in society, the process starts with a goal set by the government, private organization, or a group of people at a grassroots level. Once a goal is in place, the process is followed by breaking down the

goal into steps that will eventually lead to the desired outcome. This concept of environmental education naturally aligns with the UbD framework, as working backwards in this framework is comparable to the processes used when establishing environmental goals in society. The UbD framework is also applied in many subjects and will allow this project to be relatable in many areas of science. It will connect many different cultures in addition to examples from the Anishinaabe people that will mostly be used in this specific project.

Summary

The project described in this chapter seeks to provide examples and practices to effectively incorporate Native American cultures and values in topics pertaining to environmental education, along with collecting student data to measure student understanding during and after each unit. Using traditional ecological knowledge, students will develop critical thinking skills that require them to think differently than a western science point of view, as examples from Indigenous science will require a holistic approach. This project will include examples of incorporating this information during each unit, along with lessons that can be adapted by educators to fit their own classrooms.

In Chapter 4, I will review and analyze the conclusions from my project and reflect on the future implications it will provide. The development of the lesson and unit plans will be discussed, along with revisions and improvements to be made in the future. I will then discuss what the conclusions from this project mean for the future of my environmental education teaching experiences.

CHAPTER FOUR

Conclusion

Introduction

The purpose of this capstone is to provide high school students and teachers with resources to effectively use traditional ecological knowledge in a biology classroom. Four years of research, conversations with colleagues, and personal classroom experiences have helped me shape this capstone project into a four week unit with the purpose of productively including Indigenous knowledge to support scientific concepts. The sources I have compiled support the idea that including traditional ecological knowledge not only helps minority students identify with the material, but it also serves as an effective strategy in connecting different areas of science.

While emphasizing the positive outcomes I expect to come from my project, I needed to address the validity of referring to traditional knowledge in science. As I had a lack of exposure to any sort of Indigenous knowledge in my own education, I was pleasantly surprised to find many pieces of literature supporting traditional science being trusted to the same degree as western science. In addition, I explain that the holistic approach that comes with Indigenous ways of thinking aids students in connecting different areas of science to each other more efficiently than western science. By addressing the practicality of this project, along with applying it to modern-day

globalization, I believe I have addressed the question, “*How can traditional ecological knowledge be implemented in environmental education?*”

In this chapter, I share my findings and conclusions from the process of developing this project. I will share my thoughts by revisiting the literature review, project implications, project limitations, future work and recommendations, communicating and using results, and benefits to teachers and students.

Revisiting the Literature Review

When I was in pursuit of picking a capstone project in the spring of 2019, it was of the utmost importance to me that it was something I was passionate about and would use on a regular basis. As a high school teacher, there is nothing I am more passionate about than building connections and relationships with my students. With many of my students being Anishinaabe people, I have been intentional about incorporating Anishinaabe cultural connections in my science classes. As I stated in chapter one, after discovering many different cultural connections I could implement in my classroom, I wondered to myself why I had never been exposed to any of these connections as a student growing up, and felt I had been robbed of a portion of my education. Much of my personal education was explained upon the discovery that traditional ecological knowledge was thought as primitive irrational thought for most of the last century (Omura, 2005). When I decided to dedicate my project to creating lesson plans using traditional ecological knowledge to support scientific ideas, I was encouraged about the amount of literature that was supportive of these kinds of thinking.

While I was pleasantly surprised by the amount of Indigenous resources that were available, I had to be very intentional that my cultural examples for my student body were Anishinaabe specific when creating the lesson plans for my project. As I stated in chapter two, it is imperative that educators are culturally sensitive to their student body, and recognize that the Anishinaabe examples I used in my own lesson plans may have different values and beliefs than many other Native American cultures. In my place of work, I have witnessed many students improve their academic performance through connections made in our school's Anishinaabe Education Department. While I was a full believer that our Anishinaabe Education Department was the cause of so many student successes, I had no data to prove it. Therefore I was encouraged upon discovering that the fourth principle of McCarter and Gavin's inclusion of traditional ecological knowledge was addressing the power imbalance often experienced by minority and Indigenous students (2011). Upon my literature review, I was overcome with joy to discover the vast amount of studies that have been done promoting cultural connections, along with the values of using traditional ecological knowledge in a classroom setting. However, while I gained momentum for my research, this further caused me to wonder why I had to work so hard to find these great traditional teachings and concepts, which I felt further justified this project.

Learning how to back up my claims with qualitative and quantitative data, rather than only describing how I feel, was the most important part of the literature review for my capstone project. While the demographics and needs of my students inspired this project, it was also important to me that all students can benefit during the designed

lesson plans. Therefore, it was important to find literature that supported traditional ecological knowledge being held in the same regard as western science when it comes to accuracy and reliability. In addition to supporting the validity of this, the literature review process also led me to overwhelming support of traditional ecological knowledge connecting different branches of science, along with how to adapt to globalization in a society that is constantly changing.

The Anishinaabe science and worldview of nature, particularly the connectedness of living and nonliving things, led me to design this project. During the review of literature, I discovered that not only scientific practices of Indigenous peoples are trusted in the scientific community in the same realm as western science, but they also provide connections that can help link different areas of science. Huntington describes using traditional ecological knowledge as an effective approach to not just understanding nature, but also to connect the natural world to how we can relate to nature in modern day society (2000). Getting students to discover personal connections to aid understanding that humans are closely connected with nature was the most critical component I felt was missing from most science curricula. A major connection formed from the review of literature was that traditional ecological knowledge supports sustaining the ecosystems, as the ecosystem supports us (Newman, 2011). As all people directly or indirectly depend on the land for survival, encouraging all students to think about their personal lifestyles provided context on how to teach the importance of connectedness in ecosystems to students of all backgrounds.

Another critical component as to why I wanted to include examples of Native American cultures in my classroom is because of how well they link different areas of science, as many cultural examples are rooted in holistic thinking. Rather than viewing ecosystems as something that humans are above, many Indigenous cultures see themselves as a part of a system, not separate from it. As stated by Drew,

Traditional ecological knowledge does not represent a single body of knowledge; rather, it is a useful construct that represents knowledge gathered from undertaking several different pursuits, such as hunting, medicinal collection, preparation for spiritual ceremonies, or maintenance of a household economy. These pursuits are generalized activities found in many traditional societies and characterize ways in which Indigenous peoples interact with the natural world. These interactions, carried out over countless generations, are the genesis of traditional Ecological Knowledge” (2005, p. 1287).

This kind of thinking leads to the understanding that there is more to ecology, or any science topic, than what is learned in a classroom or a textbook. Encouraging students to establish connections to build upon the already known will open up many learning opportunities for them, and using traditional ecological knowledge to encourage these types of thinking is one of many reasons why it is valuable in a classroom setting.

The other major takeaway from the literature review process was addressing the fact that turning to traditional ecological knowledge could turn out to be more important now than ever before as our world continues to evolve and globalization becomes more prevalent. As I mentioned in chapter two, capitalism has been at the root of the

overexploitation of natural resources. This is in contrast to the values of Indigenous cultures, as it is expected that work will be put in to sustain the resources of the land, rather than just take them (Newman, 2011). While there is concern that cultural values of any kind will be passed down in today's fast-paced society, many core principles of traditional ecological knowledge have proven to withstand the test of time, as they have been practiced by Indigenous peoples for thousands of years (McCarter, Gavin, Baereleo, & Love, 2014). Discovering literature to address an ever-changing society inspired me to link Anishinaabe culture to the formation of environmental policies during the last week of my ecology unit, where students speculate on how to use holistic thinking for present and future environmental issues.

As I began my project, I continually referred to these pieces of literature to justify when and where to include Indigenous cultures, how they were implemented into the curriculum, and how to tie in different teachings to modern day ecological and environmental issues.

Project Implications

This project was designed to use traditional ecological knowledge to improve student understanding in environmental education. Rather than only using textbook examples that rarely include cultural examples, I was keen to seek out ways I could provide scientific material that my students could relate to. This project consistently revolves around Anishinaabe connections, and the sad reality is that this will be the first time many of my students will see that science has always been a prevalent part of their own cultures. Many conversations have taken place with my coworkers regarding how to

effectively teach minority students to understand that all cultures have contributed to scientific discoveries throughout history. Visits to the Anishinaabe education room during my lunch and prep time, as well as conversations with staff who work there, convinced me of the importance of students identifying with the material they are being expected to learn. It was also important to me that the Indigenous cultural examples used could connect with all students, and not just my Anishinaabe students. While establishing cultural connections with my students is a crucial component of my project, the bigger picture is that students of all backgrounds will benefit from traditional ecological knowledge. The purpose of using these cultural examples was to improve the education of all students, and I wouldn't hesitate using them in classrooms that have no Native students. I chose to design lesson plans for a 10th grade classroom, as that is the grade level where Minnesota students take biology. These lesson plans can be easily adjusted for different grade levels in middle school and high school. Although my lesson plans consist of Anishinaabe examples, this unit was designed where different cultural examples can be substituted, as many cultures, particularly Indigenous cultures, have strong values that revolve around taking care of the earth. While it will take a small amount of editing for other educators to alter this unit for their own student bodies, I am hopeful and confident that this unit can fit in any educational setting. As I look to introduce this unit in the 2020-2021 school year, I will make changes to improve the effectiveness of the unit based on my successes and failures in the classroom. There will also be many opportunities for me to expand on this unit, and use traditional ecological knowledge to make more connections in biology and other areas of science.

Project Limitations

During the many conversations I have had with my coworkers regarding my project, I have received nothing but support and guidance from both administration and fellow teachers alike. The first people I talked to about my project were the members of our Anishinaabe education room, as I wouldn't be able to fathom doing this kind of project in a place of work that didn't support me. While I feel fortunate to be in such a position, a potential limitation for other educators is the lack of support they may or may not receive from their administration and coworkers. As the Minnesota State Science Standards and Next Generations Science Standards have very few standards that include cultural examples, educators must be intentional about including traditional knowledge in their curriculum. While most people have been predominantly exposed to western science, questions may arise on why traditional ecological knowledge can support student achievement, as most people have not been exposed to it in their own educations.

As explained in chapter two, it is important to understand there are many Indigenous cultures in North America alone. With that in mind, the lesson plans in my project revolve around Anishinaabe culture, as that is most prevalent in the area in which I teach. If this project was to be used outside of northern Minnesota, northern Wisconsin, or southern parts of Canada, other Indigenous cultures would be better used to reflect the history of the area. While I designed my lesson plans to be used in my particular school, I believe the best part of my project is the adaptability of it. This will be advantageous to myself as I revise my work over the years, but more importantly it allows other cultural examples to be substituted in. Rather than the unit being based around Anishinaabe

culture, the cultural examples were simply used to support basic ecology principles, and many Indigenous resources could be substituted to support these same principles.

Future Work and Recommendations

The component of this project I am most excited about is the opportunities it will provide for future work. The adaptability of this project provides unlimited examples of how this can be used for future use, as many forms of Indigenous knowledge other than the Anishinaabe examples used in my own project could be used in this curriculum. As previously mentioned in this chapter, I will continually revise this project in the future with the goal of reaching full potential in student achievement. In addition to revision, there are endless opportunities to expand upon this work. As using traditional ecological knowledge is an untapped resource for most educators, it is my hope that it will become more common in science education. It is a goal of mine that this project not only contributes to curriculum in my own classroom, but influences other educators in and outside of my place of work. While Indigenous knowledge is extremely useful for ecology and environmental education, there are many other areas of science that would benefit from the holistic types of thinking that these cultures provide. I envision myself using the holistic thinking in this project in other areas of science throughout the course of the 10th grade school year. When I am satisfied with the effectiveness of this project in my own classroom, I plan on building on the knowledge and thinking processes of this unit to apply to other areas of biology. All of the Minnesota State Science Standards and Next Generation Science Standards are connected and relate to each other, which excites me about the possibility to expand upon the groundwork that this project had provided.

Communicating and Using Results

Measuring results from this unit are going to dictate how I communicate my findings. While it has been frustrating to postpone the use of my project due to COVID-19, my intentions of communicating results have not changed. I am first going to collect data by looking at assessment scores from this unit compared to other units in biology where I did not use Indigenous knowledge to support the material. I will use demographics such as race/ethnicity and gender to measure how different student group scores were impacted, both positively and negatively. In addition to assessments in my own classroom, I will use the same demographics to measure the success of different student groups using standardized testing. All demographic information from current and prior years regarding standardized test scores will be provided by the Minnesota Department of Education website.

While I am in unwavering support of using traditional ecological knowledge to support scientific material, I look forward to acquiring data from my own classroom. If the data from my own classroom supports that Indigenous cultures can increase student performance, I will be very outspoken about my project. This would give me a platform to collaborate with people in my place of work on how to expand on this type of unit. With the continual growth of technology, collaboration with other school districts is also possible through online learning and social media. The literature review process was incredibly helpful, as an overwhelming amount of sources supported using cultural examples in science, and expanding on this knowledge by providing my own data

through in-person interactions and technology is how I look forward to communicating my results.

Benefits to Teachers and Students

This project was designed to be used, adjusted, and expanded by other educators. While the Anishinaabe cultural references used in this project were integral to the curriculum I will use in my classroom, there are many opportunities for educators to use examples from other Native American cultures if they feel it will better fit their classroom. This project aims to demonstrate when and where traditional ecological knowledge can fit in a modern ecology unit, and the sources used in my own curriculum are only a few examples of an abundance of resources available. In addition to providing ways to include Indigenous knowledge in science, this project also provides a classroom layout for effective group discussions. The importance of small and large group activities is apparent throughout this project and demonstrates ways to monitor student centered learning that can be applied to any area of education.

Including student centered learning is an important benefit for students, as it gives them responsibility for their own education. While teachers in this unit are constantly monitoring progress based on both verbal and written responses, the students have the opportunity to choose their course of learning. Students are often asked to use examples from their own lives and experiences to relate to traditional Anishinaabe culture. There are also ample opportunities for students to provide their own opinions and input, as they refer to traditional Anishinaabe knowledge to address today's problems in ecology, environmental education, and other areas of science. This project is meant to connect

with students of all backgrounds by applying traditional ecological knowledge to different aspects of their own lives.

Summary

The revisitation of the literature in this chapter has done nothing but raise my excitement to teach this unit in my own classroom. The many sources reassuring that traditional ecological knowledge enhances student learning, especially minority students, will continue to inspire me as I test this project in my own classroom, as there are bound to be failures as well as triumphs during this process. I believe this project will help me further connect and relate to my students, and promote science as a subject all people can relate to. Despite the incredible value Indigenous knowledge brings to science, I had only included a few cultural references in my classroom prior to this project, as I hadn't yet educated myself on how to appropriately do this. The more research I did during this project, the more I recognized that the failure to include traditional ecological knowledge in biology, let alone an environmental education unit, was a severe injustice. I look forward to sharing my successes and failures with other educators as we embark on an endless mission to improve the education for our students. Shifting the view of other educators to value the inclusion of traditional ecological knowledge in a science classroom is an uphill battle, but this project gives me a platform to begin. Let's get to work.

REFERENCES

- Blenkinsop, S., & Ford, D. (2018). The relational, the critical, and the existential: Three strands and accompanying challenges for extending the theory of environmental education. *Journal of Outdoor and Environmental Education.*, 21(3), 319-330.
- Breening, N., Farnham, A., Scheutte, A. (1971). The Indian's Identification with the Earth: A Native American Curriculum Unit for the High School. NATAM XVI.
- Bruchac, J. (2005). *Code Talker: A novel about the Navajo Marines of World War Two.* New York: Dial Books.
- Bussey, J., Davenport, M. A., Emery, M. R., & Carroll, C. (2016). "A Lot of It Comes from the Heart": The Nature and Integration of Ecological Knowledge in Tribal and Nontribal Forest Management. *Journal of Forestry*, 114(2), 97-107.
doi:10.5849/jof.14-130
- Cajete, G. (2020). On Science, Culture, and Curriculum: Enhancing Native American Participation in Science-Related Fields. *Tribal College Journal.*, 31(3).

- Capurso, M. (2010). Surviving Stereotypes: Indigenous Ecology, Environmental Crisis, and Science Education in California. *Teacher Education Quarterly.*, 37(4), 71-86.
- Chang, L. (2016). Spirits in the Material World: Ecocentrism in Native American Culture and Louise Erdrich's Chickadee. *Children's Literature in Education.*, 47(2), 148-160.
- Cochran P.L. & Gelier A.L. (2002). The melting ice cellar: What Native traditional knowledge is teaching us about global warming and environmental change. *American Journal of Public Health.*, 92(9), 1404-1409.
- Drew, J. A. (2005). Use of Traditional Ecological Knowledge in Marine Conservation. *Conservation Biology*, 19(4), 1286-1293. doi:10.1111/j.1523-1739.2005.00158.x.
- Dupuis, J. and Abrams, E. (2017). Student science achievement and the integration of Indigenous knowledge on standardized tests. *Cultural Studies of Science Education.*, 12(3), 581-604.
- Gilliard, J.L., & Moore, R.A. (2007). An Investigation of How Culture Shapes Curriculum in Early Care and Education Programs on a Native American Indian Reservation. *Early Childhood Education Journal.*, 34(4), 251-258.

- Hain-Jamall, D.A.S. (2013). Native-American & Euro-American Cultures. *Multicultural Education : The Magazine of the National Association for Multicultural Education.*, 21(1), 13-19.
- Helin, S. & Sandstrom (2008). Codes, Ethics and Cross-Cultural Differences: Stories from the Implementation of a Corporate Code of Ethics in a MNC Subsidiary. *Journal of Business Ethics.*, 82(2), 281-291.
- Huntington, H. P. (2000). Using Traditional Ecological Knowledge In Science: Methods And Applications. *Ecological Applications*, 10(5), 1270-1274.
doi:10.1890/1051-0761(2000)010[1270:utekis]2.0.co;2
- Johns, R.A. & Pontes, R. (2019). Parks, rhetoric and environmental education: challenges and opportunities for enhancing ecoliteracy. *Journal of Outdoor & Environmental Education*, 22(1), 1–19.
<https://doi-org.ezproxy.hamline.edu/10.1007/s42322-019-0029-x>
- Johnson, C.C. (2006). Effective Professional Development and Change in Practice: Barriers Science Teachers Encounter and Implications for Reform. *School Science and Mathematics.*, 106(3), 150-161

- Kim, M. (2017). Indigenous knowledge in Canadian science curricula: Cases from Western Canada. *Cultural Studies of Science Education.*, 12(3), 605-613.
- Lynch, M. J., & Stretesky, P.B. (2011). Native Americans and Social and Environmental Justice: Implications for Criminology. *Social Justice : A Journal of Crime, Conflict & World Order.*, 38(3), 104-124.
- McCarter, J., & Gavin, M. C. (2011). Perceptions of the value of traditional ecological knowledge to formal school curricula: Opportunities and challenges from Malekula Island, Vanuatu. *Journal of Ethnobiology and Ethnomedicine*, 7(1), 38. doi:10.1186/1746-4269-7-38.
- McCarter, J., Gavin, M. C., Baereleo, S., & Love, M. (2014). The challenges of maintaining indigenous ecological knowledge. *Ecology and Society*, 19(3). doi:10.5751/es-06741-190339.
- Mctighe, J & Wiggins, G. (2012). Understanding by Design Framework. Retrieved from: https://www.ascd.org/ASCD/pdf/siteASCD/publications/UbD_WhitePaper0312.pdf

Minnesota Department of Education. (2009) Minnesota K-12 Academic Standards in Science (2009). Retrieved from: <https://education.mn.gov/MDE/dse/stds/sci/>

Misiaszek, G.W. (2016). Ecopedagogy as an element of citizenship education: The dialectic of global/local spheres of citizenship and critical environmental pedagogies. *International Review of Education / Internationale Zeitschrift Für Erziehungswissenschaft*, 62(5), 587–607.

<https://doi-org.ezproxy.hamline.edu/10.1007/s11159-016-9587-0>

Nam, Y., Karahan, E., Roehrig, G. (2016). Native American Students' Understanding of Geologic Time Scale: 4th-8th Grade Ojibwe Students' Understanding of Earth's Geologic History. *International Journal of Environmental and Science Education : IJESE.*, 11(4), 485-503.

Next Generation Science Standards. (2019). Read the Standards. Retrieved from: <https://www.nextgenscience.org/search-standards>

Newman, A. (2011). Inclusive Urban Ecological Restoration in Toronto, Canada. *Human Dimensions of Ecological Restoration*, 63-75. doi:10.5822/978-1-61091-039-2_5

Nicolai, S.S., and Saus, M. (2013). Acknowledging the Past while Looking to the Future: Conceptualizing Indigenous Child Trauma. *Child Welfare.*, 92(4), 55-74.

- Nyberg, L.M. (1993). Earth's Caretakers: Native American Lessons. *Earth's Caretakers: Native American Lessons.*, Earth's Caretakers: Native American Lessons., 1993.
- Omura, K. (2005). Science against Modern Science: The Socio-Political Construction of Otherness in Inuit TEK (Traditional Ecological Knowledge). *Senri Ethnological Studies*, 67, 323-344. Doi: <http://doi.org/10.15021/00002674>.
- Pennybacker, M. (2000). 'The First Environmentalists'. *The Nation*, 29-31. Retrieved from <https://www.thenation.com/article/first-environmentalists/>.
- Portman, T.A.A. & Garrett, M.T. (2006) Native American Healing Traditions. *International Journal of Disability, Development, and Education.*, 53(4), 453-469.
- Quay, J. & Jensen, A. (2018). Wild pedagogies and wilding pedagogies: teacher-student-nature centredness and the challenges for teaching. *Journal of Outdoor & Environmental Education*, 21(3), 293–305.
<https://doi-org.ezproxy.hamline.edu/10.1007/s42322-018-0022-9>
- Rich, N. (2012) Introduction: Why Link Indigenous Ways of Knowing with the Teaching of Environmental Studies and Sciences? *Journal of Environmental Studies and Sciences.*, 2(4), 308-316.

- Rosier, P. C. (2013). "Modern America Desperately Needs to Listen": The Emerging Indian in an Age of Environmental Crisis. *Journal of American History*, 100(3), 711-735. doi:10.1093/jahist/jat513
- Saito, H.C. (2014). Science and Education across Cultures: Another Look at the Negev Bedouins and Their Environmental Management Practices. *Cultural Studies of Science Education*., 9(4), 977-991.
- Thomas, G. (2018). Pedagogical frameworks in outdoor and environmental education. *Journal of Outdoor & Environmental Education*, 21(2), 173–185.
<https://doi-org.ezproxy.hamline.edu/10.1007/s42322-018-0014-9>
- United States Environmental Protection Agency. (2019). What Is Environmental Education? Retrieved from:
<https://www.epa.gov/education/what-environmental-education>
- Unsworth, S., Riggs, E.M., and Chavez, M. (2012). Creating Pathways Toward Geoscience Education for Native American Youth: The Importance of Cultural Relevance and Self-Concept. *Journal of Geoscience Education*., 60(4), 384-392.
- Wilcox, K.C. (2015) "Not at the Expense of Their Culture": Graduating Native American Youth from High School. *The High School Journal*., 98(4), 337-353.

Yang, J., Kinshuk, Yu, H., Chen, S.J., & Huang, R. (2014). Strategies for Smooth and Effective Cross-Cultural Online Collaborative Learning. *Educational Technology & Society: Journal of International Forum of Educational Technology & Society and IEEE Learning Technology Task Force.*, 17(3), 208-221.