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AMERICAN INDIAN CULTURE AND SECONDARY SCIENCE CURRICULA:
EXAMINING THE CONFLUENCE OF NATIVE EPISTEMOLOGIES AND U.S. PUBLIC
EDUCATION SCIENCE STANDARDS

by

Molly A. Wolk

A Dissertation Submitted in

Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

in Urban Education

at

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August 2021

ABSTRACT

AMERICAN INDIAN CULTURE AND SECONDARY SCIENCE CURRICULA: EXAMINING THE CONFLUENCE OF NATIVE EPISTEMOLOGIES AND U.S. PUBLIC EDUCATION SCIENCE STANDARDS

by

Molly A. Wolk

The University of Wisconsin-Milwaukee, 2021
Under the Supervision of Dr. Leanne M. Evans and Dr. Tracy J. Posnanski

Innate to the traditional science curricula taught under the auspices of United States public education are a Neoliberal axiology and Eurocentric epistemology (Howard & Kern, 2019) that do not meet the cultural needs of American Indian students (Cobern & Loving, 2001). It is inequitable that American Indian students do not see themselves and their cultures reflected in traditional public school science texts and curricula. At the confluence of often-undifferentiated science curricula and American Indian culture and language, there is a need for a responsiveness that benefits American Indian students. This present study illuminates the research question, “What is revealed about culturally responsive pedagogy for American Indian students in the process of examining the cultural content of an American Indian text alongside traditional U.S. public education science standards?” This study is framed by culturally relevant pedagogy (Ladson-Billings, 1995), culturally responsive pedagogy (Gay, 2002), and tribal critical race theory (Brayboy, 2005), and centralizes the cultural and educational needs of American Indian students whose identities have traditionally been silenced and devalued in the public school setting. Connections between culturally responsive pedagogy and classroom practices that support American Indian students are elucidated in ways that support their consideration by Native and non-Native teachers. It is through a Native text-to-science standards

analysis that the morphologies, etymologies, and usage of Native languages are connected to traditional U.S. Western science educational outcomes. The research question herein was addressed in a phenomenological methodological process through which a generalizable model was conceptualized for its applicability beyond the present study. The intent of this model is to help schools with defined belief systems understand how to align their values and culture with federal and state curricular guidelines for science. This study revealed three findings: (a) teachers used their cultural knowledge as the essence of their instruction, (b) teachers acted as language brokers when they considered instructional materials, and (c) teachers expressed ambivalence toward science standards related to their instructional planning, design, and implementation. As the findings of this study reconceptualize the confluence of Native epistemologies and Western science, there are implications for teachers, educational systems, and standards/policy decision makers.

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I dedicate this investment of time, mental fortitude, and heart to all Native peoples on Turtle Island. This research is also dedicated to all my students, especially my very first students, the Apsáalooke children at St. Charles Mission School in Pryor, MT. You stirred my soul and solidified my calling to be a teacher. Through the work required of this dissertation, I sought to *know* more so I could *do* more. This scholarship is humbly dedicated to you—all my students, past, present, and future.

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LIST OF ABBREVIATIONS

AI	American Indian
AN	Alaskan Native
CRP	Culturally Relevant Pedagogy
CRT	Critical Race Theory
DPI	Department of Public Instruction
ESS	Earth and Space Science
ESSA	Every Student Succeeds Act
ETS	Engineering, Technology and Society
IK	Indigenous Knowledge
IS	Indigenous Science
LS	Life Science
NCES	National Center for Education Statistics
NCLB	No Child Left Behind
NGSS	Next Generation Science Standards
NOS	Nature of Science
NRC	National Research Council
NSTA	National Science Teaching Association
PS	Physical Science
SEP	Science and Engineering Practices
WMS	Western Modern Science
WSS	A U.S. Midwest State's Science Standards

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Chapter 1: Introduction

Often referred to as an asterisk and scarcely mentioned in classrooms, except on Indigenous Peoples Day, the history and experiences of American Indian students deserve much more than the common statistical afterthought or obligatory annual lesson presented by a non-Native teacher to her non-Native students. This present study endeavors to centralize the cultural and educational needs of American Indian students whose identities have traditionally been silenced and devalued in the public school setting. This research is embedded in cultural responsiveness as it intertwines with American Indian culture and the subculture of Western science.

Problem Statement

Innate to the traditional science curricula taught under the auspices of United States public education is a Neoliberal axiology and a Eurocentric epistemology (Howard & Kern, 2019) that does not meet the cultural needs of American Indian students (Cobern & Loving, 2001). The number of American Indian/Alaskan Native (AI/AN) students enrolled in U.S. public, private, Bureau of Indian Education, and Department of Defense schools is 522,813 (Ninneman, Deaton, & Francis-Begay, 2017, p. 26). These AI/AN students comprised one-percent of the 50,044,522 total students enrolled in U.S. schools in 2015 (Ninneman, Deaton, & Francis-Begay, 2017, p. 26). In the lives of AI/AN students, colonization and its effects continue to be visible (Solórzano & Yosso, 2002), in part, through the enactment of pedagogical practices and the teaching of curricular content driven by the EuroAmerican and Western science subcultures (Aikenhead, 1997), intrinsic to the U.S. public education system. Furthermore, U.S. science curricula are traditionally taught within monoculturally undifferentiated methods causing a disconnect for all students, specifically American Indian students, who do not see their cultures

represented and who may hold competing epistemologies (Cobern & Loving, 2001). Western science has habitually been “hostile” to indigenous cultures and ways of learning (Smith, 2013, p. 161).

Moreover, and relevant to the cultural disconnect necessitating the present study, one of the deleterious effects of colonization on American Indian students is language loss (Brayboy, 2005). This is problematic because language and culture are innately woven together in such a manner that they cannot be disconnected (Gilbert, 2010). Regarding American Indian identities, “When a people lose their language, they lose their culture and eventually their identity as a people group” (Gilbert, 2010, p. 44). This statement is illustrative of how truly enmeshed language and culture are for American Indians. It is inequitable that American Indian students do not see themselves and their cultures reflected in traditional public school science texts and curricula. At the confluence of often undifferentiated science curricula and American Indian culture and language, there is a need for a responsiveness that benefits American Indian students.

Purpose

Although American Indians have suffered unimaginable cultural and linguistic near-erasure since European contact, tribes have since focused on cultural continuity rather than cultural loss. There is an understanding among Native nations that although their identities have been silenced, disrupted, and less visible since contact, these nations’ existence now align with the drive toward cultural continuity (Andrews, 2018). The purpose of the present study is in alignment with these efforts by connecting not only Native science and Western science, but also by making concrete the connections between the theoretical and the concrete. Connections between culturally responsive pedagogy and actual classroom practices that support American Indian students will be elucidated in ways that support their consideration by teachers.

In alignment with the phenomenological nature of this research, the unit of study will be the teachers of American Indian students. The voices and lived experience of these teachers will be captured in order to explore the confluence of an American Indian cultural text alongside traditional U.S. education science standards. This methodology intends to examine the ways in which this text is thought to be culturally responsive to the needs of American Indian students. Although only one text will be considered herein, the purpose of this study is to develop a model of the process of text analysis that captures the perspectives of those who will experience this analysis.

Research Question

The research question was reverently crafted as an extension of the study's problem statement and purpose, and is as follows: "What is revealed about culturally responsive pedagogy for American Indian students in the process of examining the cultural content of an American Indian text alongside traditional U.S. public education science standards?" Exploring this question will both a) uncover teachers' perceptions of the alignment of a Native text to Western science standards as it relates to responsive and meaningful science education for American Indian students, and b) provide a model of the process of analyzing this text-to-standards exercise.

Significance

The importance of this present study is that it serves both Native and non-Native students, as well as Native language teachers in sharing with educators a process through which curricular materials can be examined with regard to their cultural responsiveness for American Indian students. This study will represent a process through which teachers can approach a theory-to-practice culturally-based curricular examination. Analyzed in alignment with discrete

Eurocentric science content, the significance of this exercise is that culturally based science curricula are culturally responsive through their convergence with American Indian text and culture. It will be through a Native text-to-science standards analysis that the morphologies, etymologies, and usage of American Indian language can be connected to traditional Western science educational outcomes. What follows is a provision of key terms and their definitions that support engagement with this study.

Defining Terms

History has shown a narrative of assimilation, appropriation, and conflation of terminology surrounding Native peoples. The history of focus here is that of post-contact, meaning at the onset of European colonization of the U.S. as early as the 1500s. In addition to these misconceptions are the myriad misunderstandings that surround Western science. Therefore, several terms and definitions have been provided below in order to build a common understanding that is necessary to engage in this study. Other key terms and topics will be introduced, or further explored, in Chapter 2 where applicable.

Anishinaabe

The well-known 19th century North American and Canadian Catholic bishop and missionary, Frederic Baraga, defines Anishinaabe, which he spells as Anishinâbe, as “Man, (human being, man, woman or child); L. homo;) also, Indian; pl-g” (p. 39). The term Anishinaabe will be used in the present study when discussing citizens and descendants of the Three Fires Confederacy, a term defined later in this chapter.

Anishinaabemowin

Bishop Baraga (1882) defines Anishinaabemowin, which he spells as Anishinaabemowin, as “Indian language” (p. 39). Noodin (2014) more specifically defines

Anishinaabemowin as “the Anishinaabe language” (p. 1). Speakers of Anishinaabemowin call themselves Anishinaabe. Anishinaabemowin refers to the “Ojibwe” language, which is known as the language of the Ojibway, Ojibwa, Ojibwe, which, in English, refers to the Algonquian, Chippewa, Ottawa, or Odawa, and Saulteaux peoples (Nichols, 1992). The term Anishinaabemowin will be used herein when discussing the language of the Anishinaabe.

Border Crossing

A concept that is woven, both implicitly and explicitly, throughout this study is that of border crossing. Aikenhead (1997) coined the term border crossing in describing the act that Aboriginal students engage in when they “cross cultural borders from the everyday subcultures of their peers, family, and tribe, to the subcultures of school, school science, and science itself” (p. 218). In the present study this term will be utilized when discussing the crossing of cultural borders, which will include the following cultures and subcultures: American Indian cultures, adolescent subculture, the culture of U.S. public education, Western culture, and Eurocentric science subculture.

Culturally Relevant Pedagogy

One of the pedagogical, as well as theoretical, concepts grounding this study is that of culturally relevant pedagogy. Ladson-Billings (1995) defines culturally relevant pedagogy as a pedagogy that is founded on three tenets as follows: “(a) students must experience academic success; (b) students must develop and/or maintain cultural competence; and (c) students must develop a critical consciousness through which they challenge the status quo of the current social order” (p. 160). Culturally relevant pedagogy can be misunderstood as a curriculum or a “one size fits all” pedagogical approach which is simply not the case. The theory of culturally relevant

pedagogy will interweave this study in an effort to apply it to the particular settings experienced by American Indian students.

Culturally Responsive Teaching or Culturally Relevant Pedagogy

Within this study, Gay's concept of culturally responsive teaching (2018) is emphasized. This teaching framework is also referred to as culturally responsive pedagogy (2002), because it includes the components of Ladson-Billings' culturally relevant pedagogy and it involves the active participation of teachers. Gay (2002) defines culturally responsive pedagogy as "using the cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching them more effectively" (p. 106). This study will include discussions centered on both culturally relevant pedagogy (Ladson-Billings, 1995) and culturally responsive pedagogy (Gay, 2002). Moreover, the call for culturally responsive pedagogy in science classrooms across the U.S., particularly those serving American Indian students, underlies the necessity for the present study.

Culture

The term culture has been defined by many scholars and in various research efforts (Bishop, 1988; Gay, 2018; Gutiérrez & Johnson, 2017). This present study will utilize Hammond's (2015) definition of culture because it is situated within culturally responsive teaching and it aligns with the theoretical framework guiding this work. Culture is defined by Hammond (2015) as, "the way that every brain makes sense of the world," similar to how every computer has a unique set of hardware that interprets data (p. 22). The author has situated this definition of culture above other definitions because it offers a simple yet comprehensive way of defining a nuanced component of this intersectional work.

Indigenous

The term Indigenous is defined by Castagno & Brayboy (2008), who claim, “[the terms] American Indian and Alaska Native [are used] interchangeably with Native and Indigenous to reference groups of people who claim the earliest connection to land bases in the United States” (p. 944). A discussion and rationale surrounding this terminology will follow in Chapter 2.

Indigenous Science or Native Science

To define Indigenous science/Native science I draw from Brayboy & Castagno’s (2008) definition that states, “Native or Indigenous science allows the possibility that there are multiple ways of obtaining knowledge. This concept of an Indigenous science recognizes the role of culture, subjectivity, and perspective in making sense of the world, and it draws attention to the notion that we all interpret reality through a particular cultural lens” (p. 736). In this present study, Native science will be discussed as a counterpart to Western science in that there are myriad accounts of science rather than solely the typically upheld Western version.

Ojibwe

The terms Ojibwe and Chippewa are commonly used in reference to the Anishinaabe people. The term Anishinaabe will be used in the present study when discussing citizens and descendants of the Three Fires Confederacy because this term “connects a broader linguistic and cultural community” (Noodin, 2014, p. 6).

Ojibwemowin

Originally recorded and spelled by Baraga as Otchipwemowin, Ojibwemowin is the Ojibwe word for “the Chippewa language” (1882, p. 337). Ojibwemowin is also known as the language of the Ojibwe or Anishinaabe people.

Settler-Colonialism

Rather than privileging the term *settler* in identifying the Europeans who forcibly entered the present day United States in the 17th century, the term ‘colonizer’ will be used in its place. This decision was made in conscious acknowledgement of the Native counter-story to a traditionally whitewashed historical gaze. The term *settler-colonialism* refers to the ideology of acquiring land as property, while eliminating Native peoples and their values from the land (McGinty & Bang, 2016).

Three Fires Confederacy

The Three Fires Confederacy comprises the Odawa, Potawatomi, and Ojibwe ethnic communities, each characterized by their own pedagogical and cultural distinctions (Noodin, 2014, p. 6).

Western Science, Eurocentric Science, or Western Modern Science

Guiding the definition of science in the Western sense, also referred to in the present study as Eurocentric science, I rely on Brayboy & Castagno (2008) who state, “Central to mainstream Western science is the scientific method and the assumption that we can learn about the world around us through observation and experimentation of hypotheses” (p. 736). This type of science has also been referred to as Western Modern Science (WMS) (Snively & Corsiglia, 2001). All three terms will be used interchangeably throughout the present study whenever referring to the gaze of science that originated in Italy, France, England, the Netherlands, Germany, Austria, and the Scandinavian countries in the 16th and 17th centuries (Basalla, 1967).

Land Acknowledgement

This study, exploring the confluence of American Indian culture and Eurocentric science subculture, bears no value without situating this work in a statement of respect to the land and

peoples from which it was born. I ask readers who engage with my work to join me in acknowledging the land upon which this research was conducted (Keefe, 2019), which includes the territory surrounding the Great Lakes. This region is the traditional homeland of nearly two dozen American Indian nations. These nations and their peoples, cultures, and languages are acknowledged not only historically, but also with regard to their active roles in the present and future of this land. The Native nations acknowledged in this study encompass the original inhabitants of the Great Lakes region which includes the following Woodland tribes: Algonkin, Fox, Ho-chunk, Huron, Illinois, Ioway, Iroquois, Kickapoo, Mascouten, Menominee, Miami, Nipissing, Ojibwe, Ottawa, Petun, Potawatomi, Santee Dakota, Sauk and Shawnee (MPM, 2020). Not only is the land upon which this research is being conducted esteemed by its Native inhabitants, but I, too, revere both the innate value of this land as well as the fact that I live here as a result of the privilege extended to me from colonization.

Chapter 2: Literature Review

This study explored the process of examining the confluence of American Indian culture and science curricula through the lens of cultural responsiveness and modeled an analysis of this process for its usefulness and generalizability beyond the present study. The question guiding this examination was focused on what is revealed about culturally relevant pedagogy for American Indian students in the process of examining the cultural content of an American Indian text alongside traditional U.S. public education science standards. The theoretical perspective undergirding this study was that culturally responsive pedagogy (Gay, 2002) and tribal critical race theory (TribalCrit) (Brayboy, 1995). The rationale for this study is a response to the ways United States public schools' science curricula are taught in monoculturally undifferentiated methods in science classrooms in the United States, causing a neglect of the languages and cultures of Indigenous students who hold competing or otherwise differing epistemologies (Cobern & Loving, 2001).

The purpose of this study was to examine the relationship between American Indian culture and the Western science content that is supported by the U.S. public education system in order to understand how this relationship can sustain and revitalize American Indian culture and language. An additional purpose of this study is to develop a process for “producing culturally sensitive instructional strategies and curriculum materials that support student learning” (Aikenhead, 2000, p. 4) in science classrooms. The research question will be addressed in a methodological process that aims to develop a generalizable model applicable beyond the present study. The intent of this model is to help schools with defined belief systems understand how to align their values and culture with federal and state curricular guidelines for science. The

following literature review supports the present study by exploring the three primary areas of existing scholarship.

The first of three primary areas of scholarship supporting this work is that of American Indian students, the centralized constituents of this study. Literature surrounding the historical perspectives on American Indian students is explored from both the lens of colonialism and American Indian perspectives. A discussion on colonialism includes the associated notions of cultural hegemony, the individualistic cultural archetype, and a settler colonialistic gaze as it had played out both in a Midwest state. A discussion on American Indian perspectives then includes a discussion on cultural knowledge as well as American Indian nations today, to incorporate urban settings and urban education.

The second of three primary areas of study in this work is that of schooling for American Indian students. This area of scholarship comprises discussions surrounding American Indian epistemologies in comparison to the epistemological underpinnings innate to U.S. public education, highlighting the theoretical, cultural archetypal and scientific components of both epistemological camps. Another area of study herein includes a discussion on the intersection of American Indian, or Native, science with the view of science upheld by U.S. public education.

The third primary area of literature in this study is that of decolonized classrooms existing in a post-colonial setting. Here, the focus is on shifting the hegemonic paradigm by indigenizing curriculum in ways that sustain and revitalize science for American Indian students. Of primary interest in the present study is a brief exploration of American Indian history and culture as it pertains to the decolonized science classroom.

American Indian Students

The terms Native, Native American, First Nations, First Peoples, Indian, American Indian, Indigenous, and even Aboriginal have been used throughout the scholarly literature, sometimes interchangeably. These terms are typically used in reference to the 574 federally recognized tribal nations (National Congress of American Indians, 2020b) who are native to the geographical region that comprises the modern-day United States. For the purposes of this study the term American Indian has been consciously selected for use in identifying students who are centralized, although not participating, in this study. This decision was made in order to honor the multi-national contexts from which students with American Indian heritage originate and may identify. It should be noted that varying synonymous terms will be used when citing or drawing upon relevant literature that supports this study.

Historical Perspectives

This study is situated within two primary historical perspectives, one of which is settler colonialism and the other of which surrounds American Indian epistemologies. To understand why the present study was developed, it is imperative to consider the historical contexts that have shaped, and continue to shape, the lives of American Indians and, in particular, American Indian students.

Colonialism.

Of the two historical perspectives considered in this study, the colonial viewpoint will be addressed first as it provides the problematic context from which this study was necessitated. The dominant narrative surrounding the past several hundred years of history in the U.S. is that of European colonization and its accompanying ideals. This problematic narrative of colonization derives from colonial and imperial ideologies. Smith (2013) explains that the term

imperialism was initially used to frame the evolution of events that opened up the economic expansion of Europe. Some of the accompanying values of imperialism include “discovery,”—which has intentionally been given quotation marks—conquest, exploitation, distribution and appropriation. Colonialism, which is a manifestation of imperialism, places emphasis on the value of deciding which perspective dominates a historical narrative, all within a perceived universal human experience that exists along chronological time (Smith, 2013). Furthermore, the goal of colonialism is to capitalize on resources that will advance the colonial empire (Glenn, 2015). The cultural footings and implications of this narrative as they relate to American Indian students will be discussed later in this chapter.

An extension of colonialism is the notion of settler-colonialism wherein lies an emphasis and value placed on acquiring land as property which coincides with the elimination of Indigenous peoples and their ideals (McGinty & Bang, 2016). In addition to the claiming and settling of land, settler-colonialism also values the formation of new communities in these places (Glenn, 2015).

Colonization.

Beginning when Europeans colonized North America in the 17th century, driven by their quest for real estate, Indigenous peoples were forcefully removed from their lands and distanced from their languages and cultures. To colonize the land meant that the Native peoples already living on it were effectively forced into assimilating into Euro-Canadian society (Aikenhead, 2002). At the time, colonizers subscribed to Lockean theory (Locke, 1690) which ideologized the notion that, “Only a society built upon the broad foundation of private property could guarantee public morality, political independence, and social stability” (Adams, 1995, p. 5). Conversely, American Indian culture does not consider the ownership of land, rather the considerations are

focused on stewardship of and connectedness to the land. Furthermore, American Indian identity is not only very closely tied to land, but also to the inseparable relationship between language and culture (Gilbert, 2010). The societal value of private property according to Lockean theory (Locke, 1690) is in direct contradiction to the significance of land in American Indian axiology.

Individualism.

Another critical understanding of colonialism is the concept of individualism. Considered as a component of the colonial historical perspective, individualism is also one of two cultural archetypes. This archetype is the result of a shift from the communal understanding of the world that enhanced survival rates in rural human communities to a type of thinking that became individualistically inclined as humans moved from these rural settings (Hammond, 2015). The values innate to the individualistic cultural archetype include individual achievement, independence, learning, contributions and status as well as an emphasis on self-reliance and competition (Hammond, 2015). The rationale for including the individualistic archetype in a discussion on colonialism is that it more deeply elucidates the motivations of European colonizers.

Furthermore, individualism is considered mainstream in many Western countries as well as Australia (Hammond, 2015) and includes values that are related to science such as “future time orientation, the prizing of verbal skills, and beliefs about understanding and mastering nature” (van Hamme, 1996, p. 24). Individualism includes most European cultures and is the archetype that is dominant in the United States even though only approximately 20% of the rest of the world maintains this archetype (Hammond, 2015). Individualism is an archetype that roots the culturally hegemonic qualities innate to colonialism, which propelled the colonization of the present day landmass of the U.S.

Colonization of a Midwest State.

Considered by many as the first “light-skinned visitor” to the Midwest state of this study, French fur trader Jean Nicolet, arrived in 1634 from New France. Nicolet reached the state via canoe in the hopes of extending his trade into the western range of the Great Lakes region. Nicolet and the French viewed the extant tribes there as “potential partners,” presenting them with gifts and introducing to these tribal economic systems various French trade goods including those used in agriculture and hunting. These goods can be seen as disruptions to tribal economies and ways of life because of their social and political effects including the redefined role of tribal women. Some tribes thrived with the introduction of new tools and resources, but—more importantly—the increased demand for furs led to intertribal and intratribal competition for pelts, which was compounded by the availability of firearms and ammunition. The introduction of alcohol and disease, coupled with the promises of Christianity, and the arrival of the adversarial British further complicated the traditionally held Native ways of life (Loew, 2013).

Toward the end of the 19th century, American Indians who were native to a Midwest state were informed by an 1896 U.S. policy that they did not have a right to decide where their children attended schools. Children of the Menominee tribe were either sent away to government boarding schools in the northern region of a Midwest state, sent even farther away to Flandreau, South Dakota, and Carlisle Indian Industrial School, or they remained on their reservation and attended either a government boarding school or a Catholic school there. At these schools, Menominee children were forbidden from speaking their native language or practicing their cultural traditions (Loew, 2013). Similarly, while some Oneida children attended Episcopal and Methodist-run schools on their reservation, other children were sent away to government schools including Carlisle and the Hampton Institute where they were punished if they “spoke Indian”

(Robertson, 1988). In 1934 the Mohican children in a Midwest state were also sent to boarding schools both in-state and beyond where they were discouraged from speaking their native language and expressing their cultures (Loew, 2013).

Colonization of River City.

River City, a pseudonym for the city from which this study was conducted, is an urban locale in the U.S. Midwest. The city has a noteworthy, although not uncommon, cultural and linguistic history with regard to the removal of American Indians from the area by the end of the 19th century, coupled with the increase of diversity of European colonizers who moved in during the same period.

The history of River City, both pre-colonization and post-contact, is deep and layered in sociopolitical, racial, and economic ways. In consideration of the languages and cultures of not only River City, but this Midwest state, it is important to consider how and by whom River City was colonized. The city, originally home to many tribal nations (MRM, 2020), was colonized by three White men who, because they did not get along with one another, divided the land up amongst themselves (Nelsen, 2015). Decades later, these divisions would change and River City would take shape as a noticeably segregated city known for redlining and minoritizing African American families while allowing White families the privileges of desirable real estate and the benefits of associated advantages like employment, education, and access to goods and services. River City County currently has the highest population of American Indians in this Midwest state. A critical view follows, as these concepts of segregation were examined in light of Brayboy's (2005) notion of endemic colonization and how it, like a three-hundred-year-old disease, continues to overrun American Indian cultures, as illuminated in this present study by the impact of Western ideologies in U.S. science classrooms.

Since the 1700s, and prior to its colonization in the mid-1800s, several tribal nations called the River City area home including the following nations: Potawatomi, Ojibwe, Odawa (Ottawa), Fox, Ho-Chunk, Menominee, Sauk, and Oneida (Rindfleisch, 2016). But then, in 1818, a fur trader, Solomon Juneau, “settled” the east bank of one of the major rivers by establishing a trading post there (Nelsen, 2015). Interestingly, in 1820, Juneau married a Menominee woman, Josette Vieau Juneau, with whom they shared 17 children (Loew, 2013). In 1833, a Yankee named Colonel George H. Walker colonized the area south of one of the other rivers, referred to today as Walker’s Point [need pseudonym]. The following year, in 1834, a United States government surveyor, Byron Kilbourn, “settled” the west bank of one of the rivers, and it was later referred to as Kilbourntown (Nelsen, 2015). These three separate factions were not necessarily amicable but, in 1846, River City was incorporated and then divided up into five wards.

American Indian Perspectives.

The second of the two historical perspectives that frames this literature review and its associated study is that of American Indian, or Native, perspectives. This perspective is not situated *after* the colonial perspective in this chapter because it is “less than” or devalued, rather it is placed here, so that the reader may begin to realize the need for the present study, based on the largely silenced narrative presented herein. The picture that the dominant narrative of colonialism paints is one of taming savages when, in actuality, the impact that colonists had on American Indian peoples was one that caused disarray in what were orderly and established societies. Imperialism brought division between American Indian peoples and their languages, cultures, epistemologies, axiologies, and ontologies. This forced detachment from Native ways of being can be thought of as systemic fragmentation and is manifested in the displacement of

Native artwork, skeletal remains, rituals, and ways of thinking from the geographic origins of Native peoples into the hands of curators, scientists and private collectors (Smith, 2013).

Cultural Knowledge.

To understand the fundamental similarities and differences between cultures and their Eurocentric effects on American Indians, it was helpful to explore Hammond's (2015) definition of culture as well as her concept of cultural archetype. After an exploration of these ideas, Hammond's perspective on culture will be applied to the cultures in the Midwest state of this study.

As stated in Chapter 1, Hammond (2015) defines culture as "...the way that every brain makes sense of the world . . . The brain uses cultural information to turn everyday happenings into meaningful events" (p. 22). As such, everyone has a unique culture; culture is dynamic and socially situated. Moreover, with particular relevance to this study, Grimberg & Gummer (2012) argue that, "American Indian contemporary culture results from the merging of traditional tribal culture with mainstream cultural elements, and is characterized by the preservation and revitalization of the tribal cultural heritage" (p. 17). With this in mind, Hammond's (2015) concept of culture was drawn upon to parse the intrinsic differences between imperialistic values and Native values.

In light of the historically deficient definitions of culture, it is important to heed Paris & Alim's (2017) warning about the potentially oppressive lenses of dominant culture. I regard this caution by looking more closely at Hammond's (2015) definition of culture, which is born out of culturally responsive teaching. Hammond (2015) takes her definition deeper by delineating its three cultural levels. These levels are of particular importance, especially when considering Native peoples, in terms of how the misconceptions, biases, and racist views held by the majority

can impact historical perceptions as well as classroom pedagogy. Considering Hammond's (2015) cultural levels allowed me to more deeply understand the challenges of teaching culturally responsive science to American Indian students.

The first of the three cultural levels, surface culture, is the one more often considered by the mainstream and therefore can hinder comprehensive classroom instruction for students of color and students who do not speak standardized American English. Hammond (2015) explains that surface culture consists of "observable and concrete elements of culture such as food, dress, music, and holidays" (p. 22). In other words, surface culture reflects the "heroes and holidays" conception of culture. In drawing parallels between this cultural level and Native peoples, the following statement from Pease Windy Boy (1995) provides an example of how the consideration of solely surface culture is detrimental to American Indian inclusion in mainstream schools. She argues that traditional schooling presents curriculum as "a few learning units that are cosmetically brown or black in complexion or as a few festivals that celebrate the food, clothing, or dance of minorities" (p. 399). Pease Windy Boy's (1995) disposition toward the pitfalls of considering exclusively surface culture is in alignment with its necessity as posed by Hammond (2015).

The next cultural level, shallow culture, can be defined as the "unspoken rules around everyday social interactions and norms, such as courtesy, attitudes toward elders, nature of friendship, concepts of time, personal space between people, nonverbal communication, rules of eyes contact or appropriate touching" (Hammond, 2015, p. 22). Shallow culture is emotionally charged, citing "mistrust, distress, or social friction" when societal norms are disrupted. This particular level of culture is supported through some of the literature on hegemonic, monocultural teaching methods, discussed in this chapter. A component of American Indian

culture that is revealed through Hammond's (2015) notion of shallow culture is that of respecting and learning from the lessons and teachings of elders.

The third level of culture, deep culture, is comprised of "tacit knowledge and unconscious assumptions that govern our worldview" and, more so even than shallow culture, deep culture carries "intense emotional charge" as it encompasses "ethics, spirituality, health, and theories of group harmony" (Hammond, 2015, p. 23). Hammond (2015) clarifies that a person's deep culture is truly how they make sense of and function in the world. This is why everyone has a unique culture which must not be ignored when making historical analyses and pedagogical considerations. For American Indians, deep culture comprises beliefs about creation and the reasons behind ceremonial protocol including the offering of sacred medicines, for example.

American Indian Cultures.

With a continued focus on American Indians students and their cultures, Grimberg & Gummer (2012) argue, "American Indian contemporary culture results from the merging of traditional tribal culture with mainstream cultural elements, and is characterized by the preservation and revitalization of the tribal cultural heritage" (p. 17). If solely surface, or even shallow, culture is employed when considering the teaching of science in science classrooms for American Indian students, then educators are neglecting the "root system[s]" (Hammond, 2015, p. 24) of these students which are the ways they learn and make sense of the world. When defining culture, especially for tribal nations, deep culture as well as the collectivist cultural archetype must be taken into consideration.

The collectivist archetype is marked by relationships, community interdependence, and cooperative learning. This archetype can be found in most Latin American, Asian, African,

Middle Eastern, and many Slavic cultures. In the U.S. this archetype is prevalent in African American, Latino, Pacific Islander, and Native American communities (Hammond, 2015). Many American Indians value “group needs, present time orientation, nonverbal communication and reticence, and spiritual beliefs about nature” (van Hamme, 1996, p. 24). With regard to the present study, Briggs & Peat (1999) further explain the comparison between individualism and collectivism in that human consciousness is influenced by both cultural archetypes. Essentially, Briggs & Peat (1999), like Hammond (2015), acknowledge the spectrum-duality along which the two cultural archetypes exist. When defining culture, especially for tribal nations, deep culture as well as the collectivist cultural archetype must be taken into consideration in order to understand epistemological underpinnings of how American Indians both have and continue to live and move in the world.

American Indian Students Today

In this Midwest state, American Indian students represent approximately 1.2% of the total student population. In this state, there are five Bureau of Indian Education (BIE) funded schools, with a total of 1,667 enrolled students (National Center for Education Statistics, 2020a; NCES, 2020b; Department of Public Instruction, 2020), and one private American Indian tribal school with approximately 300 students (DPI, 2015). Although 1.1% of the state’s students identify as American Indian (WISEdash, 2019), the highest concentration of American Indian students in the state reside in River City County (Electa Quinney Institute, 2016). Additionally, the highest concentration of American Indians of all ages can also be found in the River City metropolitan area (Loew, 2013).

River City is a mid-sized, urban emergent city that experiences similar resource scarcities of those larger urban cities experience (Milner, 2012). Although River City is an urban city, it is

crucial not to conflate the term urban with disadvantaged, deprived, or at-risk especially when labeling poor and minority students (Milner, 2012; Weiner, 1993) and, in the case of this study, American Indian/Native students. Rather than employing a deficit mindset, or a difference approach, toward students in urban areas, it has been argued that urban students maintain a great deal of rich, cultural capital that should not be minimized (Goldstein, 2007). Further underscoring the deleterious practices and Eurocentric value of individualistic control in inner-city schools, Weiner (1993) elucidates the following common occurrences in urban schools:

1. A required adhesion to numerous school rules.
2. The seeming interchangeability of teachers and assignments.
3. The overspecialization of pedagogical functions.
4. An inordinate amount of class time spent on procedures designed to maintain school organization.
5. Little student or teacher control over assignments to classes.
6. Custodial treatment of children different in any way encouraged by the lock-step curriculum.
7. Much of the course content [is] dictated by external examinations. (p. 109)

Given these Eurocentric and hegemonic and monocultural practices, it is critical to instead consider urban American Indian students from perspectives that more appropriately support their cultures and languages, especially if these students are isolated from their tribal communities.

Urban education can be defined by a set of unique features. As previously discussed, urban schools are located in regional areas of high population density and they serve higher volumes of students than their suburban or rural counterparts (Milner, 2012). Urban education is also known for its extreme economic inequality, common infighting on its school boards,

impedance by unproductive management, students who are likely to experience health problems, transportation issues, mobility of administration, teachers, and students into and out of the area, as well as teachers who are less likely to live in the vicinity. Urban education is further characterized by having high rates of ethnic and linguistic diversity including higher populations of immigrant students (Kincheloe, 2007). Included in the ethnic and linguistic diversity found in urban areas are populations of American Indian students. With this in mind, it is critical that teachers both understand and experience ways in which to tailor their curriculum to the needs of American Indian students, and learners from non-Eurocentric traditions.

Given that the majority of a Midwest state's American Indian students live in a metropolitan area it is important to consider the "cultural isolation" these students may feel from tribal communities on reservations (Loew, 2013). There are also challenges experienced by American Indian students who attend schools either on or near their tribes' reservations. For example, the Ho-Chunk tribe cites "the need for more parental involvement as well as adult education that includes child care for nontraditional adult learners" as proposed solutions to its increasing dropout rates and declining literacy levels (*Hocak Worak*, 2022, p. 4). A study performed at a Lac du Flambeau reservation high school cites "a toxic educational culture" at the school possibly resulting from profound resentment over treaty rights, particularly spearfishing (Bowman, 2007). To better understand their educational needs, a review of existing literature on the schooling for American Indian students was conducted from three different lenses.

Schooling for American Indian Students

Although this study addresses American Indian education and its effects starting with European contact, this is not, in fact, when American Indian education started (Medin & Bang, 2014). Beginning with European contact, colonizer-controlled American Indian education took

the approach afforded by a civilization-savagism paradigm (Adams, 1995), which was founded on the Eurocentric ideology that “Indians were savages, but, like whites, could climb the ladder of civilization if they severed all ties with their past and adopt[ed] a mindset of the value of manual labor and work” (p. 256). This approach aligns with the deficit pedagogical approaches that were still dominant in American schools through the 1960s and 1970s. During the assimilative era of colonization and Indian boarding schools, American Indian students began to embrace the ethos that they suffered from innate disadvantages when compared with their White counterparts. American Indian students internalized this mentality and unconsciously shifted their epistemologies, thus completely reversing their understanding of the Indian-White history. This shift aligns with the school of thought inherent in Freire’s (1970) pedagogy of the oppressed. The pedagogy of the oppressed is a mindset resultant of the effects of dehumanization where people, specifically American Indian students in this case, are understood by their oppressors as “the pathology of the healthy society” (Freire, 1970, p. 47). Accordingly, the oppressed began to believe they are “less than.” This assimilative era of American Indian education will be further highlighted as it pertains to the present study because it marks a massive shift in American Indian education from pre-colonial to colonized pedagogies.

Given the aforementioned history, the epistemologies of both American Indians and colonizer-settler Europeans and how these two ways of knowing influence schooling and science instruction are presented and followed by the perspectives surrounding the intersection of American Indian science alongside the hegemonic gaze of science that is propagated by the U.S. public education system.

American Indian Epistemologies

In deepening the reader’s understanding of American Indian students, and in guiding the

reader toward a realization of the tensions between Native thought and Eurocentric science education, this section will present both American Indian, or Native, and Eurocentric epistemologies, beginning with Native ways of knowing and being. The first portion of this section will also include a discussion on Native science.

Tribal Critical Race Theory.

With roots in critical race theory (CRT); anthropology; political and legal theory; political science; and American Indian literature education, and studies, tribal critical race theory (TribalCrit) is concerned with “address[ing] the complicated relationship between American Indians and the United States federal government and begin[ning] to make sense of American Indians’ liminality as both racial and legal/political groups and individuals” (Brayboy, 2005, p. 428). TribalCrit goes beyond the racially dichotomous nature of CRT and deals specifically with the multifaceted legal injustices that Indigenous peoples have suffered as a result of colonization. Some of these injustices include “language shift and language loss, natural resources management, the lack of students graduating from colleges and universities, the overrepresentation of American Indians in special education, and power struggles between fed, state, and tribal governments” (Brayboy, 2005, p. 430). Further, TribalCrit is dedicated to exploring the epistemological and ontological narratives and counter-stories, or decolonized stories, of Indigenous peoples.

TribalCrit is composed of nine tenets, three of which will be presented for their relevance to this present study. The first tenet of TribalCrit posits that colonization is endemic to society (Brayboy, 2005). The effects of the colonization of the U.S. on its native peoples are manifest not only in the past, but also at present. Related to the scope of this present study, not only did colonization cause a near-erasure of American Indian culture and language in the form of Indian

boarding schools, but the endemic effects of colonization continue to play out in schools today. This is evidenced, for example, in the near non-existence of American Indian culture in traditional science classes and science standards (NGSS, 2013).

Related to the discussion on the intersection of Native and Eurocentric science, the fifth tenet of TribalCrit argues that the notions of culture, knowledge, and power are understood in new ways when considered from a Native gaze (Brayboy, 2005). This is a critical piece in the argument for the validity of Native science when juxtaposed with the misperception that Western science is more robust than Native science. Along the vein of discrediting Native epistemologies and, arguably as an extension of the endemic nature of colonization, the sixth tenet of TribalCrit maintains that assimilation of Native peoples into dominant society is the goal of governmental and educational policies towards these peoples (Brayboy, 2005). However, assimilation is problematic because it promotes culture and identity erasure for American Indians.

The endemic nature of colonization should rightly be accompanied by a deep dive into the historical consideration of the ramifications and effects of events including those having occurred at Plymouth Rock and at Indian boarding schools, the long-term implications of the establishment of reservations, and the present awareness being brought to missing and murdered Indigenous women in the U.S. (Joseph, 2021).

Given that colonization is endemic to society, in order to truly understand the impetus for the colonizers' conquest of American Indians and the land which they inhabited, it is necessary to reiterate distinct differences between the epistemological, ontological, and ideological values of American Indians as compared to those of European settler-colonizers. As such, a connection will now be made between Brayboy's (2005) TribalCrit and Hammond's (2005) notion of cultural archetypes as these theories dovetail in explaining related aspects of the fallout of North

American colonization.

TribalCrit and Collectivism Contrasted Against Colonialism.

Congruent with the fact that American Indian chiefs led their tribes with permission rather than coercion, unlike European rulers who instead governed (Loew, 2013), tribal nations upheld ideals including group interdependence, collective wisdom, collaboration and relationships. These ideals align with Hammond's (2015) concept of a collectivist archetype, briefly introduced earlier in this chapter. Conversely, European colonizers valued competition, status, and individualism which aligns with, for example, the French ideals of ruling kings who maintained central authority as well as both political and economic mightiness (Loew, 2013). It can be interesting to consider the aforementioned continuum when applying the critical lens of TribalCrit to the continued impact of imperialism on American Indian identities and cultures in the U.S. Furthermore, Brayboy (2005) argues that the individualistic cultural archetype parallels the second tenet of TribalCrit which states that, "U.S. policies toward Indigenous peoples are rooted imperialism, White supremacy, and a desire for material gain," (p. 429). Conceivably, endemic colonization can be boiled down to the predominance of the individualistic cultural archetype as manifest by settler-colonizers at the expense of American Indians. The distinct ideological differences between the collectivist and the individualistic cultural archetypes are key to understanding the colonial mindset of this conquest.

Native Science.

Derived from the Latin root *scientia*, science in the broadest sense simply means "knowledge" (Snively & Corsiglia, 2001). Elkana (1971) argues that each culture has its own iteration of science or, specifically, a particular worldview that rationally explains the physical world. Understood in this way, both Western science and Native science are simply two forms of

science that exist, even though Western science is the most prevalent form of science worldwide (Ogawa, 1989).

One understanding of Native science is that it broadly encompasses the realms of metaphysics, philosophy, art, architecture, practical technologies, agriculture, rituals and ceremonies for native peoples (Cajete, 2015). Native science, also referred to as Indigenous science, “...is a reflection of active participation, a dance with chaos and her child, the creative spirit” (Cajete, 2004, p. 49), nodding to the collectivist nature innate to Indigenous cultures. It is critical, though, to neither reduce nor conflate the meaning of Native science to “primitive animism [and] sentimentalism” (Cajete, 2015, p. 124).

Other terms that have been associated with Native science include traditional ecological knowledge (TEK) and ethnoscience. “[TEK] is essentially the cumulative body of knowledge associated with ecological relationships, which is handed down through generations by Indigenous people” (Popp, 2018, np). Critics of TEK argue that it “honors the past but also positions Native science as irrelevant to the present” (Medin & Bang, 2014, p. 183).

Ethnoscience, on the other hand, can be considered as “the body of science used by the culture to make the curriculum relevant to the individual” (Davison & Miller, 1998, p. 261). Furthermore, not only must ethnoscience be used in such a way that it makes curriculum relevant for students, but it must also holistically combine all facets of students’ lives. An example provided by Davison & Miller (1998) is that Crow tribal students may study plants that are regionally native, but in a nod toward culturally responsive science, these students “could classify these plants based on their use by the native culture using the Crow language names, religious beliefs, and the medicinal values of the plants as identifiers” (Davison & Miller, 1998, p. 263). It has been suggested that an ethnoscience approach to curriculum development demonstrably increases

cultural relevance for American Indian students who would not otherwise see their cultural “representation of authenticity” represented in curricular materials (Davison & Miller, 1998, p. 262).

Furthermore, Native science is as valid and legitimate a science as Western science in the sense that both epistemologies are ways of knowing about the natural world. In fact, it has been argued that “the very nature of the science gets done reflects who’s doing it” (Medin & Bang, 2014, p. 236). Along these lines, Cajete (2004) argues, “[In] the collective heritage of human experience with the natural world, Native science is a map of natural reality drawn from the experience of thoughts of human generations.” (p. 47). Native science is more complex and nuanced than its commonly attributed misperceptions as being comprised solely of subjective thoughts and emotions. Regarding the roles of the metaphorical mind and the rational mind in Native societies, and how although these two minds are usually balanced, the metaphorical mind is the foundation of Native science (Cajete, 2004). What’s more, Native science “goes beyond objective measurement, honoring the primacy of direct experiences, interconnectedness, relationship, holism, quality, and value” (Cajete, 2004, p. 51). Even within the constraints of empiricism and replicability in science, it has been argued that there is ample space for varying epistemologies to manifest their perspectives (Medin & Bang, 2014). So, regarding Native science and in alignment with an ideal of connection with the universe, the values of “meaning and understanding” are prioritized over a need to “predict and control” (Cajete, 2004, p. 51-52). The value of control is arguably aligned with similar values upheld by settler-colonizers which arguably parallels Hammond’s (2015) individual cultural archetype. In providing further explanation of some of the variances between Native science and Western science, the former “strives to understand and apply the knowledge gained from participants in the here and now,

and emphasize our role as one of nature's members rather than as striving to be in control of it" (Cajete, 2004, p. 47). The concept of having control over nature is in alignment with an individualistic, Lockean ideal of land ownership and the prestige that accompanies the claiming of real estate.

Addressing Misconceptions of Native Science.

Thom Alcoze (2001), Cherokee and retired forestry professor, recalls that as a graduate student, "One of my professors said it [science] didn't exist, they [Indians] didn't have any." Alcoze's professor said to him, "You see, Thom, resource management is a science, and Indians didn't have science" (Alcoze, 2001). In an interview recorded for a science teacher development project, Alcoze (2001) makes a counter argument against the stereotypes that those subscribing to Western science may hold toward Native science,

We started looking for Indian science where science is expressed in Indian tradition.

And found it with plants, starting off. Medicines. And of course the stereotype is well Indian medicine is just superstition and mumbo-jumbo, sleight of hand, and basically it's a witch doctor kind of thing [pause] a stereotype. A lot of strange noises and dancin' and singin' and a lot of shakin' but that's all it is [pause] superstitious. It's not real. What we found out when we looked for facts, we found that even today in modern America there are over 200 medicines in the pharmacopoeia that we use that have direct origins in Native American medical practice. Yes, in fact Indian people did have science. They were using science all the time. They weren't using scientific terminology. They did not publish in scientific journals [pause] that's kind of facetious at that time. But the issue of science then started to be redefined in my definition of what science is all about when we started to see that science is just another word for nature (Smithsonian Institution, 1996).

Teachers who hold traditionally Eurocentric scientific mindsets may not realize that Native ways of knowing about the natural world, or *Indian Science*, encompass a great deal of knowledge. In other words, Western science is not the only science through which to understand the natural world (Ogawa, 1989). On the opposite side of the coin, “Teachers generally viewed Western science as course content to teach or as a way of exploring nature, not as foreign culture that many of their [American Indian] students experienced” (Aikenhead & Huntley, 1999, p. 10). Even though teachers of American Indian students may respect their students’ multicultural epistemologies at face value, the teaching of Native science is not necessarily taught alongside Western science in science classrooms as the literature suggests it should be. To make this point, Aikenhead & Huntley (1999) report that “Aboriginal knowledge was respected by science teachers, but only a token amount was added onto, but not integrated with, school science” (p. 8). Echoing Aikenhead & Huntley’s (1999) reasoning, Snively & Williams (2016) offer,

IS [Indigenous Science] education must take its rightful place as a wealth of science knowledge, wisdom and processes encompassing ecology, biology, medicine, astronomy, agriculture, geology, meteorology, architecture, metallurgy, and horticulture, to name a few. (p. 46)

In this argument, Native science is an epistemology in as much as Western science is an epistemology, and that Native science should be upheld as such in science classrooms in the U.S. In other words, “Privileging ‘what knowledge is of most worth’ in science class is not the same as denying the value of other forms of knowledge” (Loving, 1997). These two sciences can be regarded alongside one another as unique epistemologies. According to Cobern & Loving (1991), “What is at issue here is the learning of when scientific knowledge should be appropriated over other competing domains of knowledge because it is the best knowledge

available for the particular situation” (p. 64). It is crucial to consider the context as well as cultural sustainment and revitalization, though, when applying a particular epistemology, in this case either Western scientific knowledge and/or Native science, in a given situation, namely American Indian schooling.

Eurocentric Epistemologies

The individualistic cultural archetype espouses the values of individual achievement and competition and is upheld typically by Western cultures. Hence, the individualist cultural archetype describes many of the teachers in the U.S. who are 81.9% White (NCES, 2012a) and 76.3% female (NCES, 2012b). In the Midwest state of this study, the percentages are 96.3% White and (NCES, 2012a) and 76.5% female (NCES, 2012b). Given the individualistic archetype subscribed to by many teachers in the U.S., coupled with the fact that American Indian students may not necessarily adhere to this cultural archetype, there lies the potential for cultural myopia. A perpetuated assimilatory push of oppressive Western values on American Indian students can result from the lack of awareness and an understanding of Hammond’s two cultural archetypes. The subsequent section herein will address the history of colonized classrooms in the U.S. followed by a particular focus on Eurocentric science that is upheld by the U.S. public education system.

Colonized “Schooling” of American Indians.

The formal acculturation through which American Indians were stripped of their language and culture started as early as 1875 in the U.S. in the form of reservation day schools, reservation boarding schools, and off-reservation boarding schools. Colonizers used these schools in their quest to “kill the Indian but save the man” (Adams, 1995), a phrase that is credited to Captain Pratt. In fact, it was these schools as well as the Bureau of Indian Affairs

(BIA) that served as the predominant instructional bodies for American Indian children through much of the 1900s (Pewewardy, 1998). These schools were assimilationist in nature and espoused the Eurocentric values of hard work, discipline, order, and rugged individualism which are all, as previously argued, in alignment with the individualistic cultural archetype that was prominent during this time period.

Further applying the notion of endemic colonization, which reaches into the classroom, education can be seen as a cultural vector of colonialism (Grimberg & Gummer, 2012). Beginning with American Indian boarding schools and extending into the present day, all occurrences of “attempt[ing] to assimilate Aboriginal students into Western science continues this colonization...raises issues of social power and privilege in the science classroom” (Aikenhead, 2002). Sometimes left with seemingly no other choice, due to an internalized consciousness of oppression (Freire, 1970), “The main solution for the socioacademic failure offered by cultural deficit majoritarian storytellers is cultural assimilation” (Solórzano & Yosso, 2002, p. 31), which historically was the glue holding American Indian boarding schools together.

In consideration of American Indian students who may fall victim to fatalism and self-deprecation, which are characteristics of the oppressed (Freire, 1970), a more humanizing approach has been taken by Solórzano & Yosso (2002) who promote TribalCrit (Brayboy, 2005) as an ontological and epistemological framework from which to distill the narrative of colonization as a means to understand both how it was originally enacted, how it continues to impact American Indians, and how to change its enactment. The theory of TribalCrit can be applied to classroom practice wherein teachers teach from the context of American Indian heritage in order that their students see connections between this heritage and the disciplines required by the U.S. public education system (Gilbert, 2010). Important to this point is the

consideration of the contradictions between American Indian and Western epistemologies with particular regard to science and its varied understandings.

Eurocentric Science.

As previously discussed, the argument that there are many forms of science (Snively & Corsiglia, 2001) is a concept that can be misconstrued. Grimberg & Gummer (2012) define science culture as, "...the combination of norms, values, beliefs, expectations, and conventional actions of a group with the purpose to produce and warrant knowledge following scientific epistemic ways" (p. 14). Further, and with regard to the notion of the synonymously referenced Western science, Eurocentric science, and Western Modern Science (WMS) (Snively & Corsiglia, 2001) throughout this chapter, the standard term for science is referred to as "Western" because it derives from Ancient Greek and European culture (Cobern & Loving, 2001). Pertaining to the theories already presented in this chapter, it was in the 1990s that non-Westerners, including American Indians, as well as some Western scholars began to counter the "imperial Western attitude" previously held toward science (Cobern & Loving, 2001). This dissatisfaction with the status quo derived from the mainstream implied notion that the only science is Western science (Cobern & Loving, 2001). Alcoze similarly argues that, "Science is often thought of [pause] America has science. Mainstream America has science. And if you are a minority culture in this country you don't have science" (Smithsonian, 1996). Furthermore, science is a mainstream way of knowing in hegemonic Western culture whose framework innately does not account for cultures other than the one from which it originated (Brayboy & Castagno, 2008). Western, or Eurocentric, science can be considered a subculture of the broader understanding of science (Aikenhead, 1996); WMS is not the only way of knowing about the natural world.

Epistemological Tensions Stemming from Colonization.

Important tensions should be considered at the intersection of Western science and Indigenous knowledge. Epistemologically, WMS considers itself the “the best available approach to truth seeking,” and it has traditionally devalued Native knowledge including IK and TEK (Corsiglia & Snively, 2000, p. 83). Western science has historically been “culturally corrosive” to non-Western cultures, co-opting ideas stemming from these cultures (Corsiglia & Snively, 2000). Furthermore, some argue that the universalistic perspective of science called the standard account, which is synonymous with the idea of Western science that has existed for 300 years, must be the only version of science taught in schools, and that while Indigenous knowledge may hold value, IK should not be labeled “science” or taught as such in science classrooms (Cobern & Loving, 2001). It is argued that Western science sacrifices the lived experiences of Indigenous people, which aligns with an epistemological Eurocentric hegemony and the idea of cultural imperialism (Cobern & Loving, 2001).

Another layer of tension between WMS and Native science is the trend of a unidirectional effort placed on American Indians to understand the Western epistemological view of science, but not the other way around (Kawagley & Barnhardt, 1998). This becomes problematic when American Indians are being asked, or told, to assimilate Western science in replacement of Native ways of knowing. On the other side of the coin, non-Native people should seek to learn a variety of epistemologies in order to relate to people with perspectives other than their own (Kawagley & Barnhardt, 1998). Those subscribing to the scientific views of the hegemonic majority may struggle with the consideration, much less understanding, of worldviews and counter-stories belonging to “the other.” It should be noted that scientists and science instructors persist in supporting an arguably patronizing view of Native science as

“useful” but not as “real science” (Snively & Corsiglia, 2001). Ideals like these further illuminate the hegemonic qualities of the Western science lens as it is applied to making sense of the natural world.

Next Generation Science Standards.

One of the manifestations of the U.S. public education system’s espousal of a Eurocentric epistemological framework in its science classrooms occurs at the state level through the voluntary adoption of the Next Generation Science Standards (NGSS) (NGSS, 2013). Even though the U.S. does not have a federally funded or mandated national science curriculum, twenty states and the District of Columbia, impacting a combined total of approximately 36 percent of U.S. students, have adopted the NGSS. Alternatively, twenty-four states, impacting approximately 35 percent of U.S. students, have developed their own teaching standards based on recommendations from the National Research Council’s (NRC) *A Framework for K-12 Science Education* (2012), subsequently referred to herein as *Framework*. One of these twenty-four states is the Midwest state of this present study (NTSA, 2014a).

Teams from twenty-six states crafted the NGSS, which offers a research-based framework containing the disciplinary core ideas, science and engineering practices, and crosscutting concepts “that students should master in preparation for college and careers” (NGSS, 2013). The disciplinary core ideas include the content of science, the science and engineering practices that encompass how science is “acquired and understood,” and the crosscutting concepts focused on how the various scientific disciplines share ideas with universal meaning (NSTA, 2014b). The standards are arranged by the three previously listed categories as well as by grade level and by discipline including the following: (a) physical sciences, (b) life sciences, (c) earth and space sciences, and (d) engineering, technology and applications of

science.

Next Generation Science Standards Appendices.

The NGSS's thirteen appendices offer more background information and nuances as well as some implementation models that support its standards. Appendices that are pertinent to the present study will be examined here. The NGSS's (2013) Appendix D offers explanations for the ways in which the standards support students of varying demographics including economically disadvantaged students, students from major racial or ethnic minority groups, students with disabilities, students with limited English proficiency, students in alternative education programs, and gifted and talented students. Furthermore, Appendix D, which is entitled, "All Standards, All Students: Making the Next Generation Science Standards Accessible to All Students," mentions American Indian and/or Native Alaskan students in only three instances. Of particular concern here is that when these students are mentioned, it is only to indicate that they fall into the category of "Students from major racial or ethnic minority groups," are beneficiaries of Title I funding because they are "disadvantaged...low-achieving," and are the population of students who "Title VII is designed for." There is no additional support delineated for American Indian and/or Alaskan Native students. Aside from these three occurrences, there is no other mention of American Indian, Native Alaskan, or Indigenous students in Appendix D nor any of the other twelve appendices of the NGSS.

Appendix F has been included in this review of the literature because it accounts for the support of English language learners, students with disabilities associated with language processing, students with limited literacy development, and students who may be categorized as speaking "non-Standard English." Appendix F underscores the importance of language usage, and the opportunity for language learning, in science and engineering practices and while

engaging in science discourse. As such, students are able to enhance their own language through science and engineering practices which translates to a deepening of their usage and understanding of the language of science (NGSS, 2013). Appendix F speaks to the concept of border crossing (Aikenhead, 1996), which is an example of a solution and tension found at the intersection of Native science and Eurocentric science in U.S. public school classrooms.

Appendix H of the NGSS (2013) provides an explanation of the nature of science (NOS) and how this concept is weaved throughout the NGSS as performance expectations that can be found in the science and engineering practices as well as crosscutting concepts. One of the benefits of the NOS is that it provides the entry points for students of varying cultural and linguistic backgrounds the opportunity to begin learning the “language” of science. This is especially crucial for American Indian students entering the science classroom with hesitations about science that encompass both content and the terminology that accompanies science education. The NOS, and more specifically Eurocentric science, can easily be conflated by society and mass media. However, by affording students the chance to learn the terminology, meanings, examples and non-examples of the observable and testable aspects of the natural world educators can remove the controversial or confrontational aspects of which students assume or fear being met.

Appendix J further highlights the interplay between science, humans, and the natural world. More specifically, this appendix draws upon the NRC and the *Framework* (2012) in underscoring the effects - both good and bad - of society’s use of natural resources as well as the results this interaction has on the health of both society and the natural world. A connection can be made here to the settler-colonial value of securing a dominion over land and its wild and human inhabitants. Appendix J also includes a section on linking school science with home

culture and community connections in order to better serve students of color and their diverse epistemologies. In addition to encouraging increased parent involvement, this appendix also suggests building the school-to-community connection by giving students the agency to identify problems and engineer solutions for community or neighborhood projects. This is an especially valuable connection to the present study as it supports a culturally relevant and sustaining pedagogy that better meets the needs of American Indian students.

A Midwest State's Science Standards.

Another relevant piece of Eurocentric science education under consideration herein is the state standards for science (WSS) that are upheld by the state of this study. In November 2017, the Department of Public Instruction (DPI) of the Midwest state considered herein adopted new content standards for K-12 science in the state (DPI, 2019). These standards were founded on content produced by the NRC's *Framework* (2012) as well as the NGSS (2013). A team of educators, scientists, and engineers worked to cull material from these two publications with the intent that this material would cultivate science students who are "scientifically literate citizens ready for college and career success" (DPI, 2019).

Similar to the NGSS, the WSS are arranged into three categories as follows: crosscutting concept standards, science and engineering practice standards, and science and engineering content standards (disciplinary core ideas). These disciplinary core ideas include the following: Life Science (LS), Physical Science (PS), Earth and Space Science (ESS), Engineering, Technology, and Society (ETS), Science and Engineering Practices (SEP) and Crosscutting Concepts (CC). Located at the top of each of the six disciplinary core ideas is the following statement, "Students use science and engineering practices, crosscutting concepts, and an understanding of [insert science content] to make sense of phenomena and solve problems" (DPI,

2017). This statement can be found overarching each learning element. Further, each learning element has been paired with its particular grade level banded K-2, 3-5, 6-8, and 9-12 performance indicators. According to the state department of public instruction (DPI), “[The state] districts have the option to use [a Midwest state] Standards for Science (WSS), the NGSS on which they were based, or other locally determined standards” (2019). Further, one of the primary contributions of the committee that devised the WSS was “creating an appendix of specific [Midwest state] contexts to support making science relevant and engaging across our communities” (DPI, 2019). This appendix, and its applications, including the degree to which it can be considered inclusive or exclusive for urban students will be addressed in the following section.

Appendix A of the WSS contains, “Ideas for [state] connections related to the disciplinary core ideas (content) in these standards, as well as related engineering extensions” (DPI, 2019). More specifically, Appendix A states that it “lists real-world connections that are specific to [a Midwest state], as well as connections to engineering and technology, for most science content standards” (DPI, 2019). This appendix provides connections under two categories as follows: a Midwest state and Engineering, Technology & Society. Appendix A then relates both of these categories to each of the four Life Science (LS), four Physical Science (PS), and three Earth & Space Science (ESS) content areas, previously referred to in this section of the chapter as disciplinary core ideas. Notably, there seem to be content connections that may or may not be culturally responsive for American Indian students who live in urban settings.

In taking a look at the disciplinary core ideas, or standards, as they have been linked with the nuance and context of a Midwest state, it is important to notice the content included and the content excluded. The following passages provide a brief summary of a descriptive coding

exercise performed by the author that is intended to parse this appendix. For the purposes of the following illustration, the term *rural* has been used when considering cities with, generally speaking, smaller population densities than River City. This decision was based on McGrail and colleagues' (2005) argument that the terms rural and metropolitan exist along a continuum that is based, in part, on population densities.

Focusing on the disciplinary core idea of Life Science (LS) as it is presented in the WSS, the following analyses have been made as to the comparison of the frequency of instances that the WSS refers to animals, plants, or 'other' (defined by this author as not necessarily plant or animal, or neither plant or animal) and whether these plants, animals or 'other,' are typically found in urban and/or rural areas and/or 'alternative location' (defined by this author as unclear as to solely urban, rural, or an alternative). Please see Table 1 (Wolk, 2020) below for a representation of the frequencies.

Table 1

Distribution of a Midwest State's Biota in its Science Standards

	Solely Urban	Solely Rural	Both Urban and Rural	Unclear
Plants	8	7	7	5
Animals	6	18	8	2
Other	4	2	2	0

With regard to a Midwest State's Connections and/or Engineering, Technology & Society Connections, and in reference to Table 1 above, the distribution of the mention of plants that live in solely urban, solely rural, and both urban and rural settings was nearly equally dispersed. However, the distribution of the mention of animals that live solely in urban settings was far outnumbered by the mention of animals that live in solely rural settings. Interestingly, though, there was a moderate mention of animals that can be found living in both urban and rural areas.

The implications for this life science curricula in an urban state's school are that students may not be making the types of relevant connections the WSS assume they will make. Furthermore, American Indian students living or attending schools in urban areas may also be ill-equipped to make particular connections via the WSS (Wolk, 2020).

Intersection of Native and Eurocentric Science

The component of TribalCrit that exists in tension at the intersection of Native science, urban education and Eurocentric science-as it is taught from the gaze of the U.S. public education system-is that of occupying liminal space (Brayboy, 2005). Urban education frameworks typically uphold an accepted binary of dos and don'ts, acceptable and unacceptable ways of behaving, and particular ways of measuring success, i.e., the hegemonic norms that derive from the academic expectations of the dominant culture (see Weiner, 1993 for an example). This ideology, coupled with the rigidity of norms upheld by Eurocentric science, leaves little to no space for the flourishing of diverse epistemologies and ways of being held by American Indian students including American Indian students in urban educational settings.

Another point of tension that is found at the intersection of Native science and Eurocentric science is the power differential innate to the imbalance of the American Indian value of existing in balance with nature as contrasted with the settler-colonial ideology of nature. In the settler-colonial mindset, which aligns with a Eurocentric science gaze, humans consider themselves apart from nature. This gaze includes the notion that nature and land are defined as property that are subject to human ownership (McGinty & Bang, 2016). American Indians have a contrasting understanding of their relationship with nature and land. Furthermore, this tension is compounded by the fact that urban American Indians occupy an even more nuanced liminal space with regard to their distancing from their original tribal homelands. It is noteworthy that

not only can liminal space be more concrete than just figuratively speaking, but that a literal geographic liminal space was enacted by settler-colonial oppressors.

Cultural Border Crossing.

There are longstanding problematic definitions and conflated understandings of culture. According to Gutiérrez & Johnson (2017), “Narrow understandings of culture contribute to narrow conceptions of learning, resulting in reductive frameworks evident across scholarship that grow out of very different sensibilities, intellectual traditions, and political aims...” (p. 249-250). This narrow notion of culture contributes to one of the challenges of teaching science from culturally informed perspectives in the U.S. Moreover, culture tends to be misconstrued as race and ethnicity and, further, there is a “trap of one-size-fits-all pedagogical approaches that assume a kind of uniformity in cultural groups that simply does not exist” (Gutiérrez & Johnson, 2017, p. 250). Conversely, as Paris & Alim (2017) state, “it is crucial that we understand that the ways in which young people are enacting race, ethnicity, language, literacy, and their engagement with culture is always shifting and dynamic” (p. 7). Taking an understanding of culture a step further, “a notion of culture that expects regularity, variance, and change helps us resist the dichotomies that are too often employed in studying, teaching, and understanding the practices of cultural communities and their members” (Gutiérrez & Johnson, 2017, p. 251). Yes, it is not enough just to be made aware of this nuance. Enacting these principles requires potentially a great deal of emotional work, often on the part of those dominant in society (Glock, et al., 2019). This condition contributes to yet another challenge facing the implementation of culturally informed pedagogies serving American Indian students.

Pertaining more specifically to the disciplinary content of focus in the present study, Western science can be considered a subculture of Eurocentric culture (Aikenhead, 1997). Since

this subculture can conflict with Native science, the learning of WMS can be considered a type of culture acquisition that “requires Aboriginal students to cross cultural borders from the everyday subcultures of their peers, family, and tribe, to the subcultures of school, school science, and science itself” (Aikenhead, 1997, p. 218). In order for border crossing to be faithfully enacted, rather than assimilatory, American Indian students must not be asked to sacrifice their own cultural and linguistic epistemologies. To account for the needs and successes of American Indian students in border crossing, it can be argued that their teachers should use these students’ culture as a “vehicle for learning” (Ladson-Billings, 1995, p. 160). A related component in the concept of border crossing is that of teacher as culture broker wherein she or he “identifies the culture in which students’ personal ideas are contextualized, and then introduces another cultural context, for instance the culture of Western science, in the context of Aboriginal knowledge” (Aikenhead, 2002, p. 4). Furthermore, it is crucial that academic success not be isolated from cultural competence (Ladson-Billings, 1995) while students are invited to cross borders between their home cultures and school culture, including the subculture of Western science.

Act 31.

In response to endemic colonization and its deleterious effects on nearly all aspects of American Indian life including the education of American Indian students, the Midwest state of this study enacted legislation to address this issue. According to [state’s] Act 31 (1989/1991) concerning American Indian Studies in the state, all public school districts and pre-service teaching programs are mandated to give instruction in the “history, culture, and tribal sovereignty of the eleven federally-recognized tribes and bands” (DPI, 2015). In the social studies curriculum, this instruction is to occur “at least twice in the elementary grades [and] at

least once in the high school grades” (DPI, 2015). More aligned with science curriculum, this statute also calls for the state superintendent to “develop a curriculum for grades 4 to 12 on the Chippewa Indians' treaty-based, off-reservation rights to hunt, fish and gather” (DPI, 2015, p. 41).

The significance of this statute is that since the state has pockets of high concentrations of American Indian students, its teachers need an understanding of this large group of students. Teachers need the capacity to ensure all students’ voices are heard so that the classroom is not yet another space that reinforces inequities in society (Chandler, 2010).

Teacher Challenges.

Teachers’ personal positionalities are another facet of this work that can be found at the intersection of Native science and the type of WMS upheld by the U.S. public education system. Specifically at play here are teachers’ willingness, ability, and efficacy in delivering culturally responsive instruction in their classrooms. Culturally responsive pedagogies will be discussed in the final section of this chapter. One of the strands of an individual’s positionality is their culture of origin which may or may not be intentionally internalized, or even identified, outside of its own gaze (i.e., White privilege). The recognition and understanding of one’s own culture, or particular way of making sense of the world (Hammond, 2015), can be considered one of the first steps toward developing into an ever-dynamic culturally responsive practitioner. If one has not, cannot, or will not interrogate his or her own personal epistemology, then it will be difficult to identify ways in which to professionally meet students where they are—culturally, linguistically, ethnically, demographically, and otherwise—from a humanistic perspective (Bartolome, 1994).

Considering that the majority of U.S. teachers are White (NCES, 2012a), it can be

daunting for teachers to not only understand, but to integrate into their existing science curriculum relevant, deep facets of American Indian culture. Deep culture encompasses how a person makes sense of and functions in the world (Hammond, 2015). With this challenge in mind, it requires less heavy lifting to incorporate solely American Indian surface, or even shallow, culture in one's science curriculum. However, this practice neglects the complexities of American Indian students, which are truly the real ways they learn and make sense of the world.

The Decolonized Classroom

To open the final section of this chapter, the following statement from Indigenous scholar Cajete (2015) is considered, “For Indigenous peoples, the revitalization of Indigenous knowledge through a truly self-determined education provides the most direct route for Native sovereignty” (p. 125). With nods to TribalCrit and culturally responsive pedagogy, the notion of decolonizing science classrooms for American Indian students can be argued as a lens of addressing the research question driving this study: What is revealed about culturally relevant science curriculum for American Indian students through the process of examining the cultural content of an American Indian text alongside traditional U.S. public education science standards? To understand the third and final section of this chapter, it is helpful to consider the following frame and definition for the arguments herein. Specifically, Smith (2013) offers that decolonization encompasses two sets of ideas—“time before, *colonized time*, and the time before that, *pre-colonized time*” (p. 25). Decolonization compresses these two periods of time into something new and present, which is a concept that should accompany the reader through the subsequent chapters of this study.

Employing a lens of decolonization, as understood through Brayboy's (2005) theory of TribalCrit, Aikenhead (2002) claims, “For Aboriginal students, it will be helpful to deal with

Western science's social, political, military, colonial, and economic roles in history." With additional regard to educational settings, Bartolome (1994) calls for "a shift from a narrow and mechanistic view of instruction to one that is broader in scope and takes into consideration the socio-historical and political dimensions of education" (p. 176). Using Brayboy's (2005) understanding of colonization, Sleeter (2010) explains decolonization as an analysis of the effects of settler-colonial values that assert the primary influences in society and how "this thought and knowledge system undergirds Indigenous peoples' loss of land and sovereignty" (Sleeter, 2010, p. 194). TribalCrit should be considered when infusing decolonizing methods into U.S. public school classrooms.

Cultural Hegemony in Science

Stemming from the call to decolonize science education for American Indian students is Cobern & Loving's (2001) argument that the cultural hegemony innate to traditional Eurocentric science education does not meet the cultural needs of Indigenous learners. In fact, science at large is taught "at the expense of indigenous knowledge [which] precipitates charges of epistemological hegemony and cultural imperialism" (Cobern & Loving, 2001, p. 52). According to Cobern & Loving (2001), Western science is used in a way that asserts itself over other forms of knowing about the natural world, such that other ways of knowing are marginalized or even silenced. Cobern & Loving (2001) assert that this mindset is, "...a hierarchic view of knowledge with science placed at the epistemological pinnacle" (p. 62). The type of science that positions itself above other ways of knowing, including American Indian epistemologies, is Western science. Furthermore, Western science often fails to consider students' (non-Eurocentric) sociocultural identities which makes sense because it "presents scientific knowledge as objective and universal, and thus fail[ing] to recognize that scientific knowledge is itself socially

constructed” (Brayboy & Castagno, 2008, p. 739). These are just some of the many challenges of teaching science from culturally informed perspectives in that the majority perspective is deep seeded and often unquestioned in its authority.

Further compounding the challenges presented by Eurocentric cultural hegemony in science education for American Indian students is a passage from Pewewardy (1998) who states, According to Vavrus (1997), public school educators as a group have a colonial mind set. They view indigenous peoples and other minorities from a falsely superior ‘we’ versus ‘they’ perspective. In the midst of this cultural mismatch, the public school system is failing American Indian learners. (p. 69)

In order to confront and counter these challenges Pewewardy (1998) specifies a “critical need” and extends a call for culturally responsive teachers for American Indian students. He cites a “cultural mismatch” between teachers and Indigenous learners as the root of these learners’ “underachievement, absenteeism...and low economic status” (Pewewardy, 1998, p. 69). A way of addressing this cultural mismatch, as well as to shift the current educational paradigm from didacticism toward a more holistic end, is to look to American Indian education (Pewewardy, 1992). One of the facets of American Indian education that can be considered here is the commonly shared tribal practice of using apprenticeship models for teaching (Medin & Bang, 2014). Pewewardy’s (1992) argument lends itself to an alignment with Lee & McCarty’s (2017) theory of critical culturally sustaining and revitalizing pedagogy.

Another piece of information to consider in the scope of needing to decolonize science education for American Indian students comes from data collected by the U.S. Census Bureau. According to the 2010 census, 78% of American Indians and Alaska Natives lived outside of tribal lands (U.S. Census Bureau, 2012) which, according to Lee & McCarty (2017), “suggest[s]

the increasing numbers of Native American children attending urban public schools” (p. 63). In fact, approximately 90% of American Indian children attend public schools (NCAI, 2020a). With traditional U.S. public school curricula in mind, and in regard to the forced colonization and near erasure of American Indian culture both in the past and at present, “public school curriculum refuses to recognize culture as a terrain of struggle” (Kincheloe, 1993, p. 249). Furthermore, European ideologies assume to be “universally applicable [and] the only valid historical experience” (Kincheloe, 1993, p. 250). Legislation including No Child Left Behind (NCLB) (2002) and the Every Student Succeeds Act (ESSA) (2015), the traditionally upheld gaze of Western science, of measuring American Indian students against Eurocentric academic norms, and in response to countering “monolingual, monocultural norms embedded in standardized testing” (Lee & McCarty, 2017, p. 69), are important concepts to employ when considering how educators can enact a shift to more sustaining pedagogies in their science classes for American Indian students.

In light of a reframing of the American Indian experience in Eurocentric science classes, as offered by Brayboy & Castagno (2008),

If we consider the fact that Indigenous peoples in the Americas created toboggans to carry the heavy carcasses of deer and caribou, kayaks and canoes that were river and sea worthy, snow shoes, and snow goggles; domesticated a wide range of plants including corn, potatoes, squash, beans, and peanuts; built architectural masterpieces in which they lived and ovens in which they cooked; used petroleum to create rubber and stars to successfully navigate the continent; and found ways to dry meat for storage and future usage, it becomes evident that Indigenous peoples have been scientists and inventors of scientific ideas for a long while. (p. 732)

In following this perspective, it is believed that Native children are actually advantaged by their cultural identities rather than disadvantaged by them (Aikenhead, 2001). In this way, Native students have the opportunity to see the world from two vastly different points of view—Native and Eurocentric. According to Brayboy & Castagno (2008), American Indian students are at an advantage when it comes to learning Western science alongside Native science. Garrison (1995) supports this notion as he states,

A Navajo student who is informed about Navajo ways of understanding the world (and the universe in general) has more than one explanation for things. To put this another way: a Navajo student who knows his or her cultural knowledge, in addition to Western cultural/scientific knowledge, already has an advanced foundation for the development of the highest level of scientific thinking, i.e., hypothesis-building, or, perhaps even more important, alternative hypothesis-building. (np)

In the context of shifting the hegemonic paradigm of Western science to one that is more culturally and linguistically informed, it must be understood that American Indian students are, in fact, at an advantage—they just need to be given the opportunity to be supported in culturally responsive, sustaining and revitalizing ways. Additionally, it is important to remember that teaching American Indian students in traditionally Western science-based science classrooms in the U.S. requires a careful teaching, or confluence, of both Western and Native science concepts alongside one another rather than positioning one epistemology over the other.

Post-colonial Science Education for American Indian Students.

As a culturally responsive counter argument to science education that is framed by the Western ideal of colonialism, Aikenhead (2002; 2000) offers indigenized counter narratives that better support American Indian students. Science education in a post-colonial society must be

accessible to and locally contextual for American Indian students. Moreover, Native science and Western science must coexist rather than supporting the tokenization of Native science as an add-on within a dominant Western science curriculum (Aikenhead, 2002). Snively & Williams (2016) echo this argument in positing that “Indigenous Science education must be seen [as]...more than a process for discovering remedies for ecological problems and environmental crises” (p. 46). An exemplar of the process of indigenizing science curriculum is found in the work of Aikenhead (2002).

In collaboration with Canadian tribal elders and teachers, Aikenhead (2002) crafted parallels between Native science and Western science for use in revised science units in classrooms serving Aboriginal students in Canada. In their exemplar of decolonized science curricula, Aikenhead (2000) utilized a cohort of regional science teachers, university personnel, and community members to create instructional strategies and units of science study to support local teachers interested in becoming *culture brokers* for Indigenous secondary students. These science units were not designed to be blindly adopted and supplanted in a random science classroom, or any other settings for which they were not carefully designed. Rather, these science units were informed by members of the local Indigenous community and then brought into relevant science classrooms for implementation with the Indigenous students for whom they were created. Furthermore, with regard to a humanizing pedagogy, Bartolome (1994) also supports a careful implementation of curricula as follows,

Although it is important to identify useful and promising instructional programs and strategies, it is erroneous to assume that blind replication of instructional programs or teacher mastery of particular teaching methods, in and of themselves, will guarantee successful student learning, especially when we are discussing populations that

historically have been mistreated and miseducated by the schools. (p. 174)

Carefully curated culturally responsive curricula are not, and should not be considered, a one-size-fits-all solution to culturally informed practice. Rather, these curricula must be responsive to the particular populations for which they were designed which is in alignment with the nature of culturally responsive theories. This argument is supported by Ladson-Billings' (1995) theory of CRP in that curricula must be contextually crafted for a particular set of students in their particular context.

In further support of post-colonial science education, Freire's warnings against the oppressive banking model of education (1970) can be taken into consideration. Just as Freire (1970) cautions against a dissemination of knowledge from a sole (teacher) source, Aikenhead and colleagues (2000) argue that when Native students bring their own cultural epistemologies and languages into the classroom, "new relationships between a teacher and a student can replace the conventional hierarchy characterized by teachers transmitting what they know to students" (np). In this way, post-colonial, or in Freire's (1970) argument, demythologized, classrooms allow formerly oppressed learners to authentically and critically engage, participate in dialogue, express creativity, and maintain "their ontological and historical vocation of becoming more fully human" (p. 56-57). Ladson-Billings' (1995) tenet of a critical consciousness is in alignment with the theories supporting post-colonial classrooms. In addition, in support of a humanizing approach to post-colonial science education for American Indian students, Bartolome's (1994) aligning stance affords that "...the humanizing effects of teaching strategies that, similar to culturally responsive instruction and strategic teaching, allow teachers to listen, learn from, and mentor their students" (p. 189). In conclusion of this section, Writer (2008) argues for decolonization via "systemic transformation" by means of the implementation of the tenets of

MCE, CRT, and TribalCrit which can serve as an amalgamated catalyst in order to support multiple epistemologies.

Decolonized Counterstory.

The success of students, schools, and U.S. education on the whole is dependent upon an ideology and teaching practices that go “beyond the white settler colonial gaze” (Paris, 2019) and begin to explore and sustain the notion of co-equals in the counterstory that is the history of the country. In continuation of the review of literature on post-colonial decolonization, counter-storying can be considered a modality of decolonization. Pewewardy (1992) states that, “It's ironic that Indian people are not allowed to be experts on themselves—it's usually someone else ‘defining’ the Indian” (p. 5). With regard to this oppressive, colonized narrative, it can be emancipating to, instead, consider the notion of counter-story. Solórzano & Yosso (2002) suggest that counterstory is “a method of telling the stories of those people whose experiences are not often told (i.e., those on the margins of society)” and that it is “a tool for exposing, analyzing, and challenging the majoritarian stories of racial privilege” (p. 32). Similarly, and with an Indigenous lens, Writer (2008) offers, “As absences, silences, inaccurate representations, and static portrayals give way to Indigenous frames of reference—that is, what we have to say about ourselves through our stories and perspectives—colonization is unmasked, exposed, confronted, and transformed” (p. 11). This is the heart of the work of decolonizing classroom spaces.

An example of an Indigenous counter-story is exemplified in a brief anecdote shared by Brayboy (2005), “My mother told me, ‘Baby, doesn’t she know that our stories are our theories?’” (p. 426). This exchange may be interpreted in the sense that theories can represent epistemologies and can explain how one understands the world including the natural world.

Further, Brayboy (2005) shares a story wherein eight American Indian graduates were sharing their views on Native sovereignty, self-determination, and self-education. These graduates “were not simply telling ‘stories;’ rather, they had clearly shown me that for many Indigenous people, stories serve as the basis for how our communities work” (Brayboy, 2005, p. 427). In Indigenous communities, stories are not “just” stories but, rather, the foundations of their cultural cloth; their revolutionary counter-stories. In closing this section, Pewewardy (1998) makes the call for counter-story quite clear as he requests that teachers, “Teach students the other side of the story—how the West was lost” (p. 72). Although there is a dominant narrative of U.S. history, there are many perspectives of its telling.

The Need for Culturally-based Practices in Science Education.

In order to meet the needs of American Indian students, it is crucial not only to understand an array of culturally informed instructional practices but also to draw upon their theoretical frameworks in classroom application. Here, several culturally informed instructional practices will be elicited as a foundation for this work.

Generally speaking, culturally informed instructional practices were born out of several theories including Critical Race Theory (Delgado & Stefancic, 2001), the Multicultural Education movement (Banks, 1997), culturally relevant pedagogy (Ladson-Billings, 1995), and culturally responsive teaching (Gay, 2002). Furthermore, Ladson-Billings, who is credited with envisioning culturally relevant pedagogy (1995) and whose own research interests include multicultural education and social studies, defines culturally relevant teaching as, “...a pedagogy of opposition (1992c) not unlike critical pedagogy but specifically committed to collective, not merely individual, empowerment” (p. 160). Ladson-Billings also draws on the “liberating praxis” of Freire (1970) who devised a pedagogy of the oppressed as a result of the effects of

dehumanization. Freire (1970) posits that unless students are considered in light of a humanistic understanding and participate in a problem-posing, inquiry-based education then they will continue to be seen by the oppressors as “the pathology of the healthy society” (p. 47). Drawing on the foundations of culturally responsive teaching and MCE, Ladson-Billings furthers the conversation by arguing that, “[culturally relevant pedagogy]...empowers students intellectually, socially, emotionally, and politically using cultural referents to impart knowledge, skills, and attitudes” (1994, p. 16-17). Ladson- Billings’ (1995) theory of culturally relevant pedagogy consists of three tenets described here: academic success, cultural competence, and critical consciousness, will now be addressed.

The first criterion of CRP (Ladson-Billings, 1995) indicates that “students must experience academic success” (p. 159). While each student may arrive at this success in varied ways, “all students need literacy, numeracy, technological, social, and political skills in order to be active participants in a democracy” (1995, p. 159). In supporting students’ academic success, the role of the teacher is to focus positive attention on students who possess social power and use their interests to call them to academic excellence and leadership (1995). Further, “culturally relevant teaching requires that teachers attend to students’ academic needs, not merely make them ‘feel good’” (Ladson-Billings, 1995, p. 160).

The second criterion of CRP states that “students must develop and/or maintain cultural competence” through which “...students’ culture[s are used] as a vehicle for learning” (Ladson-Billings, 1995, p. 159). In this criterion of CRP, the teacher uses students’ personal interests and home languages to serve as “bridge[s] to learning” (Ladson-Billings, 1995, p. 161). With regard to the present study, American Indian educator Pewewardy (1992) “asserts that one of the reasons Indian children experience difficulty in schools is that educators traditionally have

attempted to insert culture into the education, instead of inserting education into the culture.” Furthermore, Ladson-Billings (1995, p. 160) posits that “Culturally relevant teachers utilize students’ culture as a vehicle for learning.” Aikenhead (2002) expands on this notion as it bridges it with his concept of teacher as culture broker. “A culture broker identifies the culture in which students’ personal ideas are contextualized, and then introduces another cultural context, for instance the culture of Western science, in the context of Aboriginal knowledge” (Aikenhead, 2002, p. 4). This passage aligns with the previously discussed notion that American Indian students are at an advantage in science classes because they have the capacity to understand the subject from at least two points of view. It is part of the teacher’s role to facilitate this bridging. In closing this section, it must be made known that academic success should not be isolated from cultural competence.

The third criterion of CRP states that “students must develop a critical consciousness through which they challenge the status quo of the current social order” (Ladson-Billings, 1995, p. 160). This involves the ability of the student to critique the knowledge found in textbooks in relation to social action and citizenry. Ladson-Billings (1995) posits, “Beyond those individual characteristics of academic achievement and cultural competence, students must develop a broader sociopolitical consciousness that allows them to critique the cultural norms, values, mores, and institutions that produce and maintain social inequity” (p. 162). Not to be neglected in the trifold criteria of CRP are the former two criteria—academic success and cultural competence. In other words, critical consciousness should not be siloed. Further, Freire (1970) adds a sense of conscientização, or critical consciousness, as it relates to those who have internalized a dehumanized consciousness of oppression. Conscientização is what can support the oppressed in their transformation and liberation (Freire, 1970, p. 28) and would seem to align

with Ladson-Billings' concept of critical consciousness.

Culturally Informed Practices in Science Education

In applying Ladson-Billings' three tenets of CRP to specifically urban science education, coupled with the push for scientific literacy for all, Dhingra (2007)'s proposition of three scientific literacies are considered in support and application of Ladson-Billings' theory. The three scientific literacies Dhingra (2007) offers are practical scientific literacy, civic scientific literacy, and cultural scientific literacy, which appear to mirror Ladson-Billings' notions of academic success, critical consciousness, and cultural competence, respectively.

According to Holbrook & Rannikmae (2007), the nature of science education is education through science rather than science through education (p. 7). These authors go on to explain that "...the nature of science education is clearly portrayed as more than an understanding of the nature of science, or acquisition of scientific ideas. The nature of science education puts the learning of the nature of science into an educational framework" (Holbrook & Rannikmae, 2007, p. 9). With this being the charge for science educators, Cobern & Loving (2001) offer a conceptualization of curricular development in science that honors many forms and sources of knowledge. This is especially important for science educators in schools whose urban American Indian learners may live relatively removed from natural areas, open spaces, natural bodies of water, and wild plants and animals. An example of one of the ways American Indian students are asked to navigate their own epistemologies in comparison to those upheld by Western science was researched by Medin and Bang (2014), who describe the cultural variances these students must grapple with as they relate to an understanding of the scientific concept of being "alive." In their work, Medin and Bang (2014) noticed that American Indian students classify water and rocks as "living" when understood from the context of what a Native elder

would say on this matter. Conversely, these American Indian students reported that their science teacher would classify water and rocks as non-living things. Arguably, this observance is related to the notion of cultural border crossing (Aikenhead, 1996) that was discussed in the previous section, Schooling for American Indian Students. More specifically, if these students can identify the differences in Native and Eurocentric understandings of a scientific concept, without obscuring the Native viewpoint, then they are displaying cultural border crossing.

Therefore, in relation to the previously discussed example of Medin and Bang's observances of how American Indian students confront cultural orientations related to being "alive," Aikenhead and Huntley (1999) take the argument further by suggesting that science classes be changed "into culturally sensitive curricula, instruction, and assessment that make students feel more comfortable border crossing between their own culture and the culture of school science" (p. 21-22). With culturally informed perspectives in mind, coupled with the myriad student cultures represented in science classrooms, and in light of Cobern's position that "science is indeed a second culture experience for many American students" (1991, p. 9), it is critical to utilize culturally informed perspectives in the teaching of science.

One of the culturally-based practices in the literature on science education is that of culturally responsive schooling (CRS) for Indigenous youth (Brayboy & Castagno, 2008). CRS and CRP can be dually understood as teaching that "makes sense" to students who do not belong to the dominant social or cultural group (Klug & Whitfield, 2003, p. 151). CRS is necessary in science classrooms that serve American Indian students because it supports bicultural students at being adept in both mainstream and tribal societies rather than sacrificing one for the other (Brayboy & Castagno, 2008). In this way CRS stands in direct opposition to the assimilationist practices that were once upheld in Indian boarding schools as well as are still upheld in modern

U.S. public education at large.

Culturally Sustaining and Revitalizing Pedagogies.

Stemming from the previously discussed culturally-based pedagogical analyses, Paris (2012) suggests a culturally sustaining pedagogy (CSP) that goes beyond culturally relevant and responsive pedagogies. Paris' (2012) theory of CSP "seeks to perpetuate and foster—to sustain—linguistic, literate, and cultural pluralism as part of the democratic project of schooling" (p. 95). With regard to American Indian schooling, Lee & McCarty (2017) also invoke the call for culturally sustaining pedagogies (CSP) (Paris, 2012; Paris & Alim, 2014) in offering that "tribal sovereignty must include education sovereignty" (p. 61). Lee & McCarty (2017) base their support for CSP on the work of Cazden & Leggett (1978), Ladson-Billings (1995), and Paris (2012) and then extend the call for CSP to include culturally revitalizing pedagogies. CSRP takes a decolonizing stance in serving to "counter the repressive, compensatory focus of colonial language policies" (Lee & McCarty, 2017, p. 73). CSRP can also be linked to American Indian language revitalization efforts as well as an Indigenous self-determination movement. This being said, it can be argued that "Teaching Native languages to students is a culturally sustaining and revitalizing practice" (Lee & McCarty, 2017, p. 68). Lastly, the third of three tenets of CSRP "recognizes the need for community-based accountability" and that "CSRP serves the needs of Indigenous communities as defined by those communities" (Lee & McCarty, 2017, p. 62). With the theory of CSRP in mind, the present study will explore the confluence of Native culture and language with Western science that responds to the needs of American Indian students.

Science Education for American Indian Students in Urban Settings.

The literature suggests that science education in urban public schools, serving largely Students of Color, has been put on the backburner in order for more instructional time and effort

to be placed on subjects like reading and mathematics (Djonko-Moore et al., 2018; Leonard et al., 2011). Additionally, urban science curricula are reported to be largely textbook-based and non-inclusive of inquiry teaching methods, activities, field trips, and informal science experiences (Djonko-Moore et al., 2018). In fact, a research study suggests that urban science students benefited from “community-based centers and outdoor education settings [where they could use] science processes (i.e., observation, prediction, inference, problem solving, drawing conclusions, etc.) as they explored and collected data to learn about the environment, climate change, and sustainability” (p. 138). In this research study (Djonko-Moore et al., 2018), the positive outcomes for urban students that stemmed from community connections are supported through Hammond’s (2015) collectivist archetype with a nod to deep culture, Ladson-Billings’ (1995) tenet of cultural competence and Dhingra’s (2007) concept of cultural scientific literacy.

Another subset of urban students that benefit from community-based learning is that of American Indian students. More specifically, community-based learning supports the ontological nature of American Indian students’ epistemologies. Brayboy & Maughan (2009) elucidate this point as they state, “We understand ontologies as capturing the process by which individuals—and communities—come to think of themselves, are framed by others, and are integrated into their local communities” (p. 4). Ontological underpinnings of community, and also Indigenous Knowledge (IK), speak to the collectivist mindset of American Indian students, thus supporting their learning in culturally informed ways. An example of a culturally relevant practice that could support American Indian students when studying about human interactions with the natural world is exemplified in Brayboy & Maughan’s (2009) research. These authors showcased the way a particular pre-service American Indian teacher modified a typical lesson on seeds and plant growth in order to make it more meaningful not only for Indigenous students, but for all

students. In particular the pre-service teacher, “contextualized the act of growing something, transforming it from a science experiment to a way of thinking about and engaging the world in which her students live everyday” (Brayboy & Maughan, 2009, p. 11). Instead of asking her students to simply grow various beans in different types of soil and measure their growth (without having prior knowledge about beans or soil), she instead invited her students to journey with her in “starting at the beginning.” This teacher explained that she would first teach the students the morphology and physiology of each bean, or how each bean was different in its form, function and purpose. Her students would then learn about phrenology and constellations before planting the seeds and making qualitative and quantitative observations of the beans throughout the year. In this way, the pre-service teacher emphasized “the importance of bringing together forms of learning and knowing for the benefit of students and communities” (Brayboy and Maughan, 2009, p. 9), which speaks to the collectivist nature of American Indian students as well as the nature of the science content in connecting human interactions with the natural world. Medin and Bang (2014) would agree that the pre-service teacher in Brayboy & Maughan’s (2009) study was employing the premises innate to culturally based science education because she was focused on “identifying and supporting [American Indian] student epistemological orientations” (p. 184) in breaking down the schism that exists between tribal cultural practices and White male science.

Scientific Knowledge and Language in American Indian Communities.

With the intertwined nature of American Indian language and culture (Gilbert, 2010) in mind as it relates to the present study, a culturally responsive bridging of American Indian identities with a traditionally hegemonic science education may expose the relevancy in this content for American Indian students. On a general level, it has been evidenced that traditional

Native knowledge about the world “values a more nuanced, contextual, and holistic view of information from observation and thought, not just piecemeal experimentation of discrete, individual components of a system” (Luu, 2019). This ideology lies in contrast to a Eurocentric view of science. A specific example of the confluence of traditional knowledge and Native language alongside Western science comes from ecosystem studies wherein animal and plant properties have been studied and recorded by Native people to the degree that these observations are as robust as those coming out of Western science (Luu, 2019). According to Luu (2019), “As many endangered languages die out, so do the unique discoveries their speakers have preserved across generations in their oral histories (para. 9). The tradition of oral history in Native communities is an idea that will be explored in the methodology portion of this study.

Accompanying traditional knowledge about the natural world is the practice of storytelling through Native language. Native storytelling is more than simply fiction or fluff told to children to pass the time. Rather, storytelling is more akin to a pedagogy that has been used throughout Native history as a means to disseminate traditional scientific knowledge in ways that are both simple enough for children to understand and yet complex enough for children to unpack as they mature and become adults (Iseke, 2013). In this way, storytelling is a mode of transmission of a robust history of not only biological knowledge but also that of social, relational, communal, and personal insights that explain both the past and the present (Iseke, 2013).

Conclusion

This literature review has explored two historical perspectives in relation to the confluence of tribal culture and Western science for American Indian students. Considering both the historically and presently harmful effects of colonization on American Indian students in

their post-contact schooling, the chapter herein has endeavored to elucidate the contextual components necessary to engage not only with the present study, but also with the *need* for the present study. There is a critical call to cultivate in science education for American Indian students culturally responsive pedagogies that better serve the needs of students of Native heritages. This call comes into play especially as American Indian students are faced with the endeavor of bridging traditional cultural knowledge and Western science in ways that extend beyond deleterious assimilatory ways.

Land loss, cultural loss, and language loss equate to a loss of identity, which, for American Indian students, is gravely problematic. These historical losses continue to disempower and disenfranchise American Indian students in the present day. Klug and Whitfield (2003) conclude, “Our consciousness has been raised, and we cannot pretend to live in the same time and place as our forbearers. Nor would it be ethical for us to do so” (p. 287). These authors’ insistence on culturally responsive pedagogy for American Indian children still demands attention nearly two decades years later. As such, one method of addressing the need for a culturally responsive bridge between Native science and Western science is an examination of the confluence of the cultural content of an American Indian text alongside traditional U.S. public education science standards. In this way, the implications of the present study include the exploration of how traditional Western science curricula may be culturally responsive to American Indian students through the vehicle of language. The potential for Western science to be culturally-based in American Indian culture, through language, is the major implication of the present study.

Chapter 3: Methodology

This study examined the confluence of American Indian culture and traditional U.S. public school science curricula through a lens of cultural responsiveness. The question guiding this study centered on what is revealed about culturally responsive pedagogy for American Indian students in the process of examining the cultural content of an American Indian text alongside traditional U.S. public education standards. The confluence of Western science and Native epistemologies is explored through an analysis of the usefulness of a goose book in classrooms serving Native students.

The methodology utilized herein was that of a phenomenological multiple case study. Rooted in my interest in bridging theory and classroom practice, the decision to utilize this particular qualitative design was guided by a Native member of my dissertation committee. The intent behind using a phenomenological approach was to center the participants, who have a shared experience as teachers of American Indian students, as a unit of analysis (Creswell & Poth, 2018). This approach honors the expertise and essence of the pedagogical practices and experiences that these ingroup members live out in their respective settings.

Position Statement

As researchers we each bring our own assumptions, biases, philosophies, and frameworks to our practice (Maxwell, 2016). As such, it is important to identify paradigms that root and frame qualitative research. In this present study, I heed the suggestion of Maxwell (2016) who recommends the use of theoretical frameworks as well as experiential knowledge when conducting qualitative scholarship. Specific to the present study, it was through connections and inspiration from a year of work alongside a Mountain States tribe, as well as the completion of a review of literature on culturally relevant pedagogy, culturally responsive pedagogy, TribalCrit,

and science education that I engaged in an exploration of American Indian culture alongside Eurocentric science standards. Given the scholarship centered on culturally responsive pedagogy, I align with the work of Howard and Kern (2003), that suggests researchers participate in critical self-reflection or, similarly, critical reflective inquiry (Mensah, 2009). To this end, I have considered my positionality in this work and have therefore composed a statement of reflexivity.

As a White, female researcher with seven years of non-Native student teaching experience in the K-14 setting and one year of Native student teaching experience on an American Indian reservation in one of the Mountain States, I bring to this work biases related to the subculture of Eurocentric science as well as insider and outsider perceptions of Native culture. I possess outsider status in American Indian communities, while holding insider status in higher education. Benefits of my positionality include an earnest personal and professional desire to seek understanding at the confluence of Native epistemologies and Western science. A potential limitation includes an ingrained allegiance to Western epistemologies and its biases.

Aveling (2013) advises that non-Indigenous researchers exploring Indigenous contexts understand the warning, “Don’t talk about what you don’t know” (p. 203). In my reflection, I acknowledge that my expertise lies in science education and culturally responsive pedagogy more than it does in schooling for American Indian students. Since this present study centers American Indian students, through a phenomenological lens that privileges the lived experiences of participants (Creswell & Creswell, 2018) who serve these students, I deferred to the teachers I interviewed to provide their insights on the confluence of American Indian culture and Eurocentric science for their American Indian students. I believe the role of researchers is “to use our privilege [in] becom[ing] an ally of those on the other side of the privilege seesaw” (Kendall, 2006, p. 141). Furthermore, being an ally entails self-education, providing academic and

personal support, and facilitating for the academy (Aveling, 2013). It is my continued intent to walk alongside both Native and non-Native teachers in this work, as all of us strive to learn more about the connections between American Indian culture and Western science subculture as it promotes culturally responsive pedagogy in the support of students.

As an outsider, and in order to work as an American Indian ally, I humbly acknowledge my willingness to make mistakes, be uncomfortable, and center race and counterstory while decentering Whiteness and Eurocentric values. I draw from Aveling (2013), who urges White researchers to embrace allyship over upholding and speaking from the “good White” stance (p. 209). It is not enough for me to simply feel good about doing this work. I know that serving as an ally is inevitably uncomfortable (Aveling, 2013). As an ally in this work, I decenter myself and my Eurocentric biases through critical reflection while simultaneously centering the lived experiences of my participants.

Theoretical Framework

This study is supported by the theoretical perspectives rooted in culturally relevant pedagogy (CRP) (Ladson-Billings, 1995), culturally responsive pedagogy (Gay, 2002), and tribal critical race theory (TribalCrit) (Brayboy, 2005) as detailed in the literature review. The theory of CRP has intentionally been chosen to frame this study because of the ability of this framework to “empower students intellectually, socially, emotionally, and politically using cultural referents to impart knowledge, skills, and attitudes” (Ladson-Billings, 1994, p. 16-17).

According to Pewewardy (1998), there is a need for culturally responsive teachers for American Indian students. This need stems from a “cultural mismatch” (p. 69) between American Indian students and the colonial mindset typically held by public school teachers. American Indian students bring particular cultural values to the science classroom, which should

be considered when approaching the teaching and learning relationship between these students and their teachers. Cultural values that American Indians bring to their learning experiences include, “conformity to authority and respect for elders, taciturnity, strong tribal social hierarchy, patrimonial/matrilineal clans, and an emphasis on learning, which are deeply rooted in the teachings of the elders” (Pewewardy, 2002, p. 23). With these cultural values at the forefront, culturally relevant pedagogy offers a lens through which the needs of American Indian learners can be responsibly addressed, not only academically, but also culturally and sociopolitically.

TribalCrit has also been chosen to frame this study because the groundings of this critical lens seek to “address the complicated relationship between American Indians and the United States federal government and [by] begin[ning] to make sense of American Indians’ liminality as both racial and legal/political groups and individuals” (Brayboy, 2005, p. 428). TribalCrit affords this study the ability to properly situate the context of the Native teacher participants, with a focus on their American Indian students, through a decolonized lens. Along these lines, Aikenhead and colleagues (2001) conclude, “As students bring their community’s Aboriginal knowledge, language, and values into the classroom, new relationships between a teacher and a student can replace the conventional hierarchy characterized by teachers transmitting what they know to students” (p. 347). The amalgamation of CRP and TribalCrit frames the history and counterstory significant to this present study, supports the research question, and guides the selected methodology.

Research Design

This scholarship was guided by the qualitative research design methodology of a phenomenologically-situated, embedded collective case study (Creswell & Poth, 2018). Since this study explored culturally responsive science pedagogy for American Indian students through

the eyes of Native teacher participants, I decided to employ a research methodology that respectfully reflects these participants' truths. In particular, a phenomenological approach provided me the vehicle through which to "describe the lived experiences of individuals about a phenomenon as described by the participants" (Creswell & Creswell, 2018, p. 13). In this case, the phenomenon under consideration was the process of examining the American Indian cultural content of a Native text alongside science standards.

My rationale for choosing a phenomenological approach is further supported by Cajete's (2004) argument that,

Phenomenology parallels the approach of Native science in that it provides a viewpoint based on our innate human experience within nature. Native science strives to understand and apply the knowledge gained from participants in the here and now, and emphasize our role as one of nature's members rather than as striving to be in control of it. (p. 47)

What Native science implies for this study is an appropriate methodology to be used in honoring my participants and the Native students I am centering. This design decision is supported by Pewewardy (1992) who states, "It's ironic that Indian people are not allowed to be experts on themselves—it's usually someone else 'defining' the Indian" (p. 5). Pewewardy's (1992) reasoning underscores the need for me to carefully address any inherent biases in my observations and analyses as an outsider. Therefore, the authentic words offered by participants in interviews and their review of thematic Western science elements drawn out of the science standards by the researcher were of particular importance in deducing the findings of this study. In this way, participant voice will be used as counterstory validated in its own authority (Solórzano & Yosso, 2002).

Participants

In phenomenological research, Creswell & Poth (2018) advise that the quantity of participants can range from one participant (Padilla, 2003) to as many as 325 participants (Polkinghorne, 1989). Since sample size in qualitative research is dependent on the methodology being utilized, Creswell & Creswell (2018) suggest that only four or five cases are appropriate in case study research. Since the present study is a phenomenological multiple case study, I utilized a sample size of four participants in order to collect in-depth data from each participant, painting robust narratives of each of their unique essences and insights as related to the research question.

Purposeful Criterion Sampling

Creswell & Poth (2018) propose that diverse cases offering multiple perspectives should be considered when designing purposeful sampling. With this in mind, this present study features four participants who are educators from the 6-8 grade level in secondary education. This grade band was selected for several reasons, most of which stem from my understanding of this grade-level group. I utilized participants from the 6-8 grade band to offer a constant variable from which to respond to the research question. The 6-8 grade band was also selected because it aligns with my Midwest State secondary teaching credential, and because it was the grade band at which I perceived the provided text to be appropriate. I recruited participants from both Native language classrooms and from science classrooms. With the understanding that Algonquian language is the vehicle for culturally responsive science pedagogy for the American Indian students who are centralized in this study, the voices of both Algonquian language teachers as well as science teachers were considered herein to offer multiple perspectives in this work.

Furthermore, the phenomenological approach calls for a study of the essence of a similar experience that is shared by a number of participants (Creswell & Creswell, 2018). To that end, I

elicited the use of criterion sampling within my purposeful sampling design. Specifically, this study included only participants who had all experienced the one phenomenon under consideration (Creswell & Poth, 2018). Requisite for quality assurance (Creswell & Poth, 2018) is that all four participants in this study have had experience teaching Algonquian language(s) and/or science to students who identify as citizens or descendants of Algonquian nations. While these teachers did not need to identify as citizens or descendants of Algonquian nations, they did need to have taught for at least one school year. These sampling criteria will be further delineated in the subsequent section.

Recruitment of Participants

In the examination of culturally responsive pedagogy for American Indian students through the vehicle of an American Indian text alongside traditional U.S. public education science standards, the process of recruitment was crucial to this work. Contrary to the random sampling and large sample sizes integral to quantitative research (Creswell & Creswell, 2018), participants invited to participate in this present study had to value or have interest in examining the connections between Native cultures and Western science subculture. The recruitment protocol and rationale in Table 2 below were adhered to when recruiting participants for this study.

Table 2*Recruitment Protocol*

Step	Recruitment Step Description
1	<p>I gathered the names of possible participants by tracing the origin and use of the primary text, ᑎᑭᐱᑭᐱ ᐱᑭᑭᑭᑭᑭᑭᑭ ᑭᑭᑭᑭᑭᑭᑭᑭᑭᑭ / <i>I'll Take You Goose Hunting Next Spring</i> in Naskapi, or Niwii-noojinikawemin Waa-Ziigwang / <i>We Will Go Goose Hunting Next Spring</i> written Ojibwe, that is being examined in this study. Gathering names in this manner aligns with the phenomenological nature of this study. Since the primary text is written in an Algonquian language, it was necessary that participants held in common the experience of teaching students who identify as citizens or descendants of Algonquian nations (Creswell & Creswell, 2018; Creswell & Poth, 2018).</p> <ul style="list-style-type: none"> a) Recommendations and nominations of participants were considered for nominees who fit the selection criteria. b) Participants were considered from both private and public K-12 settings; non-traditional educational settings; and from higher education including private and public two-year colleges, tribal colleges, liberal arts colleges, and four-year institutions.
2	<p>I ensured that possible participants meet the following criteria:</p> <ul style="list-style-type: none"> a) Served as a teacher of Algonquian language(s) <u>or</u> as science teacher of students who identify as citizens or descendants of Algonquian nations. b) Have held a role of, or similar to, teacher of Algonquian language(s) or science teacher of students who identify as citizens or descendants of Algonquian nations for at least one year. Cannot be a first-year teacher. c) Taught at the 6-8 grade level. d) Did not need to identify as a citizen or a descendant of Algonquian nations.
3	I invited participation via email enrollment. See Appendix B for the recruitment letter.
4	Interested recruits received emailed consent forms in advance of individual virtual interview sessions, giving them time to ask me questions prior to the initial interviews.
5	Willing recruits informed me via email of their desire to participate in the study. Recruits' participation in the study established their consent to participate. Signed consent forms were not collected.
6	I contacted each participant via email to schedule their initial interview date and time. See Appendix C for this email protocol.

Using this recruitment protocol, I sent recruitment email messages to 17 teachers of

Algonquian language and/or science teachers of students who identify as citizens or descendants of Algonquin nations. Four teachers consented to participate in this study. Hoping for up to two more participants, I sent an extension invitation to the 13 teachers who had not yet replied to my initial invitation to participate. This extension yielded responses from three additional teachers. One of these teachers, who ultimately declined participation, asked for clarification on (a) whether there would be student involvement and (b) what the purpose was of the study. The other two teachers declined to participate, one of whom, a science teacher, cited (a) time constraints, specifically in needing the time to socially distance their curriculum and (b) their inability to see the connection to science, sharing their understanding that the present study is geared more toward language arts.

Each of the four teachers who agreed to participate in this study met the following recruitment criteria: (a) teach Algonquian language(s) to students who identify as citizens or descendants of Algonquian nations, (b) hold a role similar to teacher of Algonquian language(s) for students who identify as citizens or descendants of Algonquian nations, and (c) teach, or have taught, at the 6-8 grade level. Each of these teachers live in the U.S. upper Midwest. Table 3 is provided as a summary of the participants.

Table 3

The Teacher Participants

	Zhiibaasige	Gete-Anishinaabe	Auntie B	Zhashagi
Subjects Taught	Ojibwemowin	Anishinaabe Language and Culture	Ojibwemowin, History, Ojibwe Ethnobotany	Grades 3-5 in Ojibwemowin
Years Taught	10+	20+	7	10+

Data Collection

In my examination of the confluence of Native epistemologies and Western science, my data collection approach included interviews, standards (text) analysis, document review, and member checking interactions. I designed a series of steps, depicted in Table 4, through which data collection transpired.

Table 4

Data Collection Steps

Week	Data Collection Activity
1	Conduct initial interviews.
2	Participants analyze a short Algonquian story (goose book) and grade 6-8 NGSS and state science standards.
3	Conduct follow-up interviews.
4	Participants complete member checking on own.
5	Participants meet with researcher for member checking discussion.

Each step of the data collection process outlined in Table 3, and rationale for their use in this present study, is described below.

Initial Interviews

An initial interview was conducted with each of the four participants. Interview schedules were agreed upon by the participant and the researcher following participant consent to engage in the study. Participants each received a Microsoft Outlook calendar invitation that contained the virtual meeting room link required to participate in the interview. Due to challenges presented by

the SARS-CoV-2 pandemic¹, virtual, rather than in-person, interviews were conducted in order to gather participants' responses to the researcher's questions. Videoconferencing was selected to support the collection of rich qualitative data. Since this thick data, inherent in qualitative research (Creswell & Poth, 2018), relies on the connections made during the virtual interviews, I decided to use video conferencing that would offer both a visual and auditory connection with participants, rather than the less engaging approach of phone interviews.

The interviews were guided by an interview protocol focused on six open-ended questions (see Appendix D). Advantages of this method included the following: (a) the safety of the participants as well as the researcher regarding SARS-CoV-2, and (b) the ability to capture participants' thoughts in their own words, which is an integral component in phenomenological research (Creswell & Poth, 2018). A drawback to conducting interviews virtually included interpersonal barriers (Creswell & Poth, 2018) as well as technical issues such as screen freezes and occasional inaudible audio, stemming from the interface being utilized.

To mitigate these barriers and to show my commitment as a researcher to employing decolonizing research methods, I wanted to show my participants my appreciation and gratitude for the narratives they shared with me during our interviews. As such, an Anishinaabe member of my doctoral committee suggested I offer tobacco prayer ties as gifts for my participants. Since I wanted to honor the land and people of this place, Minowakiing, I made a tobacco tie for each of my participants. I carefully selected a unique color of cloth for each participant, prayed and added tobacco into each 4" x 4" cloth square, and used string to tie off each pouch. Each of these tobacco ties were then offered to each participant prior to the start of their initial interview

¹ As a result of the Coronavirus pandemic (COVID-19), the Center for Disease Control has established social distancing recommendations (CDC, 2020) that restrict in-person gatherings. I will respect these restrictions by conducting virtual interviews rather than in-person interviews.

with me. Instead of physically receiving their offered tobacco ties, one participant suggested I hang his in a tree in my yard. When I asked for his thoughts on hanging his tobacco tie in a more meaningful location, my family's cottage, he gave me permission to do so. Two other participants also supported this. Another participant asked me to hang their tobacco tie in a specific location along the Great Lakes, citing a personal significance of this location. See Appendix J for photos of the three tobacco ties that I placed at my cottage, and the one tobacco tie I placed along Lake Michigan.

My objectives of the initial interviews were to (a) gather background knowledge to build each participant's case, and to connect this knowledge to their text-to-standards analysis task, and (b) cultivate trust within the participant-researcher relationship. The recordings of the initial interviews lasted 26 minutes on average, with the longest interview lasting 33 minutes and the shortest interview lasting 20 minutes. With participant consent, these interviews were audio recorded. Interview audio files were securely transcribed by a third party in preparation for interview analysis.

Goose Book and Science Content Analysis

In the second step of data collection, participants were asked to read a goose book that was written in Naskapi and then translated into Ojibwemowin, both of which are Algonquian languages. This illustrated text, containing an English translation and glossary of terminology, was given to participants in both (a) the contextually appropriate Algonquian language and (b) the English translation. Participants began this activity by reviewing a reading guide that I constructed (see Appendix E). It was anticipated that participants would spend about 10 minutes reading the text and digesting the illustrations in the goose book. It was during this time that participants were asked to engage only with the text and illustrations, but they were permitted to

make any written observations or annotations if they desired (though it was not required). The intent was for the participants to fully experience the goose book as a reader rather than concurrently completing the content analysis activity that was to follow.

Immediately after reading the goose book, participants spent about 60-90 minutes completing a text-to-standards content analysis by reviewing NGSS and state science standards. Participants write down or typed their reflections and analyses pertaining to connections between the goose book and the science standards on a document provided to them (see Appendix F). This content analysis document captured their thoughts about the goose book's confluence with the NGSS and state standards.

Follow-up Interviews

After completion of the participants' text-to-standards analysis, follow-up interviews were then conducted with each of the four participants via individual virtual meeting rooms. These interviews took place within one week of the analysis of the goose book in order to capture rich data without allowing too much time to pass. The primary objective of the follow-up interviews was to inform the research question guiding this study, "What is revealed about culturally responsive pedagogy for American Indian students in the process of examining the cultural content of an American Indian text alongside traditional U.S. public education science standards?" Rationale for the methodological sequencing of the initial interviews, text-to-standards analysis, and follow-up interviews is as follows. Initial interviews were intended to (a) establish trust with participants, especially given the virtual, rather than face-to-face, platform, and (b) gather data to build cases for each of the four participants. The text-to-standards instrument provided an opportunity for participants to think explicitly about connections they saw between the goose book and the science standards, without the instrument being so open-

ended that the data were insubstantial or misguided. The sequencing of the follow-up interview allowed for rich data to emerge from deeper questioning, supported by clarifying questions, within the shared space of trust in the participant-researcher relationship.

The follow-up interview questions were shaped in ways that gathered thoughts from the participants about what they learned by performing their analyses, and which components of this work they might use in their own classrooms. An interview protocol was designed around phenomenology, grounded in the rigor outlined by Crewell & Poth (2018). I intentionally designed the interview questions in both general and open-ended ways (Creswell & Poth, 2018) to capture the essence of my participants' lived experiences, revealed, in part, through their text-to-standards analysis—as informed by their interactions with the American Indian students they teach. Interviews were an appropriate research method in this case study because interviews afforded opportunities for the participants to describe their experiences with the phenomenon under investigation (Creswell & Creswell, 2018) by centering their perspectives.

I anticipated that each of the follow-up interviews would last approximately 60 minutes. The average follow-up interview length was 44 minutes, with the longest being 62 minutes and the shortest being 24 minutes. With the participants' consent, these interviews were audio recorded and then securely transcribed by a third party in preparation for analysis. These interviews consisted of six directed as well as open-ended questions (see Appendix G).

Data Analysis

The analysis of the data collected in this study was informed by a theoretical frame comprising culturally responsive pedagogy (Ladson-Billings, 1995), culturally responsive pedagogy Gay (2002), and TribalCrit (Brayboy, 2005) as it pertains to the research question. Data analysis also aligns with the blended methodological approaches of case study and

phenomenology, detailed below.

First Cycle Coding

Prior to coding the participants' interview transcripts, all transcript data was deidentified and member checked by the participants. To begin my analysis, I carefully read all eight transcripts, comprising four initial interviews and four follow-up interviews, while making marginal notes and "jottings" (Miles, Huberman & Saldaña, 2014) on the transcripts. Commencing the first cycle coding, wherein "codes [are] initially assigned to the data chunks" (Miles, Huberman, & Saldaña, 2014), I used the qualitative software Dedoose to descriptively code the initial and follow-up interviews (see Appendix I). I utilized an inductive coding approach to code the data line by line in identifying and labeling the descriptive "chunks" that emerged (Miles, Huberman & Saldaña, 2014). The first cycle codes (see Appendix I) were derived inductively, meaning that codes "emerge[d] progressively during data collection" (Miles, Huberman, & Saldaña, 2014, p. 81) as opposed to being predetermined.

In support of the inductive approach to coding, and researcher reflexivity, I engaged in a reflective process through my analysis that centered the research question. I looked for inductive codes to emerge in light of their relevance to the confluence of Native epistemologies and Western science. I maintained reflexivity in this process by upholding a suggestion from Miles, Huberman & Saldaña (2014) to interpret my personal thoughts as conceptual or theoretical ideas related to the study, and to avoid the influence of bias stemming from my status as a member of the outgroup.

Dedoose Analytics

Following the first cycle of coding, I utilized Dedoose's code application feature to sift through the codes and categories or themes of codes that had high occurrences. Taking code

occurrences into consideration, I then looked at code presence across the participants. If a particular code was not evident across all four participants, I did not consider it in my continued analysis. If the frequency of a particular code was low (i.e., five occurrences or less across all participants), it was disregarded. After employing Dedoose's packed code cloud feature, I was further able to review the higher frequency codes and themes beginning to emerge. These techniques allowed for an identification of themes from the codes that were later developed into findings.

Rigor and Trustworthiness

Trustworthiness is evident in the careful selection of data collection methods and member checking. First, all interviews were audio recorded and securely transcribed by a third party. In the spirit of a phenomenological methodological approach, as well as ethical considerations, it was vital to both highlight and to protect the voices of the participants. To this end, participants were asked to provide their own deidentifiable pseudonym prior to recording their initial interviews. This methodological choice was made intentionally to honor the unique cultures of each participant. Prior to first and second cycle coding of the initial interview, text-to-standards document analysis, and follow-up interviews, participants were asked to review and critique the interview transcripts (Miles, Huberman, & Saldaña, 2014). Member checking in this manner takes a positivist epistemological approach as it validates the truth in the spoken word of the participants (Birt et al., 2016). Additionally, whenever possible, participants' verbatim quotations were used in the coding, thematizing, and culling of the four narratives as well as the findings of this study.

Data triangulation and researcher bias were also accounted for in this study. Member checking, the use of In Vivo codes, and participant interview transcript excerpts throughout the

analytical process not only triangulated the data, but served to check my personal biases. As detailed in a previous section, the use of two coding cycles ensured that the themes and findings of the present study have been derived solely from collected data, rather than researcher bias. Furthermore, all email communication, audio recordings of interviews, and text-to-standards documents completed by participants were securely stored for cross referencing.

Transferability

The methodological practices and data analysis explored in this study are transferable, though not necessarily replicable, beyond the present study. Transferability was intentionally ensured in an effort to provide for scholars and K-12 practitioners alike a model that examines the culturally responsive connections between American Indian cultures and Eurocentric science. Although the peculiarities and conditions of this study are not transferable, the methodological process (Miles, Huberman & Saldaña, 2014) is transferable to other studies of this nature. Adaptations can be made in future studies that seek to explore how versions of science can move between cultures and subcultures in service of American Indian students.

Limitations

Limitations of this study include unforeseen issues that I had little to no control over. The primary limitation in this work was the inability to meet with participants face-to-face and to observe participants in their own classrooms due to safety issues stemming from the SARS-CoV-2 pandemic. Specifically, the candor of experiential sharing that is privileged between participant and researcher was limited due to diminished abilities to build the relationships that are inherent to phenomenological research.

The sample size being utilized was also a limitation. With a smaller sample size, generalizability cannot be realized (Creswell & Poth, 2018). Instead, the smaller sample size was

optimized for a focus on a more in-depth examination of the participants' experiences providing rich and illustrative cases under examination. Another limitation of the present study was that it explored only a single text as the vehicle for culturally responsive pedagogy. A separate study may be interested in examining multiple texts, representing other authors and various stories from Algonquian tribes. The final limitation is that I worked within the scope and timeline of the parameters of a dissertation study.

The boundaries and scope of this work included a priori decisions made during the design of this study. Some delimitations include the following: (a) research question, (b) chosen sample size, (c) methodological design, and (d) timeline for initial contact and recruitment, interviews, and any follow-up. Time constraints are in effect due to my pending graduation deadline.

Conclusion

There is a need for deeper inquiry into how American Indian culture and Eurocentric science subculture interplay in classrooms that serve Native students (Cobern and Loving, 2001). This study examined the confluence of American Indian culture and traditional U.S. public school science curricula through a lens of cultural responsiveness (Gay, 2002) and TribalCrit (Brayboy, 2005) via an Algonquian goose book. The credibility of this present study is rooted in a legitimate gap in this deeper inquiry into what is revealed about culturally responsive pedagogy for American Indian students at the confluence of Native epistemologies and Western science.

The research question guiding this study is phenomenologically embedded in interpreting the shared experiences of the participants (Creswell & Poth, 2018), reflecting the process of meaning making. This study also aligns with transcendental phenomenological elements (Moustakas, 1994) in its focus on the participants' own descriptions of their experiences, followed by a conclusory thematizing of participants' expressions into research findings. The

meaning derived from this study was generated through a *horizontalization* of participants' experiences that elicited *clusters of meaning* into themes (Creswell & Poth, 2018, p. 79). The research question was explored through the lens of the teacher participants who served as the collective unit of study. The textual and structural descriptions provided by the participants informed the composite essence of this research, illuminating cultural responsiveness for American Indian students at the confluence of Native science and Western science.

Chapter 4: Findings

The lived experiences and expertise of each of the four participants considered in this study inform the research question, “What is revealed about culturally responsive pedagogy for American Indian students in the process of examining the cultural content of an American Indian text alongside traditional U.S. public education science standards?” First, the participants’ narratives will be illuminated using their voices. In this chapter, I will share the stories of the four participants, including their backgrounds and how they perceive their work with American Indian students.

Second, I will reveal three cross-case findings that emerged through an analysis of the experiences that the participants shared during their initial interviews, text-to-standards analysis, and follow-up interviews. The findings revealed in this work are reflective of the qualities of instruction that are valued across the four participants. These findings include how the teachers (a) use their cultural knowledge and Native identities as the foundation of their instructional decisions; (b) act as language brokers when they consider instructional materials for use in their classrooms; and (c) express their ambivalence toward the state standards in the process of instructional planning and design. Each of these findings will be presented and contextualized within the process of examining a Native text alongside Western science standards.

Introducing the Participants

Examining the perspectives of the participants as they engaged in a text analysis process and described their broader instructional decisions is key to understanding the confluence of Native and Western lenses in science education. Throughout this study, each participant is honored, both amongst one another and in the centering of their Native identities in their professional work. Thus, each participant’s story is presented as unique and meaningful. From

my perspective, there is no hierarchical nature among the participants or associated with their involvement in this study; therefore, I have positioned Table 5 in a vertical format to provide an overview of the characteristics of the four participants in the order in which I met them.

Participants' identities, professional roles, the grades they teach, and the types of schools in which they teach at are listed in order of importance to the current study.

Table 5

Participant Characteristics

	Zhiibaasige	Gete-Anishinaabe	Auntie B	Zhashagi
Identity ²	Pokagon Band Potawatomi	Anishinaabe	Grand Traverse Band of Ottawa and Chippewa Indians, Thunderbird Clan	Indigenous
Professional Role	Ojibwe Language (Ojibwemowin) Teacher	Coordinator and Teacher of Anishinaabe Language and Culture	Ojibwe Teacher	General Education Instructor (Ojibwe Immersion Teacher)
Grades Taught	K-8	6-8	6-8	3-5
Type of School	K-8 Private	6-8 Public	K-8 Public Magnet	K-12 Immersion

With the four participants' characteristics in mind, I provide an introductory narrative that describes how I came to know each of the individuals contributing to this study.

² To determine identities for each participant, during their initial interviews I asked them to tell me about their backgrounds during which time they self-identified their identities. Sometimes their responses gave clarity as to their cultural belief systems, and sometimes the participants mentioned a Nation, Tribe, or clan that they are citizens or descendants of. The absence of a divulged identity does not ground their response to my question. This methodological approach allowed individuals to self-identify in ways that were agentic and authentic. When designing the interview questions, I accounted for diversity in their responses.

Zhiibaasige

Zhiibaasige is a member of the Pokagon Band Potawatomi and teaches Ojibwemowin at a school in a U.S. upper Midwest state that serves American Indian students in pre-kindergarten through 8th grade. His paternal great-grandfather and great-great grandfather were survivors of Indian boarding schools³, both “coming out with” their Native language intact. Zhiibaasige’s paternal great-grandfather was the last first-language speaker of Potawatomi in his family. Zhiibaasige’s lineage includes European and Central American ancestors, but he identifies mostly with his “Native side.” During college, he began picking up Ojibwemowin and started assisting in Ojibwe language classes, later teaching Potawatomi language and serving as a consultant for his tribe.

After I explained to Zhiibaasige that I did not want to assign meaningless pseudonyms to my participants (i.e., Participant a...b...c), I asked him to provide his own pseudonym. It did not take him long to select “Zhiibaasige” as a pseudonym. When I asked him why he chose Zhiibaasige, he said it was a name given to him in ceremony.

Zhiibaasige was the third respondent to my recruitment email, responding only one day after receiving this invitation to participate in the present study. He was the first participant I interviewed based on his availability. After introducing myself during our first conversation, I asked Zhiibaasige if I could offer him a gift. As a sign of my gratitude and respect for Algonquian culture, Zhiibaasige, and the acknowledgement that I currently reside on Algonquian land, I had spent some time earlier that day making, hiking, and praying with a tobacco tie. I

³ From the late 1800s through the early 1990s, boarding schools were thought to be “the ultimate solution to the Indian problem” (Adams, 1995, p. 21), established to acculturate Indian children to White ways. “To be in Indian in white American mean[t] being carried off to a faraway place where the white man cut off your hair, put you in a uniform, and told you that your ancestors were savages” (Adams, 1995, 263). White policy makers decided that education for Indian children 1) should include instruction on how to read, write, and speak English, 2) shift Indian children’s focus from tribal life to individual interests, based on accumulation of wealth as a result of hard work, 3) include conversion to Christianity, and 4) train them how to be American citizens (Adams, 1995).

choose to use white cloth, representative of the North. When I asked if Zhiibaasige would accept this gift, and if he would want me to mail it to him, he told me to instead hang it in a tree in my yard. In thinking more about the lack of personal meaning of the yard where I live, I asked Zhiibaasige if I could instead hang his tobacco tie at the land where my family has a cottage, which is located on the land of the O^{mae}q^{no}menew-ahkew (Menominee), Waazija (Ho-Chunk/Winnebago), and Očhéthi Šakówinj (Sioux). Zhiibaasige agreed to this. Two weeks later, I brought the tobacco tie I made for Zhiibaasige to my cottage. That weekend I explained to my parents how and why I made tobacco ties for each of the participants in this study. I asked if they would pray with the ties, to which they did. Then, since my dad has known the land longer than anyone in our family, I asked if he would help me select a tree in which to hang the ties. My dad chose a cedar tree near our dock, a tree I spent countless hours playing under as a kid. He then helped me find some twine in the shed so I could hang the ties in the tree.

Gete-Anishinaabe

Gete-Anishinaabe is an Anishinaabe language and culture teacher and coordinator at an American Indian charter school in a U.S. upper Midwest state. He has been teaching Anishinaabemowin and Anishinaabe culture for over 20 years, a personal history for which he feels “very fortunate.” Gete-Anishinaabe learned Anishinaabemowin as an adult and self-identifies as an Anishinaabemowin second language speaker and learner. He shared that because “the language was gone” in his family many years before he was born, he does not consider himself a fully bilingual speaker of Anishinaabemowin.

Gete-Anishinaabe selected this pseudonym as a reflection of how he views himself. He told me that the first word, *Gete*, is Anishinaabemowin for “being old.” The second word, *Anishinaabe*, is Anishinaabemowin for “Man, (human being, man, woman or child); L. homo;)

also, Indian; pl- g”⁴ (Baraga, 1882, p. 38). After asking Gete-Anishinaabe if he would translate his full pseudonym for me, he chuckled as he said it translates to “old Indian guy.”

Gete-Anishinaabe replied to me two days after receiving his recruitment email. Each time we communicated through email, regarding the consent form and confirming the initial interview date, Gete-Anishinaabe greeted me with *Aaniin*, meaning “Hello!” or “Greetings!” in Anishinaabemowin. At the outset of his initial interview, I asked Gete-Anishinaabe if he would receive the yellow tobacco tie I made for him. I explained to him that I chose the color yellow for its symbolism of the East. Geographically, Gete-Anishinaabe lives east of where I currently reside, and I clarified to him that I took accountability if my gesture was perceived as a centering of my own geographical space. It was not my intention to decenter Gete-Anishinaabe, and I regret having chosen yellow cloth for his tobacco tie. Even so, Gete-Anishinaabe noted my “sincerity” in this act, and said I could hang his tie along with those of the other participants at my family’s cottage. At the conclusion of his initial interview, Gete-Anishinaabe prayed aloud in Anishinaabemowin that I have a safe drive to my cottage. I told him I would ask my dad to help me locate a meaningful tree in which to hang all the ties.

Gete-Anishinaabe defines his role in his community as helping students “fully understand what it means to be a member,” rather than just a descendent of Anishinaabe or Algonquian people. Citing “mixed blood” in his community and region, he explained, “most of us have had to literally claw our way back into our identity of who we are.” Gete-Anishinaabe clarified that his primary role with his K-8 students is to help them build an “ember” or “little coal” in exploring and understanding their unique identities, such that “when the time comes, when they

⁴ Bishop Frederic Baraga’s “A Dictionary of the Ojibway Language” (1882) is a widely respected lexicon of Ojibwemowin, and is still used by Algonquian, Chippewa, Ojibway, Ottawa, and Saulteaux language teachers. Baraga’s definition of *Anishinaabe* has been used here to provide additional contextual detail.

fan that, that fire can be ignited.”

When asked why he wanted to participate in the present study, Gete-Anishinaabe revealed that he supports my desire to understand and learn from Anishinaabe people “within the constraints of a colonized way of structuring our education system.” Speaking from the first-person plural, he asserted a call to action for academics, Anishinaabe people, and all people wherein the balance and openness to new ways of thinking will prime the collective to “find ways to decolonize our way of viewing our means of educating.” Gete-Anishinaabe cited that while his mobilizing message comes from within the four walls of a school building, a system which is tied to time constraints and standards, he believes, “we can accomplish some pretty amazing things within the four walls.”

Auntie B

During our initial interview, Auntie B introduced herself to me in Ojibwemowin, naming her tribe, clan, where she grew up and where she currently resides. Auntie B is a middle school Ojibwe language and culture teacher at a public school in a U.S. upper Midwest state that serves K-8 students. She earned an undergraduate degree in American Indian studies and linguistics, and she was raised in an urban U.S. midwestern setting. Auntie B comes from the Grand Traverse Band of Ottawa Indians, and she belongs to the Thunderbird Clan, she describes as a clan of “diplomats.” Auntie B finds that the teachings about her clan relate to the job she does. She shared, “We [in the Thunderbird Clan] interact with people from different communities and we are supposed to help create better bonds between different communities.” Auntie B has seven years of experience in teaching and social-emotional learning, and a year in her current role which includes teaching an afterschool program centered on Ojibwe ethnobotany.

When I asked her why she wanted to participate in the present study, Auntie B shared

that she agrees to being in research studies and having folks volunteer under her at school, because she doesn't see "enough [indigenous] representation in hard science, in media." Auntie B considers her role in this study to be one that allows for more Native knowledge to be accessible. As she spoke about Native knowledge and climate change, she explained that this study provides a platform for "stories [that] need to be heard because [Native] communities hold knowledge that we need to save our environment."

Auntie B came up with her pseudonym rather quickly, and even cheekily. When I clarified whether anyone might be able to identify her by this name, she explained that, although her pseudonym is loosely related to another name she goes by at her school, she smiled and seemed proud of herself for creating a clever pseudonym that honored her identity⁵.

Auntie B replied to my recruitment email just one day after I sent it. The next day, we confirmed her initial interview for the following week, but were unable to hold the interview because she suffered a concussion in the meantime. She recovered, and we scheduled her initial interview for two weeks from the recruitment date. At the outset of our first meeting, I asked Auntie B if she would receive the tobacco tie I made for her. I explained my rationale behind choosing blue fabric in that, having known that Auntie B once lived in a Midwest State, the color blue reminded me of the Great Lakes that have hewn its shores. As I was finishing my explanation about the blue cloth, Auntie B began crying, stating how much she misses the Great Lakes and what they mean to her, having been raised nearby. Auntie B instructed me to hang her tobacco tie in a tree at the edge of Lake Michigan on the beach at one of her favorite parks. A little over a week later, my dog and I visited this park and gratefully hung Auntie B's tobacco tie in a tree lining the beach.

⁵ The name 'auntie' is commonly used by American Indian people as a term of respect, honor, and endearment for female elders, whether or not they are close blood relatives.

Auntie B articulates her role in the education of students identifying as citizens or descendants of Algonquian nations as “offering language education in a way that’s going to ideally get students beyond Ojibwe 1.” She introduces her students to Ojibwe grammar and helps them put together pieces of vocabulary like numbers, colors, and months that they learned in their Ojibwe 1 classes, or prior to taking any Ojibwemowin language classes. Auntie B focuses her instruction on both “grammatical features and cultural teachings.” Auntie B further explains that her role “goes beyond just teaching language because it’s also about taking cultural teachings and finding out how you can use that in real life beyond the classroom.” She shared a manifestation of this concept in our initial interview by explaining her involvement in teaching an American Indian history and treaties class. For her 8th grade students, she tailored what was originally a class on treaties into a class also centered on ethnobotany and a harvesting curriculum.

Auntie B candidly shared with me some of the challenges she faces not only as a new teacher in her school, but also in the midst of the COVID-19 pandemic. This year she found herself asking questions like, “How do I manage stress?” followed by, “How do *they* manage stress?” referring to her students. Auntie B explained that she mitigates these challenges by educating her students with traditional teachings and knowledge as a way to heal themselves. She also utilizes Ojibwemowin and social-emotional learning approaches with her students when teaching about recovering from illness, including mental illness.

Zhashagi

Zhashagi is a general education instructor who teaches solely through the medium of Ojibwemowin; he has not taught in English since finishing his undergraduate studies. For over a decade Zhashagi has taught at an American Indian immersion school in a U.S. upper Midwest

state that serves students in pre-kindergarten through 12th grade. He earned both an undergraduate degree and a master's degree in education. After explaining why I was asking each of my participants to come up with their own pseudonyms, Zhashagi thought for a little while and then made his decision. To ensure deidentification, I asked him whether anyone might be able to identify him based on this name, to which he replied that Zhashagi is the name of a deceased relative, and that it means 'blue heron' in Ojibwemowin.

Zhashagi was eager to respond to my request to participate in this study. In his reply to my recruitment email he asked if I was looking for teachers of Ojibwemowin or for immersion teachers. After I explained the participant parameters of the study, Zhashagi expressed in a follow-up email that he did not know if he would "be able to provide the information" that he perceived me to be "looking for as far as science is concerned." When I told him that this study considers and is accounting for any amount of understanding of science, he agreed the following day to participate. We had to reschedule his initial interview, though, due to a conflict with a previously scheduled appointment he had to receive his second dose of the COVID-19 vaccine.

After exchanging greetings during our first conversation, one of the first things Zhashagi asked was how I was going to share the findings of the present study with Native people. I responded that I had not yet crafted a mechanism for dissemination of these findings, aside from the fact that this work will be made publicly available online. When I asked Zhashagi why he wanted to participate in this study, he said, "If honesty is a policy, it doesn't [laughter]! No offense at all." He further explained his reason for participating when he shared,

I want to help. Like I said, I know your struggle as a grad student. I know how hard it is to get participation. But, I guess if your work in any way identified an avenue through which people were more successful in teaching science through the medium I try

to teach it, that would be definitely helpful to the group, for the whole. That would be definitely useful. For me, and I think I actually mentioned this in my email, I'm not strong with science. I'm a language specialist. So, you got me hooked with Algonquian languages on the email, and knowing you needed help, and how hard that is.

Zhashagi's role in the education of Algonquian students is that of a primary instructor, but he explained to me that "when you're working in an immersion setting, or a non-dominant language, and one as close to extinction as ours, you need to do everything." Zhashagi writes books for his students, writes the curriculum, aligns the curriculum with "cultural pedagogy," develops language and checks with Ojibwemowin speakers to maintain consistency, and "anything and everything under the sun." He has created Ojibwemowin books for his students because these types of materials would not otherwise exist.

Cross-Case Findings

The cross-case findings derived from the participants' narratives have been recounted according to the flow of responses shared during the series of questions asked of them during their initial and follow-up interviews. Rooted in the phenomenological nature of this study designed to highlight the voices of the individuals, these findings represent patterns I observed across the participants' experiences. In my interactions with the participants, their unique experiences offered rich narratives from which themes emerged that linked each case to the others. In the first finding, I explore the ways the teachers used their cultural knowledge as the essence of their instruction. I then describe the qualities of language brokering I observed across the participants as they considered their instruction, and I completed the findings with what I learned about the participants' expression of ambivalence toward their respective state standards and the NGSS as these standards relate to their instructional planning, design, and

implementation.

Finding One: Teachers Use Cultural Knowledge

The teachers in this study use their cultural knowledge and Native identities as the foundation of their instructional decisions. Important to this finding is the way in which each of the participants represented their unique cultural experiences as they described the essence of their teaching and their daily practices.

I observed the participants' cultural knowledge in many ways. For example, Gete-Anishinaabe grounded his cultural experiences in what he worked to impart on his students. I noted how he conveyed the Anishinaabe value of patience within his teaching. Sparked by his cultural knowledge of the interconnection amongst respect for the environment, how human actions impact the environment, and how human actions impact one another, Gete-Anishinaabe shared his thoughts on the relationship between the grandfather and the grandson in the goose book he was asked to analyze. He offered that he views this relationship as a typical one in which an elder teaches a young one patience because, in life, "things don't come, you know, *snap!*" He also explained that while he might not specifically bring up the concept of patience with his students, he would allow a classroom discussion to organically move in this direction if the students initiated this action. He expounded that this practice is necessary for his students' growth, and that "those spirits and the Creator" are "in charge" of this growth, rather than him. Gete-Anishinaabe lets his students explore their own ideas and questions through class discussion so as not to stifle their growth, and he bases this decision on his own cultural wealth of knowledge.

To further illustrate the connection to the goose book, Gete-Anishinaabe said he would help his students understand that sometimes they have to wait for things, if a discussion

surrounding the goose book were to naturally evolve toward the concept of patience. He offered a personal example of a discussion he had with his students on the topic of patience,

I told the kids a story one time [about] when I was visiting an elder and had a question and it just bugged the heck out of me. I brought over things [asemaa and other things that are proper protocol for the thing I was asking], and I followed protocol. I sat there and we visited, and [the elder] accepted the gift. I'm thinking, Oh! Okay, cool! They accepted this gift. This was probably 25 years ago. No, probably even more than that now. Gosh. So, I'm all pumped thinking I'm gonna get an answer, and [I] hung out there [with the elder] for a couple hours—two, three hours go by and I'm like, Ah man, I gotta get goin' here, so... Well, I guess I'll catch you next time. [The elder] said, Oh, yeah! Thanks for the visit. And I left. I'm thinkin', man, he accepted my tobacco, he accepted the gift. And I'm thinking to myself, how come my [question] never got answered? He didn't even talk about it. Like didn't even mention it! And I'm just like, Huh? So, I didn't say anything. I'm like, All right. And I visited him *many* times after that. It was only a year later that he goes, Oh yeah, about that question you had—And he answered it!

When I asked Gete-Anishinaabe if either he or the elder ever addressed the amount of time that had passed from when he originally asked the question of the elder and when the elder answered it, Gete-Anishinaabe told me that neither of them did. He explained,

Nope. [I] didn't even say anything. You just understand—It happened, it happened, in that particular case, when it needed to happen, you know, which is a little bit different than, when people say, Oh, it's Indian time, it happens when it happens. Well, that's a yes and no. That's a little bit of a stereotype.

Gete-Anishinaabe reflected that his experience with the elder relates to human growth.

He described that while some aspects of growth are “up to you,” other things are very precise in their timing. For example, the date and time during which ceremonies should be held was designated by the sending out of counting sticks. “That ceremony at daybreak, it’s at *this* time. You have to wait... then we’re ready to go. And you *have* to be ready. That’s precise, that’s not the stereotypical ‘Indian time.’” Taking our dialogue back to the elder’s lesson of patience, Gete-Anishinaabe said that his students could not believe he had to wait an entire year to get an answer. He told his students, “Could have been longer. I don’t know.” Then, he said to me, “I didn’t apparently need it at that time. So, the time was right when I needed it, and the answer came.” Through narratives, such as this one from Gete-Anishinaabe, I learned how significant the participants’ cultural knowledge was to the decisions made in their work with students.

Throughout my engagement with the participants, their cultural ways of knowing were embedded in their work. For instance, I’m reminded of how Auntie B shared that Ojibwemowin is a form of science because it contains the stories of Ojibwe people. The Ojibwemowin stories provide instructions that indicate which cultural traditions occur during each season of the year. Coupled with these stories and instructions are the role and relationship of language morphemes in how people should behave and understand the natural world. Auntie B summarized her view of science in how the “indigenous science realm” provides an understanding of the connections that exist within the “Western science realm.” I learned that the cultural knowledge of the participants was revealed in several ways. In the following sections, I described how the culture of the participants demonstrated authenticity to cultural and linguistic matters, consideration of student learning levels, and respect for intercultural similarities and differences.

Authenticity Matters.

As I engaged with the teachers, I learned that their decisions were tethered to the notion

that culture and language authenticity matter in their instruction with Native and non-Native students. Fundamental to this finding are the ways the participants discussed their attention to authenticity through Ojibwe culture and language in their teaching practices.

One way a participant displayed his attention to authenticity was when Gete-Anishinaabe described Anishinaabe teachings, how to uphold this ancient knowledge, and how the elders' wisdom applies today. For example, when discussing the Next Generation Science Standards, Gete-Anishinaabe said that, although he is not familiar with the standards, the science teachers at his school are "trying to create more connectedness to real world application" as a means of addressing the standards. He explained,

I would like [the science teachers at my school] to take it, personally, a step further and not just look at just the term 'real world,' but look at who has that knowledge and wisdom for generations in their own communities that they come from, you know, throughout whatever region it is, and learn from them, you know? Learn from the people around there that have that knowledge and wisdom, and then see how you can apply that into your current real-world situation. That's where I'd like to see it get to eventually.

Gete-Anishinaabe's value for cultural authenticity was revealed through his push for science teachers to include Native cultural knowledge in their instruction.

As I talked with Gete-Anishinaabe, I observed that authenticity of language and culture mattered in his teachings. This was evident as he taught me about tobacco ties. At the outset of his follow-up interview, I recounted for Gete-Anishinaabe a description of how I hung the tobacco tie offered in appreciation for his gift of time and wisdom in the present study. Gete-Anishinaabe took the opportunity to share with me a brief explanation of some of the teachings he has learned from Anishinaabe elders who explained to him how and why to offer tobacco. He

recounted,

Some places along here, [the offering of tobacco] was done for a particular reason to tie things, like to make that offering. There were sacred trees, you know, throughout the Great Lakes, that those things would need to be taken to, and taken care of, and done in the way that they needed to properly. There's a purpose and meaning behind taking care of things that way. When we give asemaa to someone to someone else, the way it's been shared with me is, we place asemaa *open*, typically, and I've had an elder tell me that tobacco ties themselves would be given to another person in that sense. Like, to just hand them the tie. There's some higher-level teachings behind it that I won't really get into here. But, it's just, there's some cultural significance behind trying to limit, I guess, the way that that asemaa has been made before it's passed to the next person. When you pass that asemaa, that say that, especially if it's being brought to someone who may potentially use that in their pipe, then it be enough to fill that pipe.

Gete-Anishinaabe admitted that although he has spent time around pipe carriers since he was 12 or 13 years old, he does not consider himself an expert in Anishinaabe traditions. He said that there are many teachings, levels of teachings, and "massive amounts to learn," and that it has only been in the last decade that he learned of the asemaa teaching from some elders. Although Gete-Anishinaabe has learned "very old" teachings from elders, he acknowledged this new information and offered that it is "all part of the learning process." When I asked him if the elders would want him to change his practice based on new information, Gete-Anishinaabe clarified,

For me, the [elders] I listen to, it's always a suggestion. To tell you to do some other way would be impeding your growth as a human being. That would be putting myself

in front of Creator's job. The Creator determines that for you as a human being. That's not for me to decide. So, when I share that, it's a suggestion. It's not a demand.

I expressed to Gete-Anishinaabe that his support of my offering of tobacco ties echoed those of the other three participants who also did not initially tell me how to place the ties I prepared for them. During a dialogic exchange with Gete-Anishinaabe, I realized aloud, "What I've learned from you just now is not the *right* way, but *suggested* ways." After I suspended this realization, Gete-Anishinaabe said that the manner in which I placed the asemaa at my cottage was "appropriate" for where I was at in my growth.

Promoting authenticity in another way, Gete-Anishinaabe described how, in the goose book, Grandfather gets the snowmobile ready in spring so it can be used the following month. Gete-Anishinaabe wants his students to realize that some Anishinaabe traditions have evolved in certain ways. In this example, snow machines have replaced snowshoes when needing to traverse out to hunting camps. He gave additional examples of using rifles or shotguns in modern adaptations of hunting noting that, although some traditional practices have been adapted, the core belief of respecting all of creation has not changed over time. In these examples, Gete-Anishinaabe was emphasizing the dynamic nature of maintaining authenticity.

Attention to authenticity through Ojibwe culture and language was evident during each of the sessions I had with the four participants. Illustrative of this finding is Zhashagi's consideration of authentic Ojibwemowin curricula. In aligning curricula with cultural place-based activities, Zhashagi has worked alongside community members to ensure that he is meeting their cultural expectations in his classroom. He has also examined curricula from other subjects and then rearranged them in alignment with the cultural calendar. Zhashagi described that the Ojibwe cultural calendar can be understood as a yearly cycle, and that the word 'cultural'

refers to “place-based and person-based.” He explained in further detail,

The cultural calendar up here would be, especially with students coming in the fall, of course, starting with the gathering process and the wild rice. Then as fall went on, it would go into hunting. And getting into winter, we would go towards trapping, traditional storytelling, [and] ice fishing. Going into the spring, moving towards sugar bush. And that would generally be when the school year ended, going over sugar bush with the students. And by sugar bush, I mean the gathering of maple syrup, the gathering of maple sap, and then processing the maple syrup and sugar. So, that's the cultural calendar on which we would assign our curriculum, to the best of our abilities.

Zhashagi extended his description of the community relationship and cultural calendar by speaking about “coinciding factors” that he sees as necessary characteristics of an educator in a role like his. He explained that not only do immersion schools need licensed personnel and proficient language speakers, but these personnel also need to be “culturally prepared” to deliver lessons that coincide with the cultural calendar and the curriculum. According to Zhashagi, finding three educator characteristics, or “coinciding factors,” in the same person are rare.

Zhashagi called into question the reliability of the goose book in that it has gone through several rounds of translation, adding, “We don’t know what the primary source is or how reliable it is, and whether or not it matches from where they’re at in Canada to our behaviors and patterns here where I’m teaching.” He is not interested in using a text that was “built in Naskapi to be culturally appropriate and then put into English so it could be put into Ojibwe[mowin].”

Zhashagi said this would be no different than translating a primary English text into Ojibwemowin. As he considered the reliability of the goose book, he summarized, “As far as [the goose book] being an actual, reliable piece of text that will summarize scientific and technical

ideas to my students, it's an *if*." As one of our sessions drew to a close, Zhashagi said that, given the information he had about the goose book,

Nothing about this text says 'authentic.' Because there are Indian words on it doesn't mean it's authentic. Because there are literal crayon and colored pencil illustrations of brown people, doesn't make it authentic. There is no source that demonstrates to me that this is authentic. I don't know the author. I don't know the translator. I don't know the background of the story.

Confirming my observations, at a different point in our session, Zhashagi provided an example of a primary text he currently uses with his adult students because he values the text's Ojibwemowin authenticity. The text, "Portage Lake: Memories of an Ojibwe Childhood" (Kegg, 1993), is a bilingual account of an Ojibwe woman's childhood memories as told through the four seasons. According to Zhashagi, Kegg was a first language Ojibwemowin speaker who wrote from an Ojibwe mindset and grew up in a wigwam. Here, he captures her story,

[The story tells] this woman's memories of her childhood, and it's separated by the seasons, right? So, for this [lesson], if I wanted to really jump into spring, for example, with my adult learners this week, we're getting ready for sugar bush, so I assign my adult readers tasks that involve, like, five of the first ten stories in here that deal specifically with sugar bush happening in the springtime. Let me see if I can pull up this table of contents here. Now, *those* stories have inherent value to me because there's authentic language from a first language speaker. It's a primary source, right? Here's your [Ojibwemowin] spring, and so story two is [Ojibwemowin] at the sugar camp. This [*Portage Lake*] would be something where I have a selection, right, of- alright, I know there are five good stories about sugaring from a first language speaker and from an

Anishinaabe mindset, right, because we're talking about teaching from a cultural mindset, right, but who wrote the story?

Citing reliability and authenticity shortcomings when considering the use of the goose book in his classroom, Zhashagi's attention to teaching with authentic texts was made apparent when he explained why he would use a first-language perspective text like *Portage Lake* with his learners.

Authenticity mattered as participants drew from their cultural knowledge when discussing their consideration of science standards and the goose book. When Auntie B talked about her understanding of the Next Generation Science Standards, she said she observed a shift in what science educators focus on, now being technology and collaboration, and that she sees this approach tying in with Native studies. She also noted that she perceives herself as a “pest” when it comes to reminding science teachers in staff meetings that they should be integrating Native values into their curricula. She stated,

[The science teachers at my school] were really apprehensive about this because they felt like it was gonna be extra work on top of what they're already doing. I actually have met with a couple of them within the last couple of days and have been like, Hey, I know it's a lot, but know that *I* have resources, I have books on books on indigenous sciences that we can utilize to incorporate into *your* lessons around environmental justice for this project-based learning. So, sharing the burden. Like I said, *they* know the science standards and I know the traditional ecological knowledge and where to access it. Finding ways to meld those two subjects together, so *Western* science and indigenous sciences don't have to be *separate* subjects.

Through her example of supporting the science teachers in her school in an effort to infuse cultural knowledge into their lessons, I learned of Auntie B's dedication to cultural authenticity

even beyond her own classroom.

Auntie B expounded on the culturally authentic placement, within her school calendar year, of a lesson about life cycles. She explained how she would position this lesson, and the use of the goose book in tandem,

Everything I do is kind of intertwined with each other. I could see this happening in spring, so the lessons right before that would be about the winter stories. Okay, winter stories are happening. How did Nanaboozhoo⁶ cause a bunch of trouble? And what were the consequences of him not following the rules? Okay, what are the lessons we can gain from this in respect to how we respect the beings when we're out there hunting? Okay, and that then leads to the well, why might the grandpa be like, Oh, we're not doing this till next year. We're waiting? Why might the grandpa be pacing it in this way? And it's a lesson, then, in patience. So, I think that there's a lot of different content that I would not only cover during that unit, but leading up to it.

Auntie B would situate these lessons for her students within the frame of having respect for nature when her students are out hunting. Through Auntie B's account of Native values and infusion of cultural teachings into science lessons, I recognized that attention to authenticity is paramount in her instructional decisions. In the process of exploring the goose book text with the participants, it was clear to me that the authenticity of language, illustrations, cultural differences, and the mechanism of storytelling was important beyond the notion of presenting an Ojibwemowin text. I used this finding as a foundation to observe the participants' other pedagogical considerations as they centered cultural knowledge in their classrooms.

⁶ Nanaboozhoo is the Ojibwe people's teacher. The name means "foolish." Fleming (2017) states, "Nanaboozhoo represents our ancestors—those who gave us our rituals and ceremonies, our culture and language. We give thanks and acknowledgement to Nanaboozhoo" (n.p.).

Consideration of Student Levels.

Cultural knowledge was the grounding teachers used as they considered their students' grades and linguistic levels when appraising instructional materials. Pertinent to interpreting this finding is the ways the participants accounted for their students' learning levels when planning their lessons.

Illustrative of this finding is how Zhiibaasige would use the goose book to teach different content to his younger students (grades 1-2) as compared to his older students (grades 4-6),

It can be taught a couple different ways. I think for younger kids, if you're talking about seasonal round, that's one thing. If you're talking about, for some of the older kids, you know, what is the purpose of goose hunting? You know, why do you hunt at all? Why do you gather berries? Why do you do all this? And so, exploring food from a natural state, "pre-food," you know, experience and interaction versus, now, What does it mean for *those* items? Not being *items* necessarily, but potential *food* items or food things or food *beings*. Outside of them being just food, what role do they play in the overall environment and ecosystem? That would be something I would definitely engage with some of the older kids, maybe fourth or fifth grade and older. And then, some of the health benefits associated with those different items, whether or not they are purely food or they are medicinal or what have you. You know, and then, trying to equate—and this is what I would say maybe between fourth and sixth grade, trying to associate some kind of phenological cycle with that. You know, it's not just a seasonal round, but it's also, like, what all is happening in a given area over the course of the year? Not just one specific plant or one specific animal, but the system as a whole. How is that coming and going or changing over the course of the year?

I found that Zhiibaasige's consideration for student grade levels manifests in the ways he assessed the types and levels of science content he would use the goose book for in his Ojibwe immersion instructional setting.

I captured another example of the consideration of students' levels when Zhashagi detailed his rationale for the usefulness of the goose book for his students. When I inquired about how his consideration of the goose book in tandem with the science standards impacts how he might use the text with his students, he said, "I would not use this text with my students, primarily because, from an immersion standpoint, this text would be consistent with, what I would use with maybe a first or second-grade classroom, and I really didn't teach at that level." When I asked for clarification, Zhashagi detailed,

Have you been a teacher in a public school? Would you give a book with seven lines of text to your seventh graders? It would have to be a really situational occurrence to use a book with seven lines of text is what I'm getting at. When we look at this [goose] book, there are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 17 lines of text, but it's highly repetitive, right? So, if you look at the nature of the [goose] book, it's purposely repetitive, most likely to help build literacy and understanding of common vocabulary, right? But in a setting where the students who are in adult literacy in those vocabulary items, this is just a repetitive book with about seven varying lines of text, all of which is very common [language].

Reminding me that he is a "general education instructor who teaches through the medium of a different language," Zhashagi said he focuses on the "trickier parts" of language rather than on the structure, grammar, syntax, and punctuation that would be taught in an Ojibwe language class. This is why Zhashagi assessed the goose book as being written at a level that would not

serve his current students.

When asked if he had any learning objectives or outcomes in mind when using the goose book for a science lesson, Zhashagi said he did not. Recalling the text-to-standards analysis he completed for consideration in the present study, though, I remarked that he did, in fact, record some connections to the NGSS. My comment prompted Zhashagi to review his text-to-standards analysis. Reading aloud from his analysis document, he identified the two NGSS standards that aligned with the text as, “Obtaining, evaluating, and communicating...read and comprehend grade-appropriate content and other reliable media...summarize and obtain scientific and technical ideas.” Zhashagi added that, given the simplicity of the linguistics in the goose book, which he deemed appropriate for first or second grade students, he appraised the science content as being above grade level for his students. Further, he mentioned that one of his state’s standards, which he recounted as, “When the environment changes, some organisms survive and reproduce, some move to new locations, some move into transformed environments, and some die” assumes that students understand migration patterns that bring birds back from their winter homes. Zhashagi’s first and second grade immersion students, for whom he assessed the linguistic level of the goose book to be most appropriate, may not have a “strong [enough] handle on migration patterns” for the science content of the book to be useful for them. In Zhashagi’s explanation of how he appraised the usefulness of the goose book in his classroom, I understood how he used his cultural knowledge to account for his students’ learning levels.

Gete-Anishinaabe also displayed consideration for his students’ learning levels. When asked how he might use the goose book with his students, he shared,

As far as a higher, connected part—like I said, sixth grade, because that's language focused. And I know language and culture are never detached. The seventh and eighth

grade have a Native Studies, the language is English-based, but yet the content is very deeply rooted in a much bigger understanding of culture, history, traditional life skills—understanding that in Anishinaabe view, world view, in a sense, between seventh and eighth grade. Eighth gets into a lot of stereotypes, understanding our history in boarding schools, fishing waters, treaty rights, mascot issues. That's a whole other curriculum. The language, I think, would be, you know, just the component of *practicing* the language in a different way, in a different form and showing how we can *use* language to describe our wishes and our goals and things that are outside of school because the kids get so attached to, you know, [their teachers saying] Well, it's just—we gotta do this *because*. They have a hard time connecting [Ojibwemowin] outside the classroom. And it's partly the age, it's middle school, and so it really doesn't matter what the subject is. Their brains function in that way. So, I could just see [the goose book] as an extension of bringing [Ojibwemowin] outside. It's real to *them*. Because some kids hunt, some kids like going—I had a kid this year, you know, so excited because this is going to be the year he gets to sit with his grandpa in the deer blind, all pumped about it. We have those kids that—and some of them do have that tradition [of deer hunting]. And [the goose book] would be a way to connect them.

Using his cultural knowledge as a Native teacher, Gete-Anishinaabe understands where his students are developmentally, thus making instructional decisions that honor both their language and culture.

In a similar way, Auntie B explained why the goose book would be useful for her students' language instruction, given their unique learning levels. She described,

I think [the goose book] would be useful because we have a lot of videos, but I think

there's something to be said about having written text available. One thing that I struggle with is getting written text, having tangible handheld items that students can work on their literacy skills with, especially with our students who are working on their decoding. Really, [using the goose book is] another way to differentiate the learning—We're learning about the ideas of hunting and, okay, we have a video, we have an activity. We could do some sort of activity like a tag activity and, every time someone gets tagged, that's a population of animals. Doing a tag game, for the more kinesthetic learners, and then having an actual book for the more visual learners to work on their decoding is really important. Every variation that I can have allows for better learning because of the fact that [there are] different learners out there.

In this excerpt I found that Auntie B employed her Native cultural knowledge as well as pedagogical expertise to create classroom scenarios that would serve various levels of student learning. Drawing on their vast cultural knowledge, the participants were able to identify how text can be most effectively implemented with regard to their students' grades and learning levels. I observed this happening with a keen understanding of intercultural similarities and differences.

Respect for Intercultural Similarities and Differences.

As part of their wealth of cultural knowledge, the teachers esteemed an instructional perspective that respects intercultural similarities and differences. Central to this finding is an understanding of the ways in which the participants appreciate intertribal and intercultural values.

For example, I noted that Zhiibaasige's respect for intertribal values originated with some observations he made about his students' linguistic misconceptions. When Zhiibaasige started

teaching at his school, he spoke only Ojibwemowin to all of his students. He recalls his students saying to him, “Why are you speaking Spanish?” The realization of his students’ misunderstanding prompted Zhiibaasige to understand that his students had not heard enough Ojibwemowin to distinguish it from Spanish. Therefore, he has since used a bilingual approach in his Ojibwemowin classes. Zhiibaasige also took into account the fact that his students represented not only Algonquian Nations, but also nations that are not from his geographical area. Therefore, he approaches his role in the education of Algonquian students as “educating kids, as opposed to very specifically educating Algonquian kids.” Zhiibaasige uses his cultural knowledge to draw connections for his students between Algonquian experiences and where these experiences intersect with general U.S. history.

When reflecting on the notion of culture, Zhiibaasige said that folks should “not make monolithic that which is not,” because there are times when it is necessary to differentiate between cultures. He further explained,

When talking about the cultures that are at [my] school, even within a specific culture group, you have a lot of derivation and things that are just different. There's times where that gets problematic. I think one of the things that I see that doesn't mesh with Anishinaabe thinking is these concepts of how they get—at least, in how they get communicated—these concepts of the Seven Grandfathers⁷ and things like that, or [the] medicine wheel, which is all more contemporary business. It's not something that's rooted in *deep* tradition, contrary to what some people think. And so, the way that those things get communicated, it's very much [as] noun forms, which is very much an English

⁷ The Seven Grandfather Teachings are “deeply rooted ideals” (Pokégnek Bodéwadmik, 2021), including the values of wisdom, love, respect, truth, honesty, humility, and bravery, and are understood as traditional knowledge necessary for life as an Anishinaabe person.

approach or understanding of those things. But even then, that's not 100% true either because when you look at the root of English as a Germanic language, that's borrowed from so many other things, those words have roots as well. And I hear a lot of ignorance on both sides of the coin on that, when it comes to what words mean versus what they don't [mean]. When it comes to Native languages "do this," or non-Native languages "don't do that," or whatever. With that said, I would say that there's definitely things that could be given more attention that aren't necessarily. With that said, there's still quite a few differences even if you want to term things as Algonquian, because even Potawatomis do things differently than what Ojibwes do in a lot of respects, but they're still part of the Anishinaabe group, which is still part of the larger Algonquian world. Zhiibaasige added that in Ojibwe and Potawatomi languages "there's stuff that's embedded in what's being communicated," and that, accordingly, today's learners of these languages are doing so "from the ground up." He emphasized, "If you remove the attachment to the etymology, you lose a history with it." Listening to Zhiibaasige speak of his attention to the meaning of culture as well as cultural and linguistic similarities and differences between Algonquian cultures underscored his value for intercultural considerations in his practice.

When asked how he might use the goose book with his students, Zhiibaasige shared that he could see himself using the story to teach the concepts of yearly cycles and seasonal differences. He explained,

I could see [the goose book] being used with some of the younger grades with respect to, here's an example of a yearly cycle. I know that this [book] originates with the Naskapi, and I know that the Naskapi are on the Eastern side of the United States. Things are a little bit different in terms of seasonal than what they are over here. For example, even

the whole thing about goose hunting, we don't hunt goose in the springtime. We hunt them in the fall to wintertime when they're actually leaving [their northern habitat].

As Zhiibaasige identifies the significance of the goose book for the lower grades, he also recognizes the importance of understanding the cultural contrasts, so that fair comparisons can be made in discussions with his students. He added,

But the funny thing is, I would have to know—I'm ignorant of the Naskapi reason for practicing that way. From an Ojibwe perspective, a lot of times when things are coming back in the spring and early summer, we kind of leave them alone. We don't do a ton of hunting in that time because they're having their young. So, we got to have that time to replenish the population. And then, it's late fall or late summer or fall and early winter that you're starting to ramp up your hunting to get through the winter time. But, for us, for goose hunting, that's in the winter time or fall—winter time as opposed to in the spring. So, that's a difference [between Naskapi and Ojibwe practice] for sure. But, without knowing their reason for doing that, I couldn't really make a fair comparison or contrast. I could just say that, Well, they hunt in the spring and we hunt in the fall. It's a different thing. From *our* perspective, this is why we do this in the fall versus in the spring. So, stuff like that. But I mean, berries at this latitude, they come out [at the] same time of year, and it's always in the summertime. So, that's something that's comparable. The fact that it's Naskapi—so, it's an Algonquian language, so, okay.

According to Zhiibaasige, elevating the relevance of these connections is key to these comparative discussions with his students. He stated,

There's things in there that are definitely comparable and there's things that are just different, especially when it comes to an urban population where a lot of our kids don't do

a lot of snowmobiling. Seeing that as—they know that folks up north in Northern [U.S. Upper Midwest State], and stuff like that, do that. And some of them go up north and do that, but they don't really do it so much down here, as far as *these* kids do.

Acknowledging that the goose book was originally written in the Naskapi language, Zhiibaasige shows respect for the similarities and differences between several Naskapi and Ojibwe practices by describing how he would honor the relevance and teach his students about these comparisons. His bilingual, diversified approach to Ojibwemowin instruction, and consideration of hunting similarities and differences between Ojibwe and Naskapi, are indicative of his respect for intertribal cultural knowledge.

Intercultural respect is another element of teachers' use of cultural knowledge that was revealed by Gete-Anishinaabe. He does not teach or conduct ceremony in his classroom, or force Anishinaabe spirituality on his students. Gete-Anishinaabe was taught that the decision to learn about ceremony or spirituality lies within students' parents and families rather than within him or the school. While some of his students are Native students who "don't believe" and non-Native students "who don't follow," he teaches his all of his students how to apply Anishinaabe Bimaadiziwin to their lives because it is important to take care of self to be able to understand other people and other ideas.

Gete-Anishinaabe reiterated that his 7th grade curriculum centers "the importance of understanding the balance of how to live with everything and everyone around us, which is creation," and that he could use the goose book as an example of learning how to live in balance. He added that the book shows that the grandfather and grandson are displaying a generational continuity of the concept of understanding the balance of creation. Gete-Anishinaabe offered an example of how he practices a generationally handed down ceremony, that of smoking fish.

Here, he speaks about smoking fish during Middle School Camp at his school.

I build a fish rack over a fire and then we put fish over top and slow cook it and smoke it. During the time—it takes five hours to do this. That's the old way. I learned that way from some elders, from a really remote Ojibwe community up north, that you have to fly in to get to. And they don't even speak English. It's on the border of Ontario and Quebec, almost in Hudson Bay. It's an Ojibwe community. The example I get, because of that, is even though it's not shown in the story, when we were watching—there's a few of us that were learning this—and the people from [the Ojibwe community] were preparing things to make—you know, the rack and all this stuff, they're going around hackin' trees up and cuttin' things down and making poles and all that stuff, and not a *single* one of them put tobacco down that *entire* time that we were there, that we saw.

Gete-Anishinaabe described how he grappled with the contrast in protocol for preparing for fish camp, and how his cultural knowledge about the way tobacco is offered differed from what he saw. He continued,

This was years ago, and then we're like, What the heck? Aren't you supposed to put tobacco down for all those trees and stuff like that? Come to find out, talking to an elder, and they spoke a really tough dialect to understand, so we're getting kind of a translated version, he said, Well, how that's handled is through their daily ceremonial aspect. When they take care of things either in the morning on their own, doing their thing, or maybe it's another time during the week, when those prayers are done, it's acknowledged during that time for when they do that stuff. They're already—like it's a preemptive—they're already taking care of that process, okay? They didn't need to go and put tobacco in every single tree—it was done ahead of time. It was all done. That's how they live. And this is

how they live *today*. They live out in the bush. It's like, who am I to go and say, How come you didn't put tobacco in your tree? It's like, no, that's not how it works. So, it's neat to see culturally how people down here—because we're trying to reclaim it, and people say, Oh, you [need to] put your tobacco down if you take something. So, hey, we're puttin' tobacco down for everything. And you really don't—when you understand it *that* way, the *old* way, Oh, I see. It's a little bit different interpretation.

This is an example of how Gete-Anishinaabe displayed respect for intercultural similarities and differences. He resumed,

In seventh grade, and I may not even bring it up, but if kids ever asked about it, because there would be some kids in here that know that, if they say, Oh, how come in this story they didn't talk about putting their tobacco down? Or, maybe they didn't say it when—Did they put tobacco down when he got that goose? That'd be a way I would address it, is all. It would be done a little bit differently. And, always my disclaimer is I never, *ever* tell the kids [that] I'm tellin' them to believe in this particular way that I shared. It's *only* for information. They *always* have to follow and believe what their parents have decided for them and their families. It's never *this* way. Ever.

Gete-Anishinaabe used the example of his fish camp experience in how he teaches about cultural differences among the Anishinaabe people when it comes to acknowledging spiritual interpretations and practices. He would share this story with his students as an example of a protocol that those who “follow that way” would adhere to. Since he teaches at a tribal, public school where some students are “hardcore Catholics” and some are atheists, he does not tell his students what to do or believe. Rather, he states, “This is information so we can respect each other's view, respect each other's beliefs.” Gete-Anishinaabe clarified that his approach to

spirituality and beliefs would be more holistic and overt if he was teaching at a Native immersion school.

The respect for intercultural and intertribal cultural knowledge was also reflected by Auntie B who expands the consideration of cultures, to those existing worldwide, in her classroom. She illustrated that she would follow up a reading of the goose book with the use of an online resource as well as her own guiding questions, including the following: “How would you process that [animal]? What is the process of utilizing this [animal]? How have other tribes used the, say, feathers on the geese, or XYZ? Let’s do a compare and contrast.” Auntie B clarified that because she works at an intertribal school, she encourages her students to consider the multicultural aspects of what they learn. Auntie B indicated that not only would she teach about how “our community” uses an animal, but how other indigenous communities, even communities in other countries, use different species of geese or birds that are similar to geese. She then described that this approach is especially important since the student body at her school is one-third Native American, and two-thirds “standard [Upper Midwest State] public schools” students, with students from Burma and Myanmar, including Hmong students. Auntie B revealed that Hmong students “do really well” in her school because their culture is similar to Ojibwe culture in that both cultures share similar tribe and clan systems. She concluded that the reason she uses a compare/contrast approach in lessons like the one on hunting is to “celebrate” her students and their experiences.

As our conversation progressed, Auntie B divulged that she encourages her students in “thinking about cultural values from their perspectives” and in how they talk about their values with others. For her, personally, this role takes on a special meaning. Auntie B disclosed,

The timing of [our interview] today was perfect because I got to talk about this on my

grad school application, basically thinking about these same ideas. . . . For me, especially being from Thunderbird clan, I was always taught that our role within my clan was that we are supposed to be kind of like diplomats between different communities, and teaching others about our tribe and learning about these other communities, so then our tribe can learn how to coexist [with other tribes]. I think it's really funny now that I'm doing this work because it feels, like, just perfect. It feels like such a good fit.

Auntie B then added that not only do “these cultural books,” like the goose book, benefit Ojibwe and Anishinabek students, but they also benefit other indigenous students, students from other communities, Black students, and Asian students. She said, “All of us start to learn how to see these other perspectives, and it creates more empathetic and more well-rounded students.” I commented on how beautiful her statement was, to which Auntie B responded,

This is the stuff that brings me joy, and this is why I do this work, because it's really exciting, and it feels really validating to see text like this [goose book] and then be able to be like, Okay, now that I've thought this through, how can I actually utilize this? I see myself using this [goose] book in the next year or two.

I found that Auntie B used her Native identity and depth of cultural knowledge in her display of respect for intercultural similarities and differences. True to the phenomenological nature and culturally responsive theoretical framework of this study, the participants' stories exemplified ways in which their extensive cultural knowledge was used in making instructional decisions that esteemed their intertribal and intercultural students to ensure authenticity of content, relevance to students experiences and levels, and opportunities for dialogue with student about cultural similarities and differences.

Finding Two: Teachers as Language Brokers

As I examined teachers' perceptions of the usefulness of a Native text alongside U.S. public education standards, I learned that the teachers act as language brokers when they consider instructional materials for use in their classrooms. Key to understanding this finding is consideration for the ways the participants used their expertise in language and language pedagogy when examining texts to use with their students. In the subsequent sections, I describe how language brokerage was demonstrated through the participants' knowledge of students' backgrounds. The participants valued students' knowledge and centered the students to serve as intermediaries between educational materials and students' needs. In doing so, they merged their linguistic knowledge with instructional strategies.

Knowledge of Students' Backgrounds

The teachers know their students and their background experiences well enough to serve as intermediaries between language curricular materials and their students' needs. The participants in this study used their knowledge of what their students know, and do not know, when designing language lessons that meet their students' needs.

Value Students' Knowledge.

The teachers value the experiences and knowledge of their students, including their frames of reference and Native identities, when teachers broker Native texts for instructional use. I found that the participants in this study showed value for their students' knowledge by giving thought to their students' lived experiences when designing lessons.

One way a participant displayed value for his students' knowledge was when Gete-Anishinaabe described the degree of relevancy for his students in the practice of goose hunting. In consideration of the usefulness of the goose book in his classroom, he accounted for his

students' geographical setting, explaining that goose hunting is more so a practice of northern [located in Canada] indigenous communities. He mentioned that some elders and teachers he knows in the North get two weeks off of school to go goose hunting,

It's different in those communities. I could see [hunting] in our area for ducks or deer and rabbits. We need to go hunting or trapping— *that* part of it, or fishing at certain times in the spring—fall harvesting, preparing fish for the winter or, obviously, the hunting and trapping part with deer and rabbit especially, the two primary ones, maybe some duck hunting in here—would be kind of a connection. Actually, that's how I would segue it or make a local connection [for my students].

With his students' lived experiences in mind, Gete-Anishinaabe could use the goose book to make regionally contextual hunting connections for them.

Valuing students' experiences and knowledge was also apparent in how Auntie B designs learning opportunities for her students. During our second meeting, I learned that Auntie B enjoys “mixing up some of the grades,” giving students opportunities to learn together and from one another. She explained,

I do have a strong belief in allowing multiple grades, even if they're not at the same level linguistically, of also giving them some of the same content, allowing them to digest it, sharing some of the thoughts with the different grade levels, too. And then it's a good way to offer kinds of mentorship, like knowledge mentorship, to the other grades.

When I asked Auntie B if goose hunting is relevant for her students, or if a different animal hunting season would be more pertinent in their lives, she said that while she is aware that some of her students have eaten goose, the more prevalent hunting season for her students is deer hunting season. In fact, she recently taught a lesson using a deer hunting video from a

website, *The Ways: Stories on Culture and Language from Native Communities around the Central Great Lakes*. During the video, she asked her students, “How did the person show respect to the deer?” In this example, Auntie B valued (a) her students’ familiarity with deer hunting and (b) their Native identities, drawing on the ideal of respect for the natural world. Adding to this lesson, she offered that since her students had learned that the Ojibwemowin words for ‘harvesting’ and ‘hunting’ are the same morphemes⁸, she also asked her students which other animals or plants someone might hunt or harvest.

Since she values her students’ knowledge and Native identities, Auntie B referenced the goose book in describing how she could use the book with her students when discussing the topic of treaty and hunting rights in her state. She explained,

In general, [I would teach about] knowing the importance of the treaty rights, and what *can* be and what's included within the treaty rights harvesting, because there's some things that are a little more obscure that I don't know if they're even included under treaty rights like muskrats. I know they're hunted, or harvested, but I don't know if [the] DNR tracks that. Squirrels, too. Especially with our project-based learning, that's something that some students took under [as] their projects. There's a bunch of [my] students who are currently doing their project on the Wisconsin wolf hunt, and how that relates to tribal entities up in Bad River and Red Cliff.

Auntie B’s brokering of the goose book manifested in her consideration of her students as peer knowledge mentors, and their cultural frames of reference and Native identities associated with deer hunting and treaty rights.

⁸ Ojibwemowin is a polysynthetic language, and contains a high morpheme-to-word ratio (White Earth Nation/Ojibway Language, 2021). A morpheme is the meaning of a sound or word part (phoneme) (Ojibwe.net, 2021).

Centering Students in Instruction.

The teachers know their students well enough to serve as intermediaries between language curricular materials and their students' needs. The participants in this study used their knowledge of what their students know, and do not know, when designing language lessons that centered their students within the instruction.

One way I observed the centering of students was when Gete-Anishinaabe expressed how challenging it is to teach his students the importance of Algonquian culture and language. He explained,

It's been a consistent challenge to help kids realize [Algonquian culture and language] importance and significance. And I tell kids every year—I go through a kind of a step-by-step process of why this particular school opened. And, depending on their age, they hear what our ancestors had to struggle [with] to survive and go through, which ties into why our school opened, to reclaim what was taken from us. And, because they're such a young age, it's difficult to get into those concepts of cultural genocide until I get into it a lot in 8th grade because they can handle it. But the younger grades, it's extremely challenging. In knowing his students, Gete-Anishinaabe knows the students' circumstances regarding the learning and sustainability of the Anishinaabe language and culture. He explained,

As the kids get older, helping them realize [language] significance is one of the most challenging parts because our speakers are gone, it's not spoken around them, it's not spoken in the homes, for the most part, it's not as universal to them. They don't see the same value that we see as Anishinaabe people who are trying to keep this [language and culture] alive. And they're kids, that's the other thing, is without it being fully around them like an immersion school, it's much more challenging to emphasize [Anishinaabe

culture and language] significance. And it's not carried at home. That's the challenging part is, as kids come through, I still get the question, Why do I gotta learn this? Nobody speaks this [language]. And it's partly kids; it's their age in education. But, as they get older, sometimes you wonder about that ember, is it going to be strong enough for them? Hopefully, by the time they leave [the school], with what we do, we've built enough in there that they can go and reclaim it. They'll have that in them to go on. They'll get it by then by the time they leave. But it takes a lot of support.

Knowing his students well enough to know that they do not find Anishinaabemowin relevant to their lives, Gete-Anishinaabe understands that support from school and home must be in place to reach the needs of his students. Another way he illuminated how he knows his students and their needs came up as the result of a brief exchange about the expectations of the U.S. public education system. Gete-Anishinaabe described,

We just got sent information about all these assessments we gotta do, and it's like, You want me to fill out all this stuff with the kids, and you have to sit and do all these assessments when I got a classroom full of kids that don't even like themselves? They don't even care about themselves. So, do you think they care about an assessment? Do you think they care about, you know, all these other things? What about taking care of the *internal* needs first? Right? Let's put some more emphasis on that. To me, that's at the heart of what an Anishinaabe Bimaadiziwin is because, when you look at it—even if you don't tie in a spiritual connection, you can still get a lot out of it. But, for Anishinaabe people, there's no separating the spiritual part because we see ourselves, at least the way I understand it, I'm not speaking for other Anishinaabe people, just the way I've learned is all, which might be different than a lot of other people, that we are given a sacred gift of

life, Anishinaabe Bimaadiziwin.

Gete-Anishinaabe's understanding of his students goes well beyond his classroom. His commitment to his students is grounded in a personal belief about holding himself accountable in service of his relationship with his students. He reflected,

It's up to us and how we interact and take care of ourselves in order to impact anyone else. We can't go out and do anything for others without taking care of ourself. And we also have to recognize the balance of how other people help us, and that's something that can get taught in ceremony where you *have to* rely on other people sometimes. You *have* to understand you can't do it by yourself, and [accept] that important responsibility that we both have as human beings to each other, that we help *each other* in the end. That's kind of the basis of it. As soon as we wake up in the morning, we take care of ourselves. We take care of the center first. Taking care of the center means we're taking care of those four aspects of who we are as a human being. If we do the best we can with that, *then* we have a better chance at helping those other people with theirs. There's going to be times we need that help from someone else. If we're learning and knowing what that means, then we can better identify that with the kids who have zero help at all.

Gete-Anishinaabe's understanding of what families and the community is an extension of knowing his students. He added,

We have a lot of kids who don't believe and non-Native families who don't follow [Anishinaabe cultural practices]. I always tell the kids, it doesn't matter who you are. I don't talk about the spiritual side with them in the classroom just because of the [school] that we are. But, I do talk about the importance of taking care of self.

Using his understanding of what his students know and do not know when it comes to their well-

being, Gete-Anishinaabe spoke to how he serves as an intermediary between required educational assessments and the value of Anishinaabe Bimaadiziwin way of life.

Zhashagi said he could use the goose book to highlight different tenses, although the book uses only the future tense. He would use the book with the lower grade levels, including first through third grade, as well as lower-level fourth grade students. When I asked why this book might be useful for his students, Zhashagi explained,

Each of the pages end with *wii-noojinikaweyang*, right? *Wii-noojinikaweyang ziigwang*.

Wii-noojinikaweyang ishkwaabiboong. Wii-noojinikaweyang ziigwang. Wii-

noojinikaweyang ningo-giizisong. And most of them end with *nimishomis*

dibaadodamawid, right? This is a really common method used in early literacy

development to help students anticipate what they're going to be reading, and the constant repetition, even for nonreaders, can help them anticipate so that they can start to guess what's on the next page and read along with the instructor. It's a really basic formation of early literacy development.

Zhashagi explained to me how he would use a literacy matrix to break down the levels of text to determine how to scaffold it in support of early literacy in his students. He showed me an example of a literacy matrix from the University of Florida, pointing out level A, “recognize letters and their sounds, point out words,” and level D, “heavy on repetition with only minor changes in the word types, and then with the illustrations.” I identified that I used the illustrations in the goose book to aid in my own comprehension of the text when I did an initial read. Our dialogic exchange circled back to Zhashagi reiterating that, for the reasons he pointed out, and with “a couple quick fixes,” the goose book would be useful in the lower grade levels as a resource to help teach Ojibwemowin. Zhashagi knows his students well enough to identify that

those who are at earlier literacy levels would benefit from the intentional repetition used in the goose book. He also added that he could use the goose book to “engage some prior knowledge” or to help his students form hypotheses about why the boy had to wait until spring to go goose hunting, again using his knowledge of what his students already know, and what they do not yet know.

I found that Auntie B also knows her students well enough to discern the usefulness of the goose book for them. She provided several rationale for how the goose book might benefit her students when she shared,

I think with my students, it's really good for them, especially with a lot of our students being—having IEPs (individualized education plans). One thing that our school has, that's unique compared to some of the other Native schools, is we offer special ed[ucation] services. One of the things that I've been working with a lot of our special ed[ucation] teachers on is [that] a lot of our students have trouble sequencing things. Something that this book does, it's really nice, is it does focus on sequences of, okay, this happens first, and then the grandpa says, You gotta wait until *this*. And so, let's think about that time permanence and the object permanence idea of, It's going to be coming soon. You have to be patient. That's something that's really useful for [my students]. In addition to also knowing what are items that can be included in treaty rights, because [an Upper Midwest State] is pretty thorough in what they include within their treaty rights, even within the science standards. The fact that almost every grade had a [U.S. upper Midwest state] tribal standard.

In addition to how Auntie B brokers the scaffolding of literacy supports for her students, she also knows her students well enough to honor their chosen vernacular as well as to stretch their

linguistic awareness to include other dialects of Native languages. Auntie B explained how she positions herself as a language intermediary for her students as she stated,

I use any dialect of Ojibwemowin or Anishinaabemowin in my class. I make my students use the Eastern dialect all the time, or read it, and I'm just like, Tough. Deal with it. We all gotta learn how to communicate, and you have to be flexible language learners. So, if you're using, you know, a couple of words that may be different, it allows you to learn that no matter what language you're speaking, or no matter what language you're learning, there is going to be the variation. Languages change. They change across areas, across time. I often teach my students about the value of understanding linguistics, even if it's understanding prescriptivism versus descriptivism and understanding. There are some teachers who are not *for* this, but I'm like, Oh yeah, if you need to use AAVE, African-American Vernacular English, cool with me! I use the Native rezzy [reservation] talk every day in my classroom. And I don't mind students speaking in the ways that are comfortable for them because of the fact that they get their ideas across better. That's one of the things of understanding [the] linguistics of this gives you the opportunity to learn how to support your ideas and defend yourself when you are faced with this.

I learned that Auntie B used her expertise as a linguist as she approached her consideration of the goose book as well as language curriculum in general in her classroom. She also understands that languages change over time. Not only does Auntie B prepare students for these changes, but she displayed how well she knows what her students need as evidenced by her use of AAVE and Native reservation talk with her students when relevant. In alignment with the culturally responsive theoretical framework supporting study, the participants' examples of serving as language brokers who intermediated between language curricular materials and their

students' needs underscored how well the participants knew their students.

Merge Linguistic Knowledge with Instructional Strategies.

The teachers in this study merge their linguistic knowledge with effective instructional strategies to broker Ojibwemowin for their students. The participants' expertise in Ojibwemowin positioned them to preemptively identify disconnects in their students' knowledge.

Zhiibaasige offered an example of how he merges his linguistic knowledge with his instruction as he outlined a purpose the goose book would serve in his classroom,

[The goose book is] another text that represents a potential for use in the classroom. I would also say that the spelling within it is actually fairly uniform to the Fiero double vowel system⁹, which when you look at the overall breadth of material that's available for Ojibwe, which is expansive, there's not a lot that's uniformly presented in Fiero double vowel. There's quite a bit that's, like, folk phonetic, or like someone's individual idiolect means of articulating in orthography. But Basil Johnston¹⁰'s a good example of that. But there isn't a lot that's like—Oh yeah, so those that are actually *teaching* in classrooms, or teaching in schools, use *this* system of writing pretty uniformly in Canada and the U.S., but in terms of materials that are produced for the different age groups, it really does vary in terms of the spelling that gets presented in there. So, I would say, why is it useful? It's another way of, I would say, very base. It's another way of supporting what we try to communicate in the classroom in terms of the need for a uniform orthography.

Using the goose book to promote the importance of uniform spelling in Ojibwemowin is a way that Zhiibaasige displayed his ability to merge his language knowledge with his instruction.

⁹ The Fiero double vowel spelling system was created by Charles Fiero in the 1950s. This spelling system is used by the Anishinaabe people in “seeking a common orthography” (Noodin, 2015, x).

¹⁰ Basil Johnston was an Anishinaabe author, linguist, and teacher who lived from 1929 to 2015 (Edwards, 2016).

I learned that Auntie B also described how she would incorporate her language expertise with her teaching practices. She detailed an instructional approach wherein she stated,

I'd say the big way I would integrate this [goose book]—I utilized a website called theways.org. It's [called] Great Lakes Native Culture and Language. It was a [U.S. upper Midwest state] Public Radio kind of project. It's got a lot of really cool resources in relation to Great Lakes treaty rights. A lot of times when I have a book like this, I like to show a video, [and] kind of go over language. The way I would utilize it—choose seven vocab words, or seven morphemes, from the book that I know are going to be really useful.

Auntie B provided a specific example of how she would focus on a morpheme to include the linguistic origins of Ojibwemowin within her instruction. She detailed her process,

[*Nandaw* is] a preverb morpheme, so it's a morpheme that goes at the beginning of the Ojibwe word that basically means that anything after that is being—they're seeking it, or they're hunting for it, or they're gathering it. It's a really neat verb, and it's a really neat morpheme, and it's all throughout the entire [goose] book. Especially with the students I work with, well, a bunch of my students are Native, there's also a good amount that are not Native—so really focusing on morphemes is a good, tangible way for my students to kind of understand how the language works together. You know those poetry magnets? I have those for Ojibwe[mowin], with the different morphemes, so students can move stuff around and play with that. That would be a fun one to have with that kind of [goose] book or like, okay, yeah, this is *nandaw*. There's a bunch of different spellings of it, too, which is kind of cool. You kind of see the dialect of it in there. I would basically take the morphemes, teach about the different hunting morphemes. I would go over tenses with

the students and time frame with students, like okay, next year, next spring, next month, next week, tomorrow. That's a good way to review time. And then [I would also] utilize the *The Ways* website.

I learned through our conversation that Auntie B would use her cultural knowledge about treaty rights as well as her Ojibwemowin expertise about morphemes and vocabulary to teach these concepts in concert with online resources as well as handheld text.

Another way I observed how well a teacher knows his students was through Zhiibaasige's appraisal of the usefulness of the goose book. He recognized that some of the goose book vocabulary, and their associated actions (picking berries and goose hunting), would be "uncommon" for his students. He added that there are etiological variations, for example, in picking berries that should be understood, including the following: going to pick berries, getting berries, or anything dealing with the process of getting ahold of berries. Given that there are variations present in Ojibwemowin about how to verbalize these actions, Zhiibaasige detailed the importance of understanding the etymologies of Ojibwemowin words to make this content meaningful to the students he knows well. He stated,

This is where having knowledge of the workings of the etymologies of the word make a little bit more sense when you understand it at that level, [rather] than just clean translation. Because clean translation means what it means. But, what it *literally* means or what is more *accurate* to what it's truly getting at is where you would—so, we call it an interlinear translation. If you were to do the clean, original language version, and then the interlinear would have each of the parts broken down in terms of their individual meanings, and then you would have the final approved, polished-up, clean English translation of that. That's what you often see.

Zhiibaasige knows his students well enough to intermediate between uncommon textual language they may encounter and how to address this issue by using his linguistic expertise to serve their understanding.

Another example of a participant merging his linguistic knowledge with instructional strategies was when Zhashagi recounted his rationale for the usefulness of the goose book with his students. He said it would be useful for literacy development in the lower grades, noting that he would want to make edits on “quite a few miscues.” Something he pointed out was how a particular morpheme was used with different meanings. Specifically, Zhashagi spelled out the following consideration of the morpheme, *nooj*,

We also have the relationship between every page and page 15, whereas we’re using the *nooj* initial morpheme to describe hunting for a goose and *noojinikawed*, and then it’s used again in page 15 for *nooji’adikwewad*. Like I said, quick miscue fix there, and then we’ve got two different uses of *nooj* inside of the same story.

In alignment with qualitative phenomenological research that holds the participants’ shared lived experiences at the forefront, descriptions of their language instruction were evident from the stories they shared about brokering language instructional materials for their students. The participants used their knowledge of students’ backgrounds, in concert with valuing students’ knowledge and centering the students in instruction, and I observed how they merged linguistic knowledge with instructional strategies when they acted as language brokers.

Finding Three: Teachers Express their Ambivalence toward Standards

As I examined the instructional beliefs of the teachers in their engagement with the goose book analysis, I learned that their primary focus was their cultural knowledge and the manner in which language was brokered. The intent of using the goose book was to explore the confluence

of Western and Native science, and what I observed is the teachers were ambivalent about their respective state's science standards and the NGSS. Essential to an understanding of this finding is a consideration of the participants' thoughts about science (Native and Western) in general and science standards. In this finding, I describe the ways in which the participants displayed ambivalence toward science standards, exhibited a focus on the natural world, and decentered the goose book in their appraisal of its instructional value in their classrooms.

Understandings of Science.

During each of the sessions with my participants, I learned about their perceptions and understandings of science. For example, Zhashagi displayed uncertainty in his understanding of science. He responded,

I don't know. Nothing? My understanding of science, I'll tell you honestly. [It's] the hardest thing for me to teach. I don't know if it's because I was less prepared or less interested in my education, or if it's because it was the least developed curricula available to me when I started my position. Or, if it's because it's the hardest to translate because of the specialized vocabulary that comes with the field. I don't know. It's tough. Tough for me to teach.

Zhashagi revealed uncertainty in his understanding of science, which he thinks may have been impacted by his teacher preparation education, and because of the unique lexicon of Western science terminology. In another way, Zhiibaasige's conception of science highlighted the environment,

The very basis of science is observation of the natural world in motion, or in its natural state, factoring in also things that can be unnaturally manipulated, and that's it. I think [that] invoking human association with that observation, I don't think that's just the *only*

way in which that should be invoked. I think that there's other things—I guess it exists whether or not it's humans observing it, or even *only* humans observing it.

Gete-Anishinaabe also offered his understanding of science. After pausing and thinking for a few moments about how he conceptualizes science, he responded, “Depends.” He explained,

It depends, because science is a Western word. I mean, in terms of scientific discovery and, you know, trying to figure things out, the term of exploring, understanding and meaning of things, trying to understand why whatever is the way it is, for whatever reason—I guess, is science. But, if I think of it from an Anishinaabe lens, it's just our life. It's our ancestors. That's what they just lived, Anishinaabe Bimaadiziwin. It's the way they just went about their life. It was constantly interacting with everything and everyone around them and seeking ways to continue to survive connected to those things.

Further, Auntie B acknowledges two different views of science. When the question of her understanding of science came up in our initial session, she explained,

I could go on for so long about this one. For me, I see two different sciences. There's capitalized science, which is Western, super-formal science, and the science that is seen as peer reviewed. And then, there's the traditional indigenous sciences, which can be—and I say indigenous broadly—acknowledging the history of the Aboriginal Australians going back 60,000 years. And then, our sciences here in North America, knowing that our history goes back as far as the ice age, and it may go back even further—but the ice age wiped out a lot of artifacts before then, so we have limited knowledge beyond that. But science is basically anything that I think as can be—you can see the story related to a pattern that you can track, essentially.

Expanding on her understanding of indigenous science, and the stories that comprise this way of

thinking, Auntie B offered additional nuance in the form of a story about Mizhibizhew, the Underwater Panther, who lives in the Great Lakes. Auntie B recounted,

Some people call it a being of chaos, the underwater panther. I look at it as a being of accountability. And so, the stories go that there's this underwater panther that lives in the Great Lakes or Gichi Gami, the one large body of water, and it basically rights the wrongs against the water. So, any time there's something that's happening, like if you're skipping stones on the water, you're disrespecting the water, therefore, the Mishibijiw is not gonna hurt you. It's going to hurt somebody near you. It's a being of accountability. And with that, the interesting thing is, everywhere that you see a Mizhibizhew painting on rock, there's historically going to be either an underwater cave, or there has historically been a current, an undercurrent, a riptide. It serves as a warning. That in itself, is a form of science.

For Auntie B, science can be understood as patterned stories and lessons, including the example of Mizhibizhew that teaches the lesson of accountability. I learned that Auntie B's consideration of science goes beyond stories, as she explained,

Language in itself, in the *roots* of the language, is a form of science, because they hold the stories of our people and they tell us in their instructions—and so what we're supposed to do each time of the year, like how we're supposed to behave and understanding that the morphemes are related to each other for a reason. I'd say that's within the indigenous science realm—is understanding the connections between the things that we may not see as being connected within the Western science realm.

I observed the obvious focus the participants had on the natural world, which illuminated their ambivalence to the stance standards. With the participants' varied and dynamic conceptions of

science in mind, the next section details their indifference to their states' science standards and the NGSS.

Indifference to Science Standards.

It was clear to me that the participants positioned the natural world and their cultural knowledge as central in their science teaching. My observations of their positions illuminated the absence of interest and connection to standards-based teaching. The teachers in this study revealed their indifference in knowing and teaching to the state and national science standards. Their indifference to the standards was candidly revealed as the participants explained their levels of acquaintance with the standards, and their experiences in utilizing the standards.

For example, Zhiibaasige disclosed, "Because what I do is language focused, we don't ever engage with respect to overt science, but we do engage with [science] concepts broadly." He further explained his acquaintance with the science standards in his state,

I'm not actually that familiar with them. At the school, I am more familiar with the state standards for language, for world languages as they've now been articulated at the DPI [department of public instruction] level. We have done work to try to develop learning targets in association with learning targets that were approved a few years ago with the DPI for rural languages. Ojibwe has their set of standards. Menominee has their set of standards. Oneida has their set of standards. Right now, they're uniform, but down the line, I think they're gonna become more bespoke.

As a teacher of Ojibwemowin, Zhiibaasige is aware that his school has adopted the NGSS, and that it is in its first year of using "formal science standards." He also shared that conversations at his school have recently been started around ways in which "other curricula[r] areas can better infuse languages and cultures from the other groups into what they're doing."

From a language standpoint, Zhiibaasige discussed his school's adoption of a set of language standards based off of an altered version of his state's World Languages Standards. He indicated that these standards can be manifest through "I can..." statements, and that these statements are articulated as learning targets, which is what he is used to seeing as a language teacher. He was unfamiliar with how the NGSS are set up and did not speak to these standards nor his state's science standards. One of the sound system standards Zhiibaasige identified in connecting to the goose book is one that states, "I can associate specific letter combinations to make specific sounds." Additional standards he drew connections to were those dealing with multisyllabic sounds, multisyllabic words and their appropriate sounds, and associating pictures with root words.

Gete-Anishinaabe has a similar degree of familiarity with this state's science standards as Zhiibaasige does with his state's science standards. In consideration of his U.S. upper Midwest state's standards, Gete-Anishinaabe briefly shared his perceptions,

It's been a while since I've looked at them. I know they've had some revisions lately. But I can tell you from what I remember, there's little to no integrative aspects of science, culturally, to understand a different view on how we relate to our world environmentally. Gete-Anishinaabe explained the collaborative efforts he has been part of with the science teachers at his school who are working to integrate Anishinaabe culture into their science classes.

Zhashagi's understanding of his state's science standards parallels that of Zhiibaasige's and Gete-Anishinaabe's. Although Zhashagi had not "been through" the standards for "a few years," he indicated that he recalled his state's science standards having similarities with a neighboring state. Zhashagi's perception of the NGSS he reviewed for the present study is that they are "a bit lofty for the lower grades" in the context of his Ojibwemowin immersion school.

He explained why he perceives the standards to be too elevated for his students,

For example, grades K-2—use materials to design a solution to a human problem by limiting how plants or animals use their external parts or help them survive. This might just be my personal understanding of science, but to get that through to a 5-year-old who speaks a different language than you? It's a pain in the ass [laughter]. I don't know. Read text and use media to determine patterns and behavior of parents and offspring to help offspring survive? Once again, we don't have literature, so we'd have to make multiple books to meet that need, right?

Zhashagi teaches primarily at the elementary level, of which he spoke to for the majority of our time together, but he also has some experience with science standards at the middle school.

I remember doing a science fair and realizing that I can make the standards work to meet, like, 80% of the science standards for that grouping, just by doing general science experimentation. Just by going through the scientific method and presenting, and it met most of them. If [students] understand [the] scientific method, and they can produce actual observations, hypotheses, and collect data, I mean, that's the large majority of the science standards, as far as I remember.

Given that Zhashagi teaches all subjects in Ojibwemowin, I asked him how the story impacted the way he thinks about teaching the science concepts and standards that may be reflected in the story. He responded candidly,

It doesn't. I'm a very in-the-box kind of guy, you know? I'm a very concrete, linear fellow. When I looked at the story, like, I went through it a few times, looked at the standards a couple times, and there's not a lot of context inside of the story that really says to me anything about science. There are a couple of mentions about seasons. There

are a couple of mentions of some really broad ideas about gathering food. But nothing in [the goose book] says life cycle, or ecosystem, or weather patterns, or food chain, you know? It's really a broad—all the statements are really open, I would say, you know? If we take a random sample [from the goose book], Every April my grandpa goes goose hunting, nothing in that says science standards to me. Can I make it into a science standard? I mean, yeah, geese are around in April in the place and setting of this book, of which there is no context, right? I don't know where they're at.

Zhashagi's analysis of the connections between the goose book and his state's science and engineering practices resulted in "loose connections." After Zhashagi and I revisited the research question framing the current study, he offered his thoughts on U.S. public education standards in general,

Man, find me a teacher who thinks that the standards are fricking—something that should be catered to in the first place. You know, I'll be amazed for one, but for two, to think that we need to work our cultural fricking appropriateness around the g**damn standards is just ludicrous. I mean, you're not gonna find a Native teacher who's like, 'Yeah, I'm gonna base my fricking cultural pedagogy of kids [around] US traditional standards.' Never gonna happen, man. And that's why I've been so frustrated with this—not frustrated, that's why I sound so critical. I'm not gonna spend time trying to place a text based on standards. I'm gonna place it based on its usefulness for my students. And then I'm gonna see *if* it hits those standards.

Zhashagi's comment prompted me to inquire about why Native teachers should be expected to adhere to U.S. public education standards. Regarding the standards, he responded,

They're bunk and crap. I mean, not that they're bunk and crap. They're good guidelines

and checkmarks and checkpoints to know the general pace of instruction that should be underwent by any student or any classroom. But with the fricking—what do we got, 90 million public education students, or 70 million, in the U.S., and we're expecting this set of standards to broadly hit all of them, even with the variance between the states with the different fricking levels of poverty and privilege and instruction and teacher-to-student ratio and bias? I mean, there's no g**damn way that these standards are going to be applicable to everybody. They're built like everything else, to appease the masses. Right? I mean, it's not gonna work for even the masses inside of themselves. It's just going to work for the majority of the majority, right? We're really hitting on 30 percent of students [who] are going to be hitting these standards in the way they're written if they're really smart. You know, but, no, they're good checkpoints. [chuckle] Alright! Yay! Good! Good!

Zhashagi's comments illuminated his indifference, teetering on resistance, to the science standards, as well as an anti-standards approach to U.S. public education standards in general.

I noted how Auntie B also displayed indifference as we talked about the science standards. She summarized her position, "It's not about necessarily me knowing them by heart, but it's about me knowing how to have accessibility to them." Drawing on her background, Auntie B elucidated her indifference toward the standards as,

Because I'm a language instructor, I don't often dabble in the science standards. I got my undergrad in American Indian Studies and Linguistics, and then I did two years in a postgrad program for—it was teaching English to speakers of other languages, as the initial licensure, with a certificate in [a U.S. upper Midwest state] Native American languages. However, I didn't fully complete that because I got my job. I didn't actually

need that to have the job up here. My undergrad was enough. But, because of that program, I did not even ever think to look in the science state standards until I got up here. That's actually something that I'm looking into right now for our project-based learning is, how do I work with the science instructors, so I don't necessarily have to learn the standards, but how do I collaborate with the people who do know those standards?

Considering the previous excerpt, Auntie B described the utility of the goose book with her students in that it would be “useful” in reviewing the science standards, and that she could scaffold the book for all of her students in grades 5-8. After revealing how different she thought each of the sixth, seventh, and eighth grade science standards are, and how she could analyze the book linguistically for each of the grade levels, Auntie B explained that the book was probably the best fit for her seventh grade students. She cited the seventh grade curricular focus on the life and environmental sciences, including topics like the seasons and humans’ role, and “the basic sciences,” which makes this grade level the one for which she would use the text.

I learned that each participant displayed indifference to their state science standards and the NGSS, and, as the next section reveals, the participants’ de-emphasis on the standards was illuminated by the way in which the natural world was their focus as they described their approaches to science instruction

Focus on the Natural World.

The teachers who participated in this study centered their analyses and applications of the goose book on the natural world, without overtly referencing the standards and Western science terminology and concepts as significant to their teaching.

I am reminded of how Zhiibaasige spoke about the natural world through his mastery of

the Ojibwe language. He explained that, due to issues with colloquialisms and word usages in English, he spends time bringing his students up to speed on this before adding in his teaching of science concepts. Zhiibaasige equates observations of the natural world with how this “translates into a more phonic understanding of the language.” He detailed his understanding of science through Ojibwemowin speech sounds,

When you have parts of words that hold specific meaning, and you play with those in whatever language you’re working with, this is the case, then you potentially change the meaning of the word accordingly. With Ojibwe, there’s a whole classification of verbs that are expressing a phenomenon happening and nobody’s involved, no *being* is involved in that phenomenon occurring. And that includes a lot of natural phenomenon. So, nature has its own way of expressing things. Our recognition of that is articulated through some of these verb uses.

Zhiibaasige gave a deeper explanation of his use of the term *being* when he illustrated,

For example, apples and gloves and things like that, they’re considered *beings* and they’re discussed in a way as if you would discuss things about me or you, or a deer or whatever, but they’re not breathing and they’re not anything like that. I don’t use the animate versus inanimate dichotomization. I tend to go with *being* and *non-being*, or *thing* even sometimes I will say. Although, *thing* has its own problem because from its Germanic root, it’s rooted in just a meeting [meaning?], but over time it morphed into something else, so, essentially, just things that we consider in vernacular English *things* versus *beings* is what I often explain.

Zhiibaasige elucidated that the concept of animacy originates in the Greek root, *animas*, which means that something is able to breathe or move on its own. However, since Ojibwemowin

considers many things *beings* even though they do not breathe or move on their own, he indicated that it is essential to parse vernacular English with Ojibwemowin understandings.

Gete-Anishinaabe draws both distinctions and parallels between Western science and an Anishinaabe understanding of the world. He detailed,

An outsider, a Westerner, an anglicized person who looks at things academically would say, *that's science*, [when] trying to understand these Anishinaabe people who know which medicines to pick, when and where and what they can do, or what tree works best to build a canoe.

Gete-Anishinaabe began his response about science in broadly describing a Western scientific lens, before richly elucidating his understanding of science through an Anishinaabe lens. He explained that the Anishinaabe people had already made sense of how to live and survive in the world prior to Western scientists doing so. Gete-Anishinaabe further expressed, “Science, the academic stuff, to me, [is] just uncovering what our elders already knew. It’s ancient knowledge. The academics are just learning to figure it out.” In essence, Western science repackages the Anishinaabe lens of science as “new science,” as Gete-Anishinaabe asserted. He went on to explain that he hopes the academic world, including the Western understanding of science, coupled with Anishinaabe Bimaadiziwin, and the wisdom of the ancient elders, can be bridged and can come together. He added,

Man, we can learn from each other if we sit down respectfully with each other because we can get so much further ahead if we learn to understand what the [medicine] wheel represents, what Anishinaabe Bimaadiziwin represents, and that’s respecting each other.

Gete-Anishinaabe built on this idea of respecting Native epistemologies when he mentioned that even though he does not see an integration of Anishinaabe understandings in the science

standards, teachers at his school “do it specifically. They do all the work.” His colleagues bounce ideas off of him to which he provides direction as to how they can infuse Anishinaabe culture and language into their science curricula. He shared with me an example of a recent collaborative effort between the science teacher at his school and him. The science teacher integrated into her unit on water some short stories from Native elders about what water means to them. Gete-Anishinaabe said that this approach to science pedagogy changes students’ perceptions of how to take care of water as well as their understandings of the cultural connectedness of everything in creation.

Gete-Anishinaabe expounded, “The central part of us as Anishinaabe people, that spiritual inner connectedness that has allowed us to survive, and the culture to survive, is because of respecting all things. Having that central component.” His focus on the Anishinaabe value or respect for and balance in the natural world was revealed to me when he explained,

It'd be my hope and view that my students would get another example [via the goose book], a viewpoint of how even in modern day we might not know the [Anishinaabemowin] language, might not even use the language, but when you go out in the woods, or you go in another setting—maybe it's just camping. It might not even be hunting. It might be something else. You're going boating. How do you look after the environment when you're out there? And that would make [my students] think twice about doing something that might damage that environment. They have to leave it in a respectful way. They have to acknowledge that those living beings out there, that's their home. We're just visitors. Think about if someone disrupted your home.

Gete-Anishinaabe hopes that his students learn to live in balance, including not only their actions and impacts on the environment, but also how their actions impact the balance of living with one

another.

Auntie B also highlighted a focus on the natural world. After discussing her view of science, using the example of Mizhibizhew, Auntie B gave an example of one of the linguistic “lessons within lessons” that recently manifested in her sixth grade classroom. She and her students got into a “philosophical discussion” about a topic surrounding plants. Auntie B showed her students a lecture by an ethnobotanist in the Salish Territory, pausing at a point in the video that focused on health outcomes,

[The ethnobotanist] talked about how by centering the CDC, and these very Western health realms, that we are decentralizing some of these other practices, and therefore, taking away from the ethnobotanical knowledge, understanding how certain foods affect our bodies. It basically takes away that autonomy. I ended up talking with my students, So, okay, I know some of you are Native, some of you are not. Let's think about—What [does] being healthy mean to you? What does it look like for you? And it was silence for two minutes because the students were like, “Oh, my gosh, that's harder than I thought.”

I'm like, we are told so much what it mean[s] to be healthy.

Auntie B described that this interaction with her students led to a discussion about the connection between mental health and physical health. She said, “I think that lessons like this really put autonomy in the hands of our students.” Similar to how Gete-Anishinaabe discussed the “ember” he hopes carries his students through to their adult years, Auntie B stated,

I think that's the big thing, that as a teacher, a really fundamental part of my philosophy is putting autonomy in the hands of students, because if we are taking all that, by the time that they get to college, or wherever they want to go after, they're not going to learn how to advocate for themselves. I think this is a really key lesson for students of, “Okay, how

does hunting and harvesting relate to your autonomy related to food? How does it relate to your autonomy with mental health?”

After I validated her dedication to student autonomy, as evidenced in the previous excerpt, Auntie B offered, “I’m just really excited for this [study]. This really brought me a lot of joy in more ways than you know.”

In the teachers’ considerations of the goose book, including how and why they might use the book to address science standards, they spoke about the natural world rather than specific standards and Western science.

Decentering of Text.

In their discussions around the usefulness of the goose book with their students, the teachers decentered the goose book in their appraisal of the degree to which they would use it in their instruction.

Content from the goose book that Zhiibaasige would integrate into language learning standards for his students in grades 5-6 includes vocabulary usage in accordance with verb types and recognizing different prototypes. For his students in grades 7-8, he would use this story to teach objectives related to complex verb types including transitive animate. An example of this is, “me to my grandfather, or my grandfather to me” and associated prefixes and suffixes. Zhiibaasige said that one of the only downfalls of using the goose book in his classroom is that it is rather short.

When asked how his consideration of the goose book and the science standards impacts how he might use the text with his students, Gete-Anishinaabe shared that one of his challenges is that he does not teach the subject of science. Yet, he explained the ways in which he would use the goose book with his 6th and 7th grade students. The two qualities from the goose book Gete-

Anishinaabe found most applicable to his 6th and 7th grade curriculum were a) the Ojibwe language, and b) cultural customs and an understanding of humans' relationship with the environment.

Gete-Anishinaabe shared that his 6th grade curriculum is language-focused, and that he could use the goose book to embed family and generational traditions into his lessons. He offered, "I know language and culture are never detached," but that it might be "too much" for his 6th grade students to delve into the deeper roots of culture, history, traditional life skills, and Anishinaabe worldview like his 7th and 8th grade students do. With his 6th grade students, Gete-Anishinaabe would use the goose book to help them practice the language by using it to describe their wishes, goals, and things that are outside of school so that they see relevancy in the language as it applies to their lives. His students have gotten used to hearing that the reason they have to learn things in school is simply "because," which is why Gete-Anishinaabe said he would use the goose book to connect to their lives outside the classroom.

For his 6th grade students, the content of the goose book that Gete-Anishinaabe would use is storytelling, particularly the difference between stories and legends. The learning objectives he would use the story to teach would be connected to the Anishinaabe language and the concept of waiting. Gete-Anishinaabe explained that the 6th grade standards he could cover with the goose book would be "limited," but that he could still use the story itself as an example of a story and bring in traditional generational connections in the family.

Since most of his 7th grade curriculum is pre-European contact, he would use the goose book at the end of their curriculum because it would align with when he teaches about the Europeans' arrival and colonization. Gete-Anishinaabe described that the bulk of the 7th grade curriculum focuses on how Anishinaabe people "came to be," including learning to live in

balance with everything and everyone around them. This curriculum spans “before the Great Flood¹¹, what happened afterwards, and the tools that they now were receiving to help them learn to live in balance.” I found that Gete-Anishinaabe would use the goose book to further the concepts he already teaches with his students.

In dialogue with Zhashagi, I learned about his approach to instructional planning as he considered the goose book’s usefulness in his classroom. I asked Zhashagi about whether he had analyzed the usefulness of the illustrations in the goose book. He informed me that he “generally wouldn’t think to use the illustrations in a child’s book to try to meet standards.” This train of thought prompted Zhashagi to explain how he plans his lessons. Rather than scaffolding his lessons around a particular text, he begins his lesson planning by deciding on a concept. From there, he searches for additional materials that “inform the experience” he had planned. He stated,

When I'm preparing to teach a unit or a lesson based on meeting a certain set of standards, which is actually pretty backwards from how I actually do it, I wouldn't generally start with a text. I would be instead planning everything around it, and then searching for additional pre-existing materials that may inform the experience that I had planned for the learning and assessment.

Zhashagi answered my question about the illustrations by taking a quick look through the PDF of the goose book. Referring to the image on page 9, he pointed out that while Grandfather was walking with snowshoes strapped to his feet, there was no snow in the image. Zhashagi also mentioned that “nobody had long hair” in the story. This prompted him to perform a Google

¹¹ Gete-Anishinaabe explained the Great Flood, “After the first people were here, people were not following the original teachings of kindness, and taking care of each other, and being respectful and that. And the Creator destroyed the earth.”

search of the author of the text who, Zhashagi thought, physically appeared to be non-Native in his online photos. Zhashagi pointed out that, on page 14, based on the way Grandfather is depicted as cleaning the elk, the process “looks backwards.” Zhashagi explained that when preparing an elk to drag out of the bush, you wouldn’t “gut ‘em” by starting at its neck but, rather, by starting at its hindquarters and then moving upwards to remove all the organs to reduce its weight before you carry it out from where you killed it. Zhashagi offered his honest “assessment” of the elk illustration in that it could have been useful had the gutting of the animal been depicted from butt hole to sternum rather than the other way around. Additionally, as seen on page 22, Zhashagi noted that there is only one chair, but two guns, meaning that the grandson is likely standing up while holding the long 12-gauge rifle. He did identify that the illustrations seem to depict Algonquian people, and that “It’s nice when students can see themselves represented in any capacity, you know, outside of their norm.”

Zhashagi stated that while he would use the goose book to aid in teaching Ojibwe language, he would not use it to teach concepts like food chains and webs, or energy transfer. He clarified that although he can “see the possibilities” in using the book to teach science content, there is not enough “detail” in the story to do so without being “a huge waste of time.” Specifically, he voiced that he would likely end up “working around [the text] instead of just finding something that would be more applicable.” Furthermore, he noted that his students would likely say, “It’s just a story” if he were to use this text in class. Although Zhashagi found some validity and value in the goose book, he admitted, “There are also thousands of other books that are more valid and more to the point and, you know, would give more due to the standard than this [book] would for me.” Zhashagi further explained his rationale for assessing the goose book as a text he would likely not use with his immersion students,

I could probably write, like, four good lesson plans and identify the needed materials inside of 90 minutes, you know, instead of looking at a book and trying to make it fit. Like I said, it's a difference in planning style. I'm never gonna pick up a book and say, "Alright, let's spend two days' worth of prep time for a public education, public system teacher, to figure out how to make this text fit." I would never do that. If I pick up the text and, like, oh hell yeah, there's inherent value here, and I see exactly how this fits, here's where I'm gonna put it. But as far as me using [the goose book], specifically to teach a science concept, I highly doubt it. I mean, there's definite value in all materials, you know, but with the specific task you gave me, I couldn't find a way to apply it to the science standards for my grade level.

I learned that Zhashagi used his lesson planning approach—(a) plan around the concept, goals, and objectives, (b) determine how to make the concept “presentable in a way that might excite [students] and engage them,” and (c) “find out which standards it checks off”—when appraising the goose book.

Auntie B shared that she would use the goose book to teach the concept of life cycles. In fact, even if she did not teach life cycles “directly,” she would work with a science teacher to pair, or line up, this lesson with what the sixth and seventh grade science classes. Auntie B pointed out that while students are learning about life cycles in their science classes, in her classes she could lead students through learning the names of the animals in the life cycles they’re studying, discuss when in their life cycles they are allowed to be hunted as it pertains to treaty rights, discuss the morphemes involved in these associated Ojibwemowin terms, and review time and seasons. Auntie B listed the four learning objectives she would implement surrounding the goose book: (a) “Students will be able to understand [four] cultural teachings

around winter and spring,” (b) “Students will be able to break down, or name, words related to the morphemes,” (c) “Students will be able to name five things that could be hunted or gathered,” and d) “Students will be able to explain what the DNR or TDNR does.”

In addition to the previous practices Auntie B described in building a lesson that decenters the goose book, she excitedly told me about a website, wisconsinfirstnations.org, that she would use in conjunction with her practices. She explained that this website contains information that pertains to Ojibwe people in several Midwest states that could be used to supplement a lesson on hunting, for example.

Conclusion

The expertise shared by the four participants involved in this study illuminated the research question, “What is revealed about culturally responsive pedagogy for American Indian students in the process of examining the cultural content of an American Indian text alongside traditional U.S. public education science standards?” The stories they told about how they perceive their work with American Indian students revealed three cross-case findings. In their process of examining a Native text alongside Western science standards, an analysis of the participants’ experiences revealed that they a) use their cultural knowledge, b) serve as language brokers, and c) express their ambivalence toward science standards. In the final chapter, I discuss how these findings interplay with the theoretical framework of culturally responsive pedagogy, and their implications for the field of science education for American Indian students.

Chapter 5: Discussion

American Indian students deserve dedicated pedagogies that are responsive to their identities. U.S. public school science pedagogy is commonly guided by standards founded on a Eurocentric gaze (Howard & Kern, 2019). Symptomatic of the endemic nature of colonization in the U.S. (Brayboy, 2005), American Indian students' cultures and languages are not reflected in U.S. (i.e., Western) science standards, texts, and curricula (Cobern & Loving, 2001). Western science, a subculture of Western ideology, has typically aggressed indigenous ways of knowing, including indigenous cultures and beliefs about learning (Smith, 2013). It is problematic that American Indian students do not see their cultures and languages reflected in traditional public school science classrooms. At the confluence of hegemonically Eurocentric science curricula and American Indian culture and language, there is a need for pedagogical responsiveness that honors the identities of American Indian students.

The objective of this exploration of the confluence of Native and Western science was to use a phenomenological case study approach to illuminate a process through which language and science teachers of American Indian students examined a Native text for its connectedness to state science standards and the Next Generation Science Standards (NGSS). This work was guided by the question, "What is revealed about culturally responsive pedagogy for American Indian students in the process of examining the cultural content of an American Indian text alongside traditional U.S. public education science standards?" In this research, the teacher participants served as the unit of study while their students were held central in the goose book text analysis. The participants shared their perceptions of the alignment of a Native (goose book) text to science standards, and the text's usefulness in their classrooms. The voices of the teachers

were captured to highlight their perspectives and expertise in this phenomenological approach. The stories and counterstories shared by the participants shaped the findings of this study.

Description of Findings

The findings that emerged from this study speak to the need for culturally responsive science instruction for American Indian students. The three findings offer insight into the participants' cultural knowledge, language brokerage, and an ambivalence toward science standards. Analysis of the data illuminated the interconnectedness among the cross-case findings. I found that the cultural knowledge of the participants was the essence of their pedagogical decision making. As a significant component of their cultural identities, the participants' language knowledge positioned them as language brokers, specifically as they described their thoughts about the science standards and the usefulness of the goose book. When asked to examine the curricular merits of the goose book in light of participants' state science standards and the NGSS, the participants exercised their cultural knowledge and language brokerage in sharing their insights through this examination. The participants' pedagogical decisions were powerfully rooted in their cultural knowledge (Finding 1) and grounded in their perceptions of themselves as language brokers for their students (Finding 2). Their commitment to language and culture further revealed a distinct ambivalence toward the science standards across the participants' experiences (Finding 3).

The participants' conviction to authenticity and respect for intercultural similarities and differences influenced their indifference to the standards when they considered the merits of a Native text (the goose book). This conviction stemmed from the participants' Native identities, and, at a humanistic level, influenced their focus on the consideration of student levels when

appraising cultural texts. I recognized that the teachers' cultural epistemologies contributed to their ambivalence about the role of science standards in their pedagogical decision making.

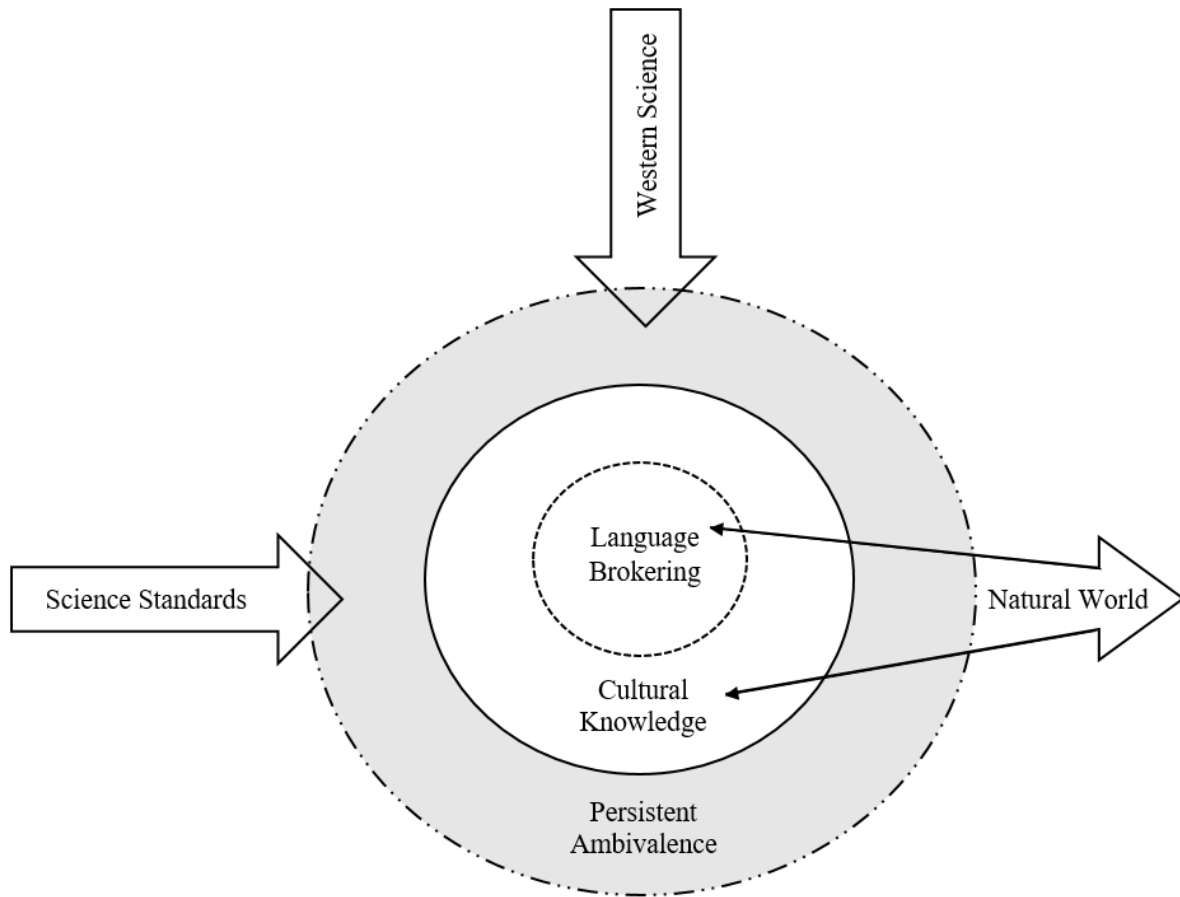
The teachers' abilities to broker Ojibwemowin for their students was displayed in how they valued and used their knowledge of their students' backgrounds to center students' needs in their instructional practices. I observed how the teachers' language brokering—rooted in cultural knowledge and a conviction to authenticity—related to their ambivalence toward the science standards. From the teachers' perspectives, the lack of representation of Native cultures and languages in the science standards was a rationale for their indifference to these standards.

The teachers' ambivalence toward the science standards was expressed in their indifference to teaching to the standards. They instead emphasized the natural world and the centering of culture and language, rather than focusing on standards or a text (i.e., the goose book). Figure 1 offers a representation of the complementary components, as well as the tensions, revealed in the findings.

The visual representation of this study's findings (Figure 1) portrays the nested nature of Native culture and language, and the relationship to the Western constructs of science and standards. I chose to display the relationship of the findings with concentric circles, which although presented in this one-dimensional format, is actually a three dimensional spherical conceptualization.

Figure 1

Model of Findings



Beginning with the concentric circles, language brokering and cultural knowledge are housed within a solid line to represent the conviction participants showed toward the grounding of culture and language in their pedagogical decisions. The line of the language brokerage circle is dotted to represent that language is a facet of culture, shown here as nested within the cultural knowledge circle. This relationship between language and culture reminds me of Geta-Anishinaabe's words, "I know language and culture are never detached." His words echo Gilbert (2010) who states, "When a people lose their language, they lose their culture and eventually their identity as a people group" (p. 44). The inseparable nature of the bond between culture and

language reveals why these two facets of personhood are so important in Native identities. The participants in this study demonstrated their conviction to sustaining cultural identity and language brokerage, and they held the constructs of identity and culture at the forefront of their pedagogical actions.

In Figure 1, cultural knowledge and language brokering are surrounded by a persistent ambivalence, or indifference that the participants demonstrated toward the influence of Western science and science standards. A dotted line was used to convey the persistence and unyielding opinion surrounding the teachers' thoughts about Western science. The two large arrows perforating the ambivalent zone illustrate two of the Western influences the participants navigate in their classrooms. Pointing inward, the arrows representing Western science and science standards are unidirectional, and do not move beyond the layer of ambivalence. I depicted my findings this way because the participants did not invite the Western science and science standards into their pedagogies—rooted in their cultural knowledge. The single, large arrow representing the natural world, and the participants' understandings of science, originates within the language brokerage and cultural knowledge spheres, and emerges through the ambivalent Western science and science standards zone. The arrow representing the natural world is bidirectional to indicate the balanced relationship and influence the natural world has on the beliefs of the participants in centering their Native cultural and linguistic knowledge in their practice. Although I conceived the relationship between the findings, the balance I discuss lies in the dynamic qualities among culture, language, and the natural world. This dynamic balance reminds me of when Auntie B explained how *Mizhibizhew* holds people accountable when they disrespect the water; there is a balance in the interplay between the lesson *Mizhibizhew* teaches and how people should treat the water in the future. To comprehend the extent of the dynamic

relationship among the findings of this study, depicted in Figure 1, it is necessary to understand the phenomenological approach guiding this study.

The Significance of a Phenomenological Approach

In this study, the voices and lived experiences of the teachers were highlighted in order to reflect their expertise at the confluence of an American Indian text alongside traditional U.S. education science standards. To engage in this examination of the confluence of Native and Western science, I relied on a phenomenological ideological perspective to centralize the lived experiences of the teacher participants and decentralize myself, as the investigator of the phenomenon at hand: teachers of American Indian students engaging in the process of analyzing a Native text.

In my examination, I drew from the tenets of phenomenology as I analyzed and reflected on the participants' experiences. Moustakas (1994) states, "The phenomenal experience becomes increasingly clarified and expanded in meaning as the phenomenon is considered and reconsidered in reflective process" (p. 50-51). As such, I began analyzing the data by hand-writing jottings (Miles, Huberman & Saldaña, 2014) as I reviewed the words of the participants. These jottings captured my "fleeting and emergent reactions and commentary" (Miles, Huberman & Saldaña, 2014, p. 94) as I made meaning of the data with which I engaged. I moved through the analysis process to preserve the phenomenon of the teachers' lived experiences revealed through their stories.

A phenomenological approach to this study allowed for a richness and depth in the stories I heard from the participants. Their stories illuminated their lives as teachers, and their narratives unveiled perceptions of roles in the education of American Indian students. In my reflections of these narratives, I held central the notion that "perception is regarded as the primary source of

knowledge, the source that cannot be doubted” (Moustakas, 1994, p. 52). Accordingly, the participants’ understandings of their cultures, languages, and the science standards were analyzed in their “original texture” (Moustakas, 1994, p. 59), and respected for their innate value in the present study. The “essence” of the participants’ descriptions of their lived experiences (Creswell & Creswell, 2018) culminated in an understanding of their shared phenomenon—the process of using their expertise to analyze the goose book. This discussion proceeds through this grounding within phenomenology.

Critical Perspectives

In a study of this nature, it is paramount to employ a lens of critical consciousness that “challenge[s] the status quo of the current social order” (Ladson-Billings, 1995, p. 160). Framing this discussion requires (a) a self-examination of my non-Native positionality as well as (b) my dedication to advancing critical frameworks in an examination of the participants’ experiences in analyzing the utility of the goose book in their classrooms.

Critical Positioning of a White Researcher

As a White, non-Native female researcher, I understood that a critical stance was required to conduct a qualitative research study that centralized Native participants. To be a non-Native researcher in this work meant that I frequently engaged in reflection and discussions with my committee that challenged my Eurocentric epistemologies, allowing for a discerning analysis of the data. In consideration of the research question guiding this study, I felt it paramount to utilize a methodological framework that focalized the participants’ voices. I intentionally crafted the design and rigor of the present study in ways that authentically conveyed the phenomenon of participants’ stories and counterstories surrounding their examination of a Native text.

Based on the findings of this study, I reverently realize more of the nuance and depth of

participants' motivations at the confluence of Western culture and Native epistemologies. Specifically, evident in the participants' stories was a conscious dedication to a dynamic state of balance in caring for others, self, and nature. The value of interconnected balance is atypical of the Western ideologic framework I was brought up in. My personal interest in exploring the weaving of Native and Western science underscores why I feel fortunate to have had the trust of the participants as they shared their stories with me. My exploration of the participants' Native identities, cultural knowledge, and language brokering illuminated for me why they displayed an indifference to science standards and decentered the goose book; their focus was on the natural world because the natural world was a direct corollary to their deep cultural knowledge.

What I learned about myself as a White researcher through my interactions with the participants in this study encompasses the humanistic and spiritual realms. Knowing the varied ways Native people have been harmed by White people, whether intentionally or not, I began this work with caution and an attentiveness to the intergenerational trauma still experienced by Native people. I did not want to propagate the mistreatment of my participants in any way.

I come from a Western worldview, and my belief system is influenced by Western ideals, so it was essential that I monitor my biases throughout this study as I approached the concept of culturally responsive pedagogy for American Indian students. I believe that when a non-Native person engages in research with Native peoples, they should be willing to confront their non-Native identities and the ways in which race accounts for advantages and disadvantages experienced by racial groups. My beliefs are supported by Singleton (2015), who states,

We need to challenge our racial unconsciousness in the conversation to reach a greater understanding of race in our own lives. People of color, like me, tend not only to be more conscious of our own racial experience but also understand a great deal about White

racial culture as well, because we live in a White-dominated society. Simply put, racial discomfort is heightened when racially dominant people of lesser consciousness are required to interact with racially targeted or oppressed people of greater consciousness in circumstances in which the racially dominant, or White people, possess greater power and authority or have a higher level of confidence in their own ill-formed racial beliefs. (p. 93).

Guiding my work is the understanding that non-Native researchers need to be willing to interrogate their power, privilege, and biases when working alongside Native peoples in research. Researchers must proceed in their work with full knowledge of the impacts their identities have on Native people, and that even the act of recruiting a Native person to their study may be too oppressive a situation for the person to agree to participate. In this way, non-Native researchers must not only realize that their positionalities can be linked to Native fears about non-Native researchers coming into their communities, collecting data, and then using this data to profit from, with no benefit to the Native community—but they should also commit to acting in ways that do not cause further trauma to Native peoples. Non-Native researchers must be vulnerable, open, and respectful of cultures other than their own. They must have an authentic desire to listen to and learn from their participants, and to use a methodological approach that centers their participants' voices.

As a White researcher, I learned that I had to listen more than I usually do. I had to try not to make sense of what I was hearing based on my previous knowledge and non-Native paradigm, but to base my sense-making on the paradigms my participants used when sharing their truths. In this realization, I draw from Swan (2017) who asserts, "Listening is not a feel-good panacea" (p. 553). As such, my listening gave way to appreciating and understanding

authentic experiences that are different than mine. My interactions with each participant impacted me. For example, when Gete-Anishinaabe shared his experience with the remote Ojibwe tribe in Canada, I felt like I could actually smell the fish at the fish camp. I could almost *feel* the befuddlement Gete-Anishinaabe felt as he tried to figure out why the elders did not place tobacco at the bases of the trees they cut down for supplies. This story is an example of the cultural reverence I experienced through Gete-Anishinaabe.

My vulnerabilities as a non-Native researcher stemmed from my lack of cultural knowledge of the rituals held by Ojibwe people. I felt especially vulnerable when offering tobacco ties to my participants. I did not want to incorrectly carry out any component of the ritual—creating the ties, offering them, or placing them. Even when I hung the tobacco ties in a tree, a protocol more aligned with some of the Western U.S. tribes’ traditions, rather than laying tobacco at the base of a tree as Ojibwe people in the Great Lakes region would do, Gete-Anishinaabe reminded me that my action was “appropriate” for where I was at in my growth. What did my practice of offering tobacco tie practice mean in the greater scheme of this research? I listened. I could have appropriated the ritual of offering tobacco but, instead, I sought the advice of a trusted elder about protocol, asked my participants if they wanted to receive the tobacco, and learned how I would place the tobacco differently in the future.

While I approached this study from a White paradigm, over time, I was drawn to the decentering of Western science based on what I learned from the participants. It was through my data analysis and listening to the thoughts and expertise of the participants, that I realized the White paradigm I brought to this work had also influenced my perception of the goose book. My preconceived understanding of the constructs of science in the goose book, and how the participants would link these constructs to the standards, was framed by Western notions of

science (i.e., biogeochemical cycles, mammalogy, and ecosystems). When I performed a cross-case review of the participants' text-to-standards analyses of the goose book and noticed that they indicated very few overt connections to the science standards, I began to realize the profundity of what *wasn't* there. From the initial interviews to the text-to-standards analysis to the follow-up interviews, the arch of explanations my participants shared about how Native epistemologies interact with Western science revealed their deep cultural convictions. I now understand the relevancy and role of cultures as reflected or, in this case, not reflected in the academic standards that are often crafted by those with Eurocentric values.

Critical Frameworks as Essential to Intercultural Work

As I positioned myself in this scholarship, I relied on frameworks of critical scholars who preceded me in this work. To more fully understand the lives of teachers of American Indian students, I valued the critical frames of culturally relevant pedagogy (CRP) (Ladson-Billings, 1995), culturally responsive teaching (Gay, 2002), and tribal critical race theory (TribalCrit) (Brayboy, 1995).

As I consider the meaning of this study to intercultural work, it is important to understand the construct of culture, specifically with regard to the myriad cultures of students and the design and implementation of culturally relevant and responsive learning experiences. When considering American Indian students, their heterogeneous cultures must be understood at a deeper level than just the surface cultural components of "heroes and holidays," food, and dress (Hammond, 2015). Just as Zhiibaasige stated about Native languages, "Do not make monolithic that which is not," consideration of American Indian cultures must move beyond a homogenous pan-Indian approach. Zhiibaasige's words remind us to not make sweeping generalizations about cultures that are not our own, or that we do not take care to learn and listen about. Western ideals

and Whiteness are a powerful monolith. This powerful monolith simplifies and minimizes other cultures in acts that require no self-examination. Conceiving of Others in this way degrades the nuances, elements of deep culture, and the profoundly human ontology of peoples. Saleh (2021) offers a point of clarification,

Attempting to (individualistically and heroically) humanize those deemed less-than-human or non-human by injecting facts, arguments, and/or stories to convince others of their/our humanity reproduces the external (colonial) gaze as central to their/our recognition, legitimization, and existence. For, if I as “teacher” feel it necessary to humanize those I perceive as Other, what does that say about my ability to recognize the *already-intact* humanity of an Other? (p. 221-222).

Within intercultural work, critical reflections of Whiteness, and what it means to humanize an Other—not in light of ourselves, but in recognition of the extant fullness of humanity in the Other—are required to engage at the confluence of Western ideals and Native epistemologies.

Pease Windy Boy (1995) warns that it is not enough for classroom lessons to appear “cosmetically brown or black in complexion” (p. 399). While it can be validating to see a melanated face on a classroom poster—not to say that this surface element of culture is not important, but—deeper aspects of culture may matter more. A facet of deep culture that White teachers need to realize is that it is not just “other people,” People of Color, who have culture (Ladson-Billings, 1994). White teachers should explore and critically examine the role that Whiteness and White culture has on the classroom experiences of American Indian students. It is vital that White teachers understand the history, and continued pervasiveness of Whiteness that needs to be not only recognized, but reflected on and addressed. To cosmeticize a culture is harmful and it has deleterious impacts on school and life outcomes for children. The deep

cultural aspects and spirits of students are nullified. This is the danger of the Western monolith.

It is necessary that Native students' cultures are realized at the deeper levels of culture—shallow and deep—in order to not only understand, but to teach to, the “trees of knowledge” (Hammond, 2015) that students carry in their lived experiences. Without understanding the deep cultural schema of Native cultures, we fail to understand Native ways of being, knowing, and understanding—the ways that Native students make sense of the world. Cultures and languages are being eradicated, and dehumanizing persists in schooling when culturally responsive paradigms are not fully enacted.

Culturally Relevant Pedagogy.

In consideration of Ladson-Billings' (1995) theory of culturally relevant pedagogy, two tenets of this theory that speak to the findings of this study are cultural competence and critical consciousness. When teachers have an understanding of cultural competence, coupled with critical consciousness, they can respond to their student's needs in ways that dismantle dehumanizing practices. Native students and Students of Color do not need to be “corrected” or further colonized (Saleh, 2021) by a mindset that positions Whiteness in a posture of judging the Other's humanity. Qualities of people's cultures are threatened by how these cultures have been treated by mainstream cultures over time (Sonn et al., 2000). Persistent inequities may lead to people not identifying with their cultures. I am reminded of when Zhiibaasige explained that few of his Native students, at the all-Native school he teaches at, identified as Native, or that they seemed apathetic about their cultural identities. If teachers of Native students keep this student position in mind and use a sense of consciousness about why it is that students feel this way, they can more effectively and responsively provide relevant instruction that supports their students' grappling with cultural racism and identity.

A critical caution should be taken by educators to not to convolute culturally relevant pedagogy to a misappropriation of their students' cultures while still grounding their instruction in an allegiance to the standards. Science standards are rooted in Whiteness and in Western values which exclude cultural relevancy for Native students. This is why the Native teachers in this present study displayed ambivalence to the standards. This is evidenced by Zhashagi's words, "To think that we need to work our cultural fricking appropriateness around the g**damn standards is just ludicrous." The crux of culturally relevant pedagogy that teachers should keep at the forefront is a use of curricular materials and instruction that serves the concepts that students need to learn, rather than starting with the standards. Zhashagi offered a culturally relevant pedagogical decision he would make for his students, "I'm not gonna spend time trying to place a text based on standards. I'm gonna place it based on its usefulness for my students. And then I'm gonna see if it hits those standards."

Culturally Responsive Pedagogy.

Another critical framework used to guide the present study was Gay's (2002) culturally responsive pedagogy. While Native cultures share some similarities, they do not have homogeneous qualities. Gay stresses the importance for teachers in, "Developing a knowledge base about cultural diversity, including ethnic and cultural diversity content in the curriculum" (2002, p. 106). Non-Native teachers would better serve their Native students by more deeply realizing the heterogeneous, deep cultural qualities that comprise Native communities and from where students come. Without this understanding, teachers may remain "stuck" in perpetuating the making of assumptions about their students' cultures and needs. When this happens, the needs of Native students continue to be devalued over their White and non-Native peers in service of the standards. This is why culturally responsive pedagogy matters, especially when

thinking about the decolonization of classrooms that serve Native students. In a world of confluence between Native epistemologies and Western science, culturally responsive pedagogy prioritizes the needs of students before assessments. Gete-Anishinaabe spoke to the idea of responsiveness, “What about taking care of the *internal* needs first? Let's put some more emphasis on that. To me, that's at the heart of what an Anishinaabe Bimaadiziwin is.”

Decolonized classrooms grounded in culturally responsive practice prioritize a balance between students' needs (cultures and languages) and standards.

Tribal Critical Race Theory.

A discussion of the relationship among teachers' cultural knowledge, language brokerage, and ambivalence to science standards can be understood in light of Brayboy's (2005) tribal critical race theory (TribalCrit). Rooted in critical race theory, anthropology, and political and legal theory, TribalCrit reveals the “complicated relationship between American Indians and the United States federal government and begins to make sense of American Indians' liminality as both racial and legal/political groups and individuals” (Brayboy, 1995, p. 428). A consideration of three of the tenets of TribalCrit provides for a deeper understanding of the findings of this study.

Endemic Colonization.

In reflecting on Brayboy's TribalCrit (1995), his first tenet states, “Colonization is endemic to society” (p. 429). One of the ways the endemic effects of colonization are present in U.S. schools is that its state standards and NGSS make little to no mention of American Indian culture and language and Native science. TribalCrit also speaks to language loss, epistemological and ontological narratives and counter-stories, or decolonized stories, of Indigenous peoples (Brayboy, 2005). It is through the lens of TribalCrit that the findings of the present study can be

understood.

Native Gaze.

Although all the tenets of TribalCrit have informed my work, my findings turn me to specifically focus on the fifth tenet. Related to the intersection of Native and Eurocentric scientific epistemologies, the fifth tenet of TribalCrit posits that the notions of culture, knowledge, and power are understood in new ways when considered from a Native gaze (Brayboy, 2005). With this tenet, I am reminded of Gede-Anishinaabe's explanation of Anishinaabe Bimaadiziwin, the Anishinaabe way of life, wherein cultural knowledge encompasses a balance through which life should be lived—balance in nature, between humans and nature, between humans and other humans, and within self. I understand the power dynamic inherent in Anishinaabe Bimaadiziwin as a worthwhile counterstory to the Eurocentric notions of individualism, capitalistic power, and human value as tied to property ownership. This is important to my intent to contribute a paradigm to a field where White, non-Native and Native educators understand the confluence of Native epistemologies and Western science—because it opens a conversation about how one of the aspects of deep culture (Hammond, 2015) interplays with a dominant, Western narrative. Hegemonic dispositions of White and non-Native teachers can be identified, interrogated, and disrupted when teachers commit to taking an antiracist stance in their pedagogical considerations and instruction.

When space is not made for the Native gaze—when the work of educating Native students is not grounded in the Native experience—it is Native students who suffer the loss of the pedagogical considerations their White counterparts receive. Put another way, acting upon the Native gaze is a way for teachers, administrators, and policy makers to begin to understand how to create curricula that are culturally responsive to the needs of Native students.

Understanding the Native gaze, as described in the TribalCrit framework, aligns with the third finding of this study, illuminating why the teachers displayed ambivalence to the standards. I learned that the teachers examined the goose book through the perspective of their Native identities, which decentered the traditionally Western ideologies that comprise the science standards. The participants' understandings of science—incorporating their Native knowledge, cultures, and understanding of power—revealed a counterstory to the subculture of Western science. Their counterstory remembers a history of trauma and near-erasure, where children were forcibly pulled from their families and communities, and where Natives were wounded or murdered for displaying their own cultures and languages. Native counterstories also hinge on balance and respect for nature and highlight the interconnectedness of all elements of the natural world, including humans. The concept of TribalCrit's Native gaze reveals why the teachers in this study emphasized the natural world, and decentered the goose book, instead of focusing on the standards.

Assimilation of Native Peoples.

Also relevant to my examination of the confluence of Native epistemologies and Western science is the final component of TribalCrit considered in this study, the tenet that maintains assimilation of Native peoples into dominant society is the goal of U.S. governmental and educational policies toward these peoples (Brayboy, 2005). However, assimilation is problematic because it promotes culture and identity erasure for Native people. I recall how proud Zhiibaasige was to share that his paternal great-grandfather and great-great-grandfather not only survived Indian boarding schools, but they emerged with their Native language intact. His relatives had not fully assimilated into the expectations of Eurocentric monoculture and language. Zhiibaasige's family members provide a counterstory; their lived experiences display

active culture and language preservation amidst the forces of colonization.

When there are assimilationist views in schools, Native students continue to experience the harmful effects of a colonial, hegemonic education system that does not consider their needs as people, learners, and members of unique cultural groups. School, district, state, and federal policies that uphold assimilationist expectations of students, elevate and centralize the cultures of majority of students who are White and non-Native. Educational policies that do not take a clear counter-assimilationist approach are, in effect, still promoting the assimilation of Native students—a position that nullifies the Native story. The paradigm of the counterstory is important in disrupting an assimilationist educational system because a counterstory way of knowing values a confluence of voices.

The Confluence of Native Epistemologies and Western Science

The purpose of this study was to examine the confluence of Native science and Western science as this confluence plays out in science classrooms that serve Native students. I intentionally chose the word “confluence” to convey the relationship between Native and Western understandings of the natural world because this term reflects the phenomenon wherein two separate waterways meet and form a distinctly new waterway. What I noticed through this work, though, is that the confluence I imagined at the outset of the study was not really a confluence (yet). The relationship between Native science (and epistemologies) and Western science played out more like two separate and parallel rivers, with the Western “river” trying to intersect the Native “river,” but the Native “river” not necessarily showing interest in the intersection.

Does this mean that Native epistemologies and Western science will only ever just parallel one another? I propose that this does not have to be the case, and instead, the paradigm

can shift to disrupt this binary approach. I suggest that what lies at the confluence of Native epistemologies and Western science are opportunities—opportunities for listening, having discourse, and suspending homogenous, hegemonic allegiances to Western science in service of views of science that are responsive and sustaining of all who seek to understand.

A Reconceptualization of the Confluence of Native Epistemologies and Western Science

As displayed in Figure 2, these opportunities for listening and discourse occur within a reconceptualized zone of confluence that holds space for discourse among Native ways of knowing, Western science, and science standards. This zone is a place where all voices can disrupt the hegemonic practices and policies that do not serve Native students in culturally responsive ways. Figure 2 reveals a reconceptualized view of the confluence of Native epistemologies and Western science, wherein the concentric circle of language brokering remains nested in cultural knowledge to hold language and culture central. The change occurs in the representation of the Western influences on Native epistemologies. In the reconceptualization of the confluence, the influence of Western science and the science standards are imagined as exerting less imposition on Native cultural and linguistic epistemologies; therefore, significantly reducing the Western impact that provoked the persistent ambivalence illustrated in the relationship of the findings in Figure 1. As such, Western science and the science standards are represented in Figure 2 as less influential, with smaller arrows.

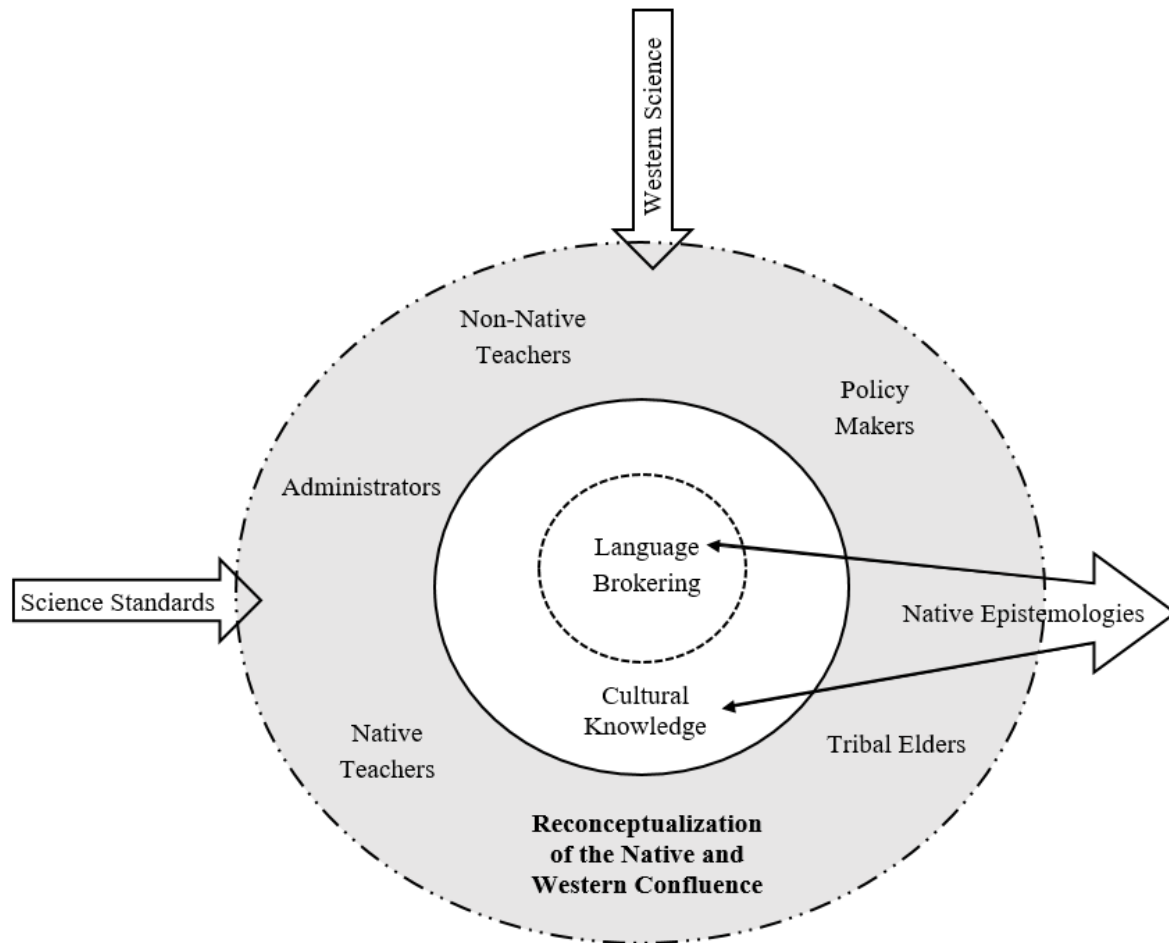
When I originally conceptualized the scope, and potential findings, of this study, I imagined that the participants would speak about the ways they wove Native science with Western science in their classrooms. Instead, what I found is that the participants revealed their ambivalence to Western science and science standards and indicated an understanding of science (the natural world) that should not be simplified to “just” Native science. To reduce the

epistemologies of the participants to “just” Native science could give the impression of perpetuating a binary view of science as either Western science or not really “science” at all. I learned from the participants that their cultural and linguistic knowledge—comprising Native epistemologies—served as the bedrock of their understanding the natural world. This is why I reconceptualized the natural world arrow as displayed in Figure 1 to represent Native epistemologies in Figure 2. Referring to Native ways of knowing about the natural world as simply Native science did not feel reverent and accurate enough of a way to identify the deeply rooted Native epistemologies at work in Native interactions with the natural world.

To realize the reconceptualization of the confluence of Native epistemologies and Western science together, Figure 2 is brought to fruition by the addition of important voices—Native teachers, tribal elders, non-Native teachers, administrators, and policy makers. These groups of people must work in a dynamic balance to meet the cultural and linguistic needs of Native students. Figure 2 illuminates Native and non-Native (Western) educators extending themselves into the reconceptualization zone where they can listen and re-envision science education for Native students—a confluence of Native and Western ways of understanding.

Figure 2

Reconceptualization of the Confluence of Native Epistemologies and Western Science



Who Gets to Own Science?

In reflecting on the reconceptualization of the confluence of Native epistemologies and Western science as described in the model above, it is important to ask, “Who owns science?” (Medin & Bang, 2014, p. 8). As my findings evidence, science should not be understood as only a monocultural endeavor. In fact, there is a “common presumption that science is intrinsically acultural and value-free” (Medin & Bang, 2014, p. 9). It is the case that Whiteness, the dominant representation in Western science, assumes aculturality. Science, as the participants have expressed, is not acultural. Rather, a person’s understanding of science and science education is

reflective of their values, beliefs, social class, genders, and cultures (Medin & Bang, 2014).

Science is not solely Western, nor is science necessarily subjective. Science does not need to be owned by the monolith of Whiteness and Western frameworks.

First Science.

As I reflect on the findings of this study, I am reminded of how Auntie B spoke about her understanding of two distinct “sciences,” Western science and traditional indigenous sciences, as well as her own view of science. The view of science that Auntie B spoke of centered on the observation and telling of stories that are related to patterns. What if this is what science truly is—a narrative that the natural world weaves, and that we, as humans, are both spectators of the story as well as characters in it? I propose my conceptualization of a culturally responsive theory—a theory that suggests no one “owns” science, and that how the natural world can be understood is not through a Western gaze, but through what I imagine as a *First science* stance. A *First science* understanding of the natural world does not involve Western ideals or its cognitive interference but, instead, relies on phenomenological observations of the chronicles masterfully told by the natural world itself. My use of the word *first* in reference to a *First science* scientific way of knowing is out of respect for its relationship to Native—sometimes referred to as First Nations, First People, and First Americans—ways of knowing about the natural world. The word *first* connotes prior to colonization. With less of an allegiance to Western notions of science and the natural world, and a more culturally inclusive approach to science, it is necessary to bring a *First science* lens into science classrooms that serve Native students.

Decolonizing Western Science Instruction

In a critical reflection about how Western ideals of science and science standards are

monoculturally Eurocentric in nature, and that these ideals do not meet the needs of American Indian students and non-Native students, it is paramount that non-Native and Native educators alike commit to acts of decolonizing Western science instruction in their classrooms. This decolonizing work can begin broadly, as Finding 1 revealed, with an increased awareness and respect for intercultural similarities and differences among students. As teachers open themselves up to interrogating their own cultural positionalities, they will be more equipped to respond to the cultural and linguistic needs of their students. When teachers understand their own identities and the knowledge they bring to the classroom, coupled with a deeper knowledge of their students' cultures, languages, and values, teachers can begin to broker science content for their students. Teachers who are willing to serve as intermediaries between the learning standards and their students' cultural values and needs are doing the work required of culturally responsive teaching. Culturally relevant pedagogy (Ladson-Billings, 1995), culturally responsive pedagogy (Gay, 2002), and TribalCrit (Brayboy, 1995) are three theories that can disrupt the colonized educational frame placed on Native students. Western science instruction can be decolonized by considering the power of counterstories. This approach to instruction reminds me of Geta-Anishinaabe's story of growth with the elder who showed him how he believes growth should happen—"it happened when it needed to happen." Decolonizing instruction can be realized when countercultural methods are consciously used to support the growth of students.

Study Implications

Returning to the reconceptualization of Native epistemologies and Western science, displayed in Figure 1, this model can be employed when thinking about how teachers approach the teaching of science to their Native students. The consideration of the virtues innate to Native cultural knowledge and language brokering reveals how the science standards can be taught in

order to centralize Native students' needs. The implications of utilizing this model are transformative in nature, offering a framework through which decolonized pedagogical approaches can be viewed.

I envision an interwoven relationship of Native teachers, non-Native teachers, administrators, policy makers, tribal elders extending their hearts and ears into the reconceptualization zone, depicted in Figure 2—willing to listen to the epistemological contributions Natives can have in a decolonized education system. As the findings of this study reconceptualize the confluence of Native epistemologies and Western science, there are implications for teachers, educational systems, and standards/policy decision makers.

Implications for Teachers

As the voices and experiences of the participants of this study are honored, there are implications for teachers that emerged. Building the Native teacher workforce should always be a priority (Kaden et al., 2016). As there continues to be a mostly White, female teacher demographic, however, it is essential that teacher education institutions develop culturally responsive, equity-oriented preparation programs grounded in dialogic action, Native people's perspectives, and stories that counter the White monoglossic lens. We can honor, value, and teach White teachers and Native teachers, alike. This can be manifested in action steps like the ones shared by Gete-Anishinaabe and Auntie B when they spoke about teacher collaboration across subjects. Native and non-Native teachers can collaborate by sharing ideas across disciplines and languages when planning lessons in ways that respond to and sustain the cultural and linguistic experiences of their students, whether or not they are Native.

We must support teachers in asking themselves questions like, When are we asking students what they need? As teachers prepare for their science instruction, what cultural values

and epistemologies do students bring to the classroom? I am reminded of Auntie B who works to help her students manage stress, especially in navigating the COVID-19 pandemic. She uses “traditional teachings and the traditional knowledge as a way to heal—healing through language.” When teachers center their students, you can hear it in their voices. You can *feel* the way teachers use what they know about themselves, their students’ cultures, and “good teaching” (Ladson-Billings, 1995) when they center their students in their instruction.

Implications for Educational Systems

The findings of this present study—the teachers’ use of their cultural knowledge, serving as language brokers, and their ambivalence toward the standards—has implications for educational systems. Specifically, districts can partner with Native teachers, linguists, elders, and community members to devise culturally responsive development or centers of practice, depending on the size of the district. This collaboration between the district and Native people utilizes the reconceptualized zone of the confluence of Native epistemologies and Western science, depicted in Figure 2, to share and listen to cultural and linguistic knowledge in ways that serve Native students. The work of culturally responsive pedagogy for Native students should not rely only on the scrutiny and effort of the teachers. Administrators must dedicate themselves to this work by reaching into the zone of reconceptualization to extend their willingness to listen and work alongside Native voices.

Implications for Standards and Policy Makers

As I think about how policy makers at the national, state, and district levels can support culturally responsive pedagogies for Native students, thought needs to be given to *how* (“saying” we are doing it, but not actually listening to all voices) and *when* (at which point during the planning process) we are welcoming teachers’ voices in the development and review of

academic policies and learning standards. Or, are teachers only the receivers of policy or standards-based decisions that have already been made *for* teachers, *without* teachers? Without teachers' input, cultural knowledge is not being welcomed and embedded in the listening and discourse needed for instructional work. Policies and academic standards will persist within U.S. educational systems, prompting my critical question of how to ensure that all students—yes, even, and especially, the 1% of students who identify as American Indian—rights to a quality education are being designed and implemented.

Those in positions of power of setting the learning standards for large communities of people need to look at who is represented among them, and who is not represented, especially in how this representation aligns with the cultures of the students they serve. The voices and experiences of students must be represented at the level of policy and standard-making, or it is likely that Native teachers will continue to display indifference, and resistance, toward Eurocentrically hegemonic standards that do not align with their values. It is encouraging that, at the level of the states, ESSA (2015) allows for tribal representation in education. In reality, ESSA “shifts considerable oversight and decision-making authority to state legislators whose support is yet undetermined” (Mackey, 2017, p. 783). As such, the voices of tribal leaders and Native teachers are required for “meaningful implementation” of collaboration and decision-making (NICA, 2021) that provides culturally responsive learning experiences for Native students.

Final Thoughts

In the process of examining the cultural content of an American Indian text alongside traditional U.S. public education science standards, the participants in this study revealed the ways in which their Native identities and convictions shaped their instructional approaches. The

Native language and immersion teachers in this study are doing the work outlined in culturally-based pedagogies, but not necessarily because they have heard of these pedagogical tenets, or because anyone told them to teach this way. These teachers engage in culturally-based work because they live and breathe in dynamic connection with their cultures, languages, and students. The layers of humanity, spirituality, and pedagogical craft that were expressed by the participants in this study had a palpability to them—almost as if they moved and operated out of a primal necessity, and a dedication to cultural continuity and sovereignty.

Native teachers cannot be the only teachers who are doing this work. Non-native teachers of Native students have just as much responsibility to create classroom experiences that respond to and sustain Native epistemologies. What this study contributes to culturally responsive pedagogy for American Indian students is that culturally responsive pedagogy and practices should not lie only on the shoulders of Native teachers or peoples. Non-native policy makers, administrators, and teachers must realize that equitable science instruction is not a burden to be handed off to Native teachers. All teachers, especially those who are non-Native, need to be willing to critically care about the essence of Native indifference, and start actively listening to the stories of Native experiences—“the other side of the story” (Pewewardy, 1998, p. 72). This is where, guided by the timing of the Creator, confluence is possible.

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Appendix A:

IRB Approval Letter



Department of University Safety & Assurances

Melody Harries
IRB Administrator
Institutional Review Board
Engelmann 270
P. O. Box 413
Milwaukee, WI 53201-0413
414-662-3544

New Study - Notice of IRB Exempt Status

Date: February 15, 2021

uwm.edu/irb
harries@uwm.edu

To: Tracy Posnanski
Dept: Teaching and Learning

CC: Molly Wolk, Leanne Evans

IRB #: 21.186

Title: American Indian Culture and Secondary Science Curricula: Examining the Confluence of Native Epistemologies and U.S. Public Education Science Standards

After review of your research protocol by the University of Wisconsin – Milwaukee Institutional Review Board, your protocol has been granted Exempt Status under **Category 1 & 2** as governed by 45 CFR 46.104(d).

This protocol has been approved as exempt for three years and IRB approval will expire on **February 14, 2024**. Before the expiration date, you will receive an email explaining how to either keep the study open or close it. If the study is completed before the expiration date, you may notify the IRB by sending an email to irbinfo@uwm.edu with the study number and the status.

Any proposed changes to the protocol must be reviewed by the IRB before implementation, unless the change is specifically necessary to eliminate apparent immediate hazards to the subjects. You are responsible for adhering to the policies and guidelines set forth by the UWM IRB, maintaining proper documentation of study records and promptly reporting to the IRB any adverse events which require reporting. You are also responsible for ensuring that all study staff receive appropriate training in the ethical guidelines of conducting human subjects research.

You must also adhere to UWM and UW System Policies, and any applicable state and federal laws governing activities which are independent of IRB review/approval (e.g., [FERPA](#), [Radiation Safety](#), [UWM Data Security](#), [UW System policy on Prizes, Awards and Gifts](#), state gambling laws, etc.). When conducting research at institutions outside of UWM, be sure to obtain permission and/or approval as required by their policies.

Contact the IRB office if you have any further questions. Thank you for your cooperation, and best wishes for a successful project.

Respectfully,

A handwritten signature in cursive script that reads "Melody Harries".

Melody Harries
IRB Administrator

Appendix B:
Recruitment Letter

Dear [Study Recruit],

My name is Molly Wolk and I am a doctoral candidate in the Urban Education Department at the University of Wisconsin - Milwaukee. I am writing to invite you to participate in my research study about culturally responsive pedagogy for American Indian students. You are eligible to contribute to this study because you have taught [Algonquian language(s) and/or science] to students who identify as citizens or descendants of Algonquian nations, and have done so for at least one school year. I obtained your contact information from [source].

If you decide to participate in this study, you will be invited to engage in the following: 1) complete a brief initial interview, 2) read a short Algonquian text (provided in Naskapi, Ojibwe, and English), 3) perform an analysis of the story, 4) complete a follow-up interview, and 5) take part in a member checking exercise. I would like to audio record both the initial and follow-up interviews. I will use this interview data, a document analysis, and our member checking discussion in order to establish the findings of this study.

Remember that your participation in this study is completely voluntary. If you would like to participate, or have any questions about the study, please email me at mawolk@uwm.edu by [date]. Thank you very much.

Respectfully,

Molly Wolk
University of Wisconsin - Milwaukee

Appendix C:
Informed Consent and Scheduling Email

Dear [Study Participant],

Thank you for agreeing to participate in my research study. The next steps in your dedication to this work are to review 1) the consent form and 2) schedule our first meeting time.

Please review each of the tasks below and their estimated time commitments. **Then, please reply to this email indicating when you are available for the initial interview during the week of January 18-24.** During this interview, we will schedule the rest of our meeting dates.

Weeks	Activity	Where	How long	Up next...
Week 1 January 18-24	Initial interview with me	Microsoft Teams	30-45 minutes	Look for an email from me containing a reading guide, the goose book, and text-to-standards analysis tool.
Week 2 January 25-31	1.) Read goose book 2.) Complete text-to-standards analysis	At home	60 minutes	Submit your text-to-standards analysis to me via email by the end of the week
Week 3 February 1-7	Follow-up interview with me	Microsoft Teams	60 minutes	Look for email from me containing 1.) your deidentified interview transcripts, and 2.) instructions on how to perform member checking
Week 4 February 8-14	Member checking on own	At home	Up to 60 minutes	Email me if you would like to set up a virtual meeting to discuss any

				inconsistencies in your transcripts.
	Member checking discussion with me	Microsoft Teams	Up to 60 minutes	

You will receive individual Microsoft Outlook calendar invitations from me confirming each of the meeting times and due dates you select. Thank you so much for your participation in this study.

Regards,

Molly Wolk

Appendix D:

Initial Interview Protocol

Basic Information

The researcher will note the time, date, and location of the interview as well as the name of the participant. All identifiers will be de-identified prior to inclusion in the study. The interview will be given a name and its start time, end times, and duration will also be recorded.

Introduction

The researcher will share an introduction with each participant as follows. “Thank you for agreeing to participate in this study. My name is Molly Wolk and I am a dissertator in the Urban Education Doctoral Program at the University of Wisconsin - Milwaukee. The purpose of this study is to explore the confluence of an American Indian cultural text alongside traditional U.S. education science standards. This study will examine the ways in which this Native text is culturally responsive to the needs of American Indian students.

The general structure of this initial interview will consist of 1.) a series of six questions to get to know you, 2.) closing remarks, and 3.) questions you have for me. Do you have any questions before we begin the interview?” The researcher will address the interviewee’s question(s). Lastly, the interviewer will ask the participant for verbal permission, which is in addition to the consent already obtained prior to the interview, to audio record the interview.

Opening Question

With participant consent, the researcher will press record on the audio recorder. At the beginning of each recording, the researcher will ask the participant to state their pseudonym so that the transcriber can distinguish between voices without knowing identities. The research will then ask the interviewee the following ice-breaker question: “What is the last natural body of

water you swam in?” The interviewer may offer her own response if the participant asks for one.

Participant Questions

1. Please share with me a little bit about your background.
2. What has been your role in the education of students who identify as citizens or descendants of Algonquian nations?
3. Please tell me about your experiences with using American Indian or Algonquian culture and language with your students.
4. What is your understanding of:
 - a. Science?
 - b. [Name of state] science standards?
 - c. Next Generation Science Standards?
5. Why does participating in this study interest you?
6. Is there anything else you would like to add?

Closing Instructions

The researcher will then ask the interviewee if they are willing to be contacted for any follow-up questions if clarification is needed. At this point, the researcher will remind the participant of the next steps in the research process which are to engage with the provided Algonquian text and record their thoughts regarding text-to-standards alignment. Please see Appendix E for this document. The participants will then be asked if they have any final questions before the researcher reminds them of the confidential nature of their responses. The researcher will then thank the interviewee for their time.

Appendix E: Reading Guide

Dear [Study Participant],

The next step in your commitment to this research study is to engage with an Algonquian goose book, ᑎᑭᑭᑦ ᐱᑭᑭᑦ ᐸᑦᑕᐱᑦᑭᑦ ᑭᑦ ᑭᑦᑭᑦ / *I'll Take You Goose Hunting Next Spring* (Naskapi) or *Niwiinoojinikawemin Waa-Ziigwang / We Will Go Goose Hunting Next Spring* (Ojibwe), by Bill Jancewicz.

It is expected that you will spend about 15 minutes reading and reflecting on the illustrations in this goose book. Immediately thereafter, you will spend about 60 minutes reviewing relevant science standards that the researcher has identified as connecting to elements of the story. You will record your observations and analyses pertaining to connections between the story and the science standards on a document attached to this message. Please scan or attach and email your responses back to me by [provide date].

You are encouraged to ask any questions you might have before you begin. Please contact me at mawolk@uwm.edu and I will promptly return your email.

Regards,

Molly Wolk

Appendix F:

Algonquian Text-to-Science Standards Analysis

Algonquian Text-to-Science Standards Analysis Formatted for Typed Responses

1. Engage with the short story

Please spend about 10 minutes reading the text and viewing the illustrations in the provided short story. The story was originally presented in Naskapi, ᑎᑭᑭᑦ ᑭᑦᑭᑦᑭᑦᑭᑦ ᑭᑦᑭᑦᑭᑦ / *I'll Take You Goose Hunting Next Spring*, and has also been provided in Ojibwe, Niwii-noojinikawemin Waa-Ziigwang / *We Will Go Goose Hunting Next Spring*, respectively.

2. Perform text-to-standards analysis

After engaging with the story, please spend about 60-90 minutes capturing your experience with the text as you think it relates to a) the Next Generation Science Standards (NGSS) Disciplinary Core Ideas (DCIs) and Science & Engineering Practices and b) your state's science content standards and science & engineering practices for your students. Please consider only the grade band(s) at which you teach.

All participants, please use the following NGSS hyperlinks:

- Disciplinary core ideas (DCIs): [DCI Arrangements of the NGSS](#)
- Science & Engineering Practices: [Science & Engineering Practices in the NGSS](#)

Wisconsin participants, please use the following hyperlink:

- Science & Engineering Practices (p. 27-49) and DCIs (p. 50-101): [Wisconsin Standards for Science](#)

Minnesota participants, please use the following hyperlink:

- Dimension 1 (Science & Engineering Practices) and Dimension 3 (DCIs): [Minnesota K-12 Academic Standards in Science](#)

Michigan participants, please use the following hyperlink:

- Grade performance expectations (include DCIs) and grade performance expectations that “integrate traditional science content with engineering”: [Michigan K-12 Standards Science](#)

On the following pages:

1. Under column 1, list content from the short story that you think connects to the NGSS and/or your state's standards.
2. Under column 2, make note of any connections you see between the story and the NGSS.
3. Then, under column 4, expand on any connections that come to mind between the story, the NGSS standards, and the American Indian students you teach.
4. Under column 3, make note of any connections you see between the story and your state's standards.
5. Lastly, under column 4, expand on any connections that come to mind between the story, your state's standards, and the American Indian students you teach.

3. Submit your analysis

Save and email your completed document back to me at mawolk@uwm.edu by March 7, 2021.

Column 1	Column 2	Column 3	Column 4
Goose story content	List aligning NGSS Science & Engineering Practices and DCIs	List your states aligning Science & Engineering Practices and DCIs	List connections to your American Indian students

Appendix G:

Follow-up Interview Protocol

Basic Information

The researcher will note the time, date, and location of the interview as well as the name of the participant. All identifiers will be de-identified prior to inclusion in the study. The interview will be given a name and its start time, end times, and duration will also be recorded.

Introduction

The researcher will share an introduction with each participant as follows. “Thank you for agreeing to participate in this follow-up interview. As you know, my name is Molly Wolk and I am a dissertator in the Urban Education Doctoral Program at the University of Wisconsin - Milwaukee. As a reminder, the purpose of this study is to explore the confluence of an American Indian cultural text alongside traditional U.S. education science standards. This study will examine the ways in which this Native text is culturally responsive to the needs of American Indian students.

The general structure of this follow-up interview will consist of 1.) an opening question, 2.) seven questions related to the goose book you have already read and, lastly, 3.) closing remarks. Do you have any questions before we begin the interview?” The researcher will address the interviewee’s question(s). Lastly, the interviewer will ask the participant for verbal permission, which is in addition to the consent already obtained prior to the interview, to audio record the interview.

Opening Question

With participant consent, the researcher will press record on the audio recorder. At the beginning of each recording, the researcher will ask the participant to state their pseudonym so

that the transcriber can distinguish between voices without knowing identities. The researcher will then ask the interviewee the following ice-breaker question: “What is your favorite family tradition, past or present?” The interviewer may offer her own response if the participant asks for one.

Content Questions

1. For science teachers: How does this story impact the way you think about teaching these science concepts and standards?
2. For Algonquian language(s) teachers: When you consider this story and the aligned science standards, how does this impact how you might use this text with your students?
3. For all interviewees:
 - a. How might you use this story with your students?
 - b. How might this story be useful with your students?
 - c. Why might this story be useful with your students?
 - d. What content would you teach students when you use this story?
 - e. What learning outcomes/objectives would you have in mind when using this story with your students?
 - f. Is there anything else you would like to add?

Closing Instructions

The researcher will ask the interviewee if they are willing to be contacted for any follow-up questions if clarification is needed. The participants will be asked if they have any final questions before the researcher reminds them of the confidential nature of their responses. The researcher will then explain that she will provide the participants with the findings of the study in the form of her dissertation abstract. The full dissertation will be made available upon request.

The researcher will then thank the interviewee for their time.

Appendix H:

Member Checking Protocol

Participants will be offered the opportunity to perform a member check of their initial interview and follow-up interview transcripts. This will occur after both of these interviews have been transcribed by a third party. Within the recruitment letter, potential participants will be informed of the option to member-check to verify the accuracy of the views, feelings, and experiences they shared during the initial and follow-up interviews. The member checking materials, including their own transcripts and instructions, will be emailed to each participant in separate, unique emails. The member checking email will include the following questions to guide the participants during their review:

1. Do the transcripts accurately reflect your views, feelings, and experiences?
2. If you do not feel your views, feelings and experiences are accurately reflected, please explain what you feel should be changed, added, or removed to better reflect your truth.
3. Is there any missing or partial information that should be addressed before concluding the study?

If the participant does not request to complete the member checking conversation with the researcher, they will be asked to respond with any concerns or amendments within seven days of receipt. No response from a participant will be considered permission to proceed with the analysis with unaltered data. If a participant responds with a concern, the researcher will make any necessary amendments to the transcript(s). The new data will become part of the analysis and reflexivity process and will be accordingly noted. If a participant affirms that their views, feelings, and experiences are accurately portrayed in the transcripts, the researcher will send confirmation of receipt and a thank you email. The researcher will then upload the revised files

to her password-protected computer. This member checking protocol has been adapted from Turner (2020).

Appendix I:
List of Inductive Codes

Analysis of Science Content in Goose Book

Anishinaabe Bimaadiziwin

Anti-Standard Stance

Authenticity: Conviction to

Authenticity: Language

Authenticity: Attention to

Challenges: Translation

Claiming Culture

Connecting Instruction to (Science) Standards as Second Thought

Considering Culture

Contention between Standards and Culture

Context Clues in (Language) Instruction

Cultural Application (Outside Classroom)

Cultural Disconnect or Comparison

Cultural Knowledge

Cultural Misconceptions

Culturally-centered C & I Matters

Culture First, Standards Second (Afterthought)

Culture Preservation: Active

Culture Preservation: Challenges

Culture-School Boundary

Curriculum Aligned with Culture/Language

Developmentally (Age) Appropriate Instruction

Disconnect between Languages

Goose Book Science Content Analysis

Implementing (Science or Language) Standards

Indifference to (Science) Standards

Integration of Language, Culture, and Science

Integration of Science and Native Values: Teacher Collaboration

Language Etymology Considerations

Language Pedagogical Considerations

Language Preservation: Active

Language Preservation: Challenges

Linguistic Considerations

Native Identity: Claiming it

Native Identity: Conviction to

Native Identity: Teachers' Efforts Toward

Natural World = Science

Natural World as a Being

Participant Narrative

Pedagogy-Shifting from Western Conventional Approaches

Researcher as Participant

Science is Finding Meaning

Science is Western

Science/Nature as Anishinaabe Bimaadiziwin and Balance

Science: Bridging Native and Western Understandings

Science: Understanding of

Science: WMS as Co-opting Native Understandings

Staff Uncertainty

Standard Alignment Considerations

Standard or Content-Student Disconnect

Tentative Approach to Science

Urgency for Language Preservation

Western-Native Worldview: Bridging

Western-Native Worldview: Decolonize Education

Western-Native Worldview: Disconnect

APPENDIX J:

Tobacco Ties



Molly A. Wolk

EDUCATION

- Ph.D.** University of Wisconsin – Milwaukee, Milwaukee, WI, August 2021
Concentrations: Urban Education, Curriculum & Instruction, Science Education
Dissertation: *American Indian Culture and Secondary Science Curricula:
Examining the Confluence of Native Epistemologies and U.S. Public
Education Science Standards*
Committee: Leanne M. Evans, Ph.D. (co-chair), Dr. Tracy Posnanski, Ph.D.
(co-chair), Margaret A. Noodin, Ph.D., and Dr. Aaron Schutz, Ph.D.
- M.S.** University of Wisconsin – Milwaukee, Milwaukee, WI, May 2012
Concentrations: Curriculum & Instruction, Science Education
Master's Paper: *The Biases of Predominantly Creationist High School Biology
Students Regarding the Nature of Science, Evolution, and Natural
Selection*
Advisor: Craig A. Berg, Ph.D.
- B.A.** St. Norbert College, De Pere, WI, May 2007
Major: Religious Studies, Minor: Biology
Semester Abroad: John Cabot University, Rome, Italy, Fall 2006

RESEARCH EXPERIENCE

- 2017-2021 **Graduate Research Assistant and Culturally Responsive Practices
Facilitator**, Asset-based Cultural Competency Ensuring
Student Success (ACCESS), United States Department of Education SEED Grant,
University of Wisconsin – Milwaukee, Milwaukee, WI.

FACULTY APPOINTMENTS

- 2021-Present **Visiting Assistant Professor**, College of Education, IDoTeach Department,
Boise State University, Boise, ID.
- 2016-2017 **Instructor/IDoTeach Master Teacher**, Education Department, College of
Western Idaho, Nampa, ID.
- 2014-2017 **Adjunct Faculty**, STEM Department, College of Western Idaho, Nampa, ID.
- 2013-2014 **Dual Enrollment Teacher**, Dual/Concurrent Enroll Program, College of Western
Idaho, Nampa, ID.
- 2010-2014 **Secondary Biological Science Teacher**, Science Department, Compass Public
Charter School, Meridian, ID.

TEACHING LICENSURE

- 2020-Present **Lifetime License**, License No. 1590038173, 1605-Biology (EA-A) and 1606-Life and Environmental Science (EA-A), Wisconsin Department of Public Instruction, Madison, WI.
- 2020-2025 **Standard Secondary Biological Science 6/12**, License No. 7421, Idaho State Department of Education, Boise, ID.
- 2015-2020 **Professional Educator**, T001 - Teacher, License No. 1001170621, 1605-Biology (EA-A) and 1606-Life and Environmental Science (EA-A), Wisconsin Department of Public Instruction, Madison, WI.
- 2015-2020 **Standard Secondary Biological Science 6/12**, License No. 7421, Idaho State Department of Education, Boise, ID.
- 2010-2015 **Initial Educator**, T001 - Teacher, Entity No. 728038, Biology/Life Science (605) and Life and Environmental Science (606), Wisconsin Department of Public Instruction, Madison, WI.
- 2010-2015 **Standard Secondary Biological Science 6/12**, Idaho State Department of Education, Boise, ID.

PROFESSIONAL TEACHING EXPERIENCE

- 2022- ED CIFS 333 Elementary Science Curriculum & Instruction, College of Education, Boise State University, Boise, ID.
- 2022- STEM-ED 101 Step 1: Inquiry Approaches to Teaching. IDoTeach Department, Boise State University, Boise, ID.
- 2022- STEM-ED 310 Classroom Interactions, College of Education, IDoTeach Department, Boise State University, Boise, ID.
- 2021-Present ED CIFS 333 Elementary Science Curriculum & Instruction, College of Education, Boise State University, Boise, ID.
- 2021-Present STEM-ED 310 Classroom Interactions, College of Education, IDoTeach Department, Boise State University, Boise, ID.
- 2015 ALLH 101 Medical Terminology, Exercise and Health Sciences Department, College of Western Idaho, Nampa, ID.
- 2015-2017 EDUC 101 Step 1: Inquiry Approaches to Teaching, Education Department, IDoTeach Department, College of Western Idaho, Nampa, ID.

2015-2017	EDUC 102 Step 2: Inquiry-Based Lesson Design, Education Department, IDoTeach Department, College of Western Idaho, Nampa, ID.
2015-2017	BIOL 100 Concepts of Biology, Life Sciences Department, College of Western Idaho, Nampa, ID.
2015	BIOL 120L Environmental Science Lab, Life Sciences Department, College of Western Idaho, Nampa, ID.
2014-2015	BIOL 210 Science Literature & Environment, Life Sciences Department, College of Western Idaho, Nampa, ID.
2014-2016	BIOL 100L Concepts of Biology Lab, Life Sciences Department, College of Western Idaho, Nampa, ID.
2014-2015	BIOL 227L Human Anatomy & Physiology 1 Lab, Life Sciences Department, College of Western Idaho, Nampa, ID.
2014-2015	BIOL 228L Human Anatomy & Physiology 2 Lab, Life Sciences Department, College of Western Idaho, Nampa, ID.
2013-2014	Advanced Biology/Dual Credit BIOL 201, Science Department, Compass Public Charter School, Meridian, ID.
2012-2013	Advanced Placement [®] Biology, Science Department, Compass Public Charter School, Meridian, ID.
2010-2014	Honors Anatomy & Physiology, Science Department, Compass Public Charter School, Meridian, ID.
2010-2014	Honors Biology/Dual Credit BIOL100, Science Department, Compass Public Charter School, Meridian, ID.
2010-2014	Life Science, Science Department, Compass Public Charter School, Meridian, ID.
2010-2012	Environmental Science I and II, Science Department, Compass Public Charter School, Meridian, ID.
2010-2011	Health, Science Department, Compass Public Charter School, Meridian, ID.

ACADEMIC PRESENTATIONS

National and International Conferences

- 2021 Pasternak, D. L., **Wolk, M. A.**, Harris, S., Lewis, C., Wu, X. & Evans, L. M. (2021, April 9-12). *Building Empowerment: Teacher Engagement in Culturally Responsive Practice Centers*. [Paper presentation]. Virtual American Educational Research Association (AERA) Annual Meeting. Washington, DC, United States.
- 2020 Pasternak, D. L., **Wolk, M. A.**, Harris, S., Lewis, C., Wu, X. & Evans, L. M. (2020, October 13-14). *Partnering for Equity and Justice: Building Culturally Responsive Practice Centers*. [Paper presentation]. Teacher Education Council of State Colleges and Universities (TECSCU) Annual Fall Meeting. LaCrosse, WI, United States.
- 2020 Pasternak, D. L., **Wolk, M. A.**, Harris, S., Lewis, C. & Wu, X. (2020, September 30-October 2). *Culturally Responsive Practice Centers: Engaging the (Dis)comfort of Engagement in CRP*. [Paper presentation]. Center for Culturally Responsive Evaluation and Assessment (CREA) Conference. Champaign, IL United States. (Accepted)
- 2020 Pasternak, D. L., **Wolk, M. A.**, Harris, S., Lewis, C., Wu, X. & Evans, L. M. *The Language of Culturally-Based Pedagogy in Teacher Education Research*. [Paper presentation]. International Congress of Qualitative Inquiry (ICQI) Urbana, IL, United States. (Accepted for presentation but conference cancelled due to COVID-19 pandemic).
- 2019 Pasternak, D. L., **Wolk, M. A.**, Smith, N., Chenault, L., Saunders, K., Evans, L., Hussa, J., Malloy, A., Roberts, N. (2019, November 21-24). *ACCESSing Culturally Responsive Practice through Onsite National Writing Project Institutes*. [Conference session]. National Council of Teachers of English (NCTE) Conference on English Leadership – Creating Opportunities: Leadership to Ignite Movements and Momentum. Baltimore, MD, United States.
- 2019 Evans, L. M., **Wolk, M. A.**, Allen, K., Harris, S. D., Malloy, A. (2019, November 11-12). *A.C.C.E.S.S.ing student success: Supporting culturally responsive pedagogy across professional development practice centers*. [Conference session]. Critical Questions in Education (CQIE) Symposium. Chicago, IL, United States.
- 2019 **Wolk, M. A.** (2019, October 24-26). *Culturally Relevant Pedagogy in the Indigenous Secondary Science Classroom: Enhancing Learning by Getting to Know Your Students Better*. [Conference session]. National Science Teaching Association (NSTA) Salt Lake City Area Conference. Salt Lake City, UT, United States.

- 2019 Pasternak, D. L., **Wolk, M. A.**, Hussa, J. A., Malloy, A., Roberts, N. D. (2019, July 23-25). *ACCESSING Culturally Responsive Practice through Professional Development Schools Focused on the Teaching of Writing*. [Conference session]. Modern Language Association's (MLA) 2019 International Symposium partnering with Faculdade de Ciências Humanas Universidade Católica Portuguesa. Lisboa, Português.
- 2018 Pasternak, D. L., Wu, X., Evans, L. M., Schramm, A., Allen, K. R., Turner, C. R. & **Wolk, M. A.** (2018, November 15-18). *A.01. A.C.C.E.S.S.ing Student Success: Supporting Culturally Relevant Pedagogy across Professional Development Practice Centers*. [Conference session]. National Council of Teachers of English (NCTE) Annual Convention. Houston, TX, United States.
- 2018 Evans, L. M., **Wolk, M. A.**, Allen, K. & Turner, C. R. (2018, October 5-7). *A Critical Examination of Terminology Used to Identify and Represent Culturally and Linguistically Responsive Research and Practice*. [Conference session]. First International Conference on Literacy, Culture, and Language Education (ICLCLE). Bloomington, IN, United States.

Local and Regional Conferences

- 2020 Noodin, M. A. & **Wolk, M. A.** (2020, April 16-18). *Indigenous pedagogy in the sciences classroom: Achieving high standards without sacrificing cultural relevancy*. [Conference session]. 2020 WIEA Conference "Indigenous STEAM: Science, Technology, Engineering, Art & Math." Wisconsin Indian Education Association. Milwaukee, WI, United States. (Accepted for presentation but conference cancelled due to COVID 19 pandemic).
- 2019 **Wolk, M. A.** (2019, March 7-9). *Culturally relevant pedagogy (CRP) in the Indigenous secondary science classroom*. [Conference session]. Wisconsin Society of Science Teachers (WSST) Annual Conference. Madison, WI, United States.
- 2019 **Wolk, M. A.** (2019, February 23). *Culturally relevant pedagogy: Enhancing learning by getting to know your students better*. [Conference session]. University of Wisconsin – Milwaukee Writing Project Conference on the Teaching of Writing. Milwaukee, WI, United States.
- 2017 Billing, C., Straub, S., & **Wolk, M. A.** (Spring). *20 Ways to connect with students and parents*. [Conference session]. Federal Programs Conference: Imagine the Possibilities. Idaho State Department of Education, Boise, ID, United States.
- 2016 **Wolk, M. A.** (2016, October 6-7). *Using "why" to get at "wow" and "what."* [Conference session]. Idaho Super Conference: Learning Across All Dimensions, Timberline High School, Boise, ID, United States.

- 2016 **Billing, C. & Wolk, M. A.** (Spring). *When D.C. knocks on your door: Effects of the U.S. Department's HEA Title II Report Cards on teacher preparation programs at community colleges*. [Conference session]. Mountain Plains Adult Education Association (MPAEA) and Idaho Lifelong Learning Association (ILLA) Conference, Riverside Hotel, Boise, ID, United States.
- 2013 **Wolk, M. A.** (Fall). *Savory science: Biology on a (grocery) budget*. [Conference session]. Idaho Science Teachers Association, Idaho Council of Teachers of Mathematics, and Idaho Science, Math, and Technology Coalition Conference, Century High School, Pocatello, ID, United States.
- 2012 **Wolk, M. A.** (Fall). *Teaching evolution to Creationist students*. [Conference session]. Idaho Science Teachers Association, Idaho Council of Teachers of Mathematics, and Idaho Science, Math, and Technology Coalition Conference, Borah High School, Boise, ID, United States.

PROFESSIONAL DEVELOPMENT PRESENTATIONS

- 2020 **Wolk, M. A., Knapp, J. M. & Lewis, C.** (2020, January 19). *Teaching and cultural competence Session 2: Exploring cultural knowledge to support students*. Preparing Future Faculty Workshop Series. University of Wisconsin - Milwaukee Graduate School, Milwaukee, WI, United States.
- 2018 **Wolk, M. A. & Turner, C. R.** (2018, February 16). *A.C.C.E.S.S.ing Cultural competence: An exploration of a cultural framework & its connection to classroom practice*. Towards Culturally Responsive Community Schools. Milwaukee Public Schools (MPS). Milwaukee, WI, United States.

INTERACTIVE STEM DEMONSTRATIONS

- 2016 **Wolk, M. A.** (2016, February 27). *Edible epithelial tissue*. West Central Mountain iExploreSTEM Festival, Mountain Life Church, McCall, ID, United States.
- 2015 **Wolk, M. A.** (2015, October 16). *Thinking like a Mountain and Edible epithelial tissue*, STEM Out! Into PTE, Micron Center for Professional Technical Education, Center for New Directions and Professional Technical Education, College of Western Idaho, Nampa, ID, United States.

HONORS AND AWARDS

- 2020-2021 **Chancellor's Graduate Student Award**, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2020-2021 **Amy Tessmer Boening Scholarship**, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.

- 2019-2020 **Graduate Student Travel Award**, 2019-2020 academic year, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2019 **Graduate Student Travel Award**, NSTA 2019 Salt Lake City Area Conference in Salt Lake City, UT, October 24-26, 2019, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2019 **Graduate Student Travel Award**, 2019 Wisconsin Society of Science Teachers (WSST) Conference in Madison, WI, March 7-9, 2019, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2019-2020 **Chancellor's Graduate Student Award**, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2019-2020 **Amy Tessmer Boening Scholarship**, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2018 **Graduate Student Travel Award**, First International Conference on Literacy, Culture, and Language Education in Bloomington, IN, Oct. 5-7, 2018, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2018-Present **National Honor Society for Educators**, Beta Epsilon Chapter at the University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2018-2019 **Chancellor's Graduate Student Award**, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2018-2019 **Amy Tessmer Boening Scholarship**, Awarded by University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2016 **Faculty of the Month** (November), Awarded by College of Western Idaho, Nampa, ID, United States.

CONTINUING EDUCATION

- 2017 **Face-to-Face Course Certification**, Center for Teaching and Learning, College of Western Idaho, Boise, ID.
- 2017 **27th Annual Idaho Water Quality Workshop**, Boise State University, Boise, ID.
- 2016-2017 **Twelfth Annual Boise State University Writing Project (BSWP) Invitational Summer Institute and Fellowship Year**, Boise State University, Boise, ID.

- 2016 **Idaho Super Conference: Learning Across All Dimensions**, Timberline High School, Boise, ID.
- 2016 **GEM – Helping our Students Shine**, Center for Teaching and Learning, College of Western Idaho, Boise, ID.
- 2015 **Project Learning Tree: Wildfires and Weeds**, Foothills Learning Center, Hulls Gulch, Boise, ID.
- 2015 **Designing to Achieve – Badge Design in Blackboard**, Center for Teaching and Learning, College of Western Idaho, Nampa, ID.
- 2015 **Online Instructor Course Certification**, Department of Online Learning, College of Western Idaho, Nampa, ID.
- 2015 **Anatomy & Physiology Faculty Workshop**, Partnership for Undergraduate Life Sciences Education, College of Western Idaho, Nampa, ID.
- 2015 **Idaho Community College Biology Meeting**, College of Western Idaho, Nampa, ID.
- 2015 **Idaho State Board of Education STEM Summit**, Boise State University, Boise, ID.
- 2015 **University of Idaho-Micron 2015 STEM Innovations Conference**, Riverside Hotel and Discovery Center of Idaho, Boise, ID.
- 2015 **57th Academy of Science and Engineering Annual Meeting and Symposium**, Boise State University, Boise, ID.
- 2014 **Defensive Driver Training for 15-Passenger Vans**, Fleet Management, College of Western Idaho, Nampa, ID.
- 2014 **Blackboard 101**, Computer Information Systems, College of Western Idaho, Nampa, ID.
- 2014 **Boise State Writing Project Inquiry Institute: Inquiry and the CCSS**, Boise State Writing Project, Boise State University, Boise, ID.
- 2014 **Idaho Community College Biology Meeting**, College of Southern Idaho, Twin Falls, ID.
- 2013 **Idaho Science Teachers Association, Idaho Council of Teachers of Mathematics, and Idaho Science, Math, and Technology Coalition Conference**, Century High School, Pocatello, ID.

- 2012 **Advanced Placement® Summer Institute: Exploring the Nature of Education**, Biology, Conserve School, Land ‘O Lakes, WI.
- 2012 **Advanced Placement® Conference in Biology**, College Board®, Robert McQueen High School, Reno, NV.
- 2012 **Common Core Standards and Common Assessment**, In-service, Compass Public Charter School, Meridian, ID.
- 2012 **Idaho Science Teachers Association, Idaho Council of Teachers of Mathematics, and Idaho Science, Math, and Technology Coalition Conference**, Borah High School, Boise, ID.
- 2011 **2011 Teacher Workshop – Natural Resource Education**, Trees for Tomorrow Natural Resource Specialty School, Eagle River, WI.
- 2011 **Idaho Science Teachers Association, Idaho Council of Teachers of Mathematics, and Idaho Science, Math, and Technology Coalition Conference**, Idaho Falls High School, Idaho Falls, ID.
- 2010 **Bring the Field into the Classroom through Nature Photography**, Craters of the Moon National Monument and Preserve, Arco, ID.
- 2010 **FISH Philosophy Training**, Chart House Learning, Compass Public Charter School, Meridian, ID.
- 2010 **National Science Teachers Association – Annual National Conference**, Minneapolis, MN.
- 2010 **Wisconsin Society of Science Teachers – Annual Conference**, Eau Claire, WI.

ACADEMIC SERVICE

- 2019-2022 **Committee on Research in Science Education**, National Science Teaching Association (NSTA), Arlington, VA, United States.
- 2018-Present **Teacher Consultant**, University of Wisconsin – Milwaukee Writing Project (UWMWP), Milwaukee, WI, United States.
- 2018-2021 **Graduate Student Ambassador**, School of Education, University of Wisconsin - Milwaukee, Milwaukee, WI, United States.
- 2018 **Judge**, (2018, April 12). STEM Fair. Milwaukee Public Schools (MPS). Miller Park, Milwaukee, WI, United States.

- 2016-Present **Teacher Consultant**, Boise State Writing Project (BSWP), Boise, ID, United States.
- 2016-2017 **Education Department Senator**, Faculty Senate, College of Western Idaho, Nampa, ID, United States.
- 2016-2017 **Work-Study Supervisor for the IDoTeach Program Assistant**, Education Department, College of Western Idaho, Nampa, ID, United States.
- 2015-2017 **STEM Video Blog (Vlog) Co-Coordinator**, Blog: Think Tank, Science is a Verb Series, College of Western Idaho, Nampa, ID, United States.
- 2015 **Faculty Volunteer**, Kiss 103.5 Live for 175, CWI Marketing and Advancement Department, College of Western Idaho, Nampa, ID, United States.
- 2014-2016 **Successful Start Volunteer**, One Stop, Ada County Campus Lynx Building, Boise, ID and Micron Center for Professional Technical Education, College of Western Idaho, Nampa, ID, United States.
- 2014-2015 **Project Leader**, School Supply Donation to Caldwell Housing Authority, College of Western Idaho, Nampa, ID, United States.
- 2014-2015 **Committee Member**, BIOL 100 Curriculum Design Committee, College of Western Idaho, Nampa, ID, United States.
- 2012-2013 **Co-Organizer**, Farmway Village Service Trip, Compass Public Charter School, Meridian, ID, United States.
- 2010-2011 **Co-Advisor**, Outdoor Club, McCall and Ketchum Overnight Backcountry Trips, Compass Public Charter School, Meridian, ID, United States.

STUDENT TEACHING EXPERIENCE

- 2010 **Student Teacher**, Biology and Honors Biology, 10th grade, St. Thomas More High School, Milwaukee, WI, United States.
- 2009 **Student Teacher**, Earth Science, 8th grade, Humboldt Park K-8 Charter School, Milwaukee, WI, United States.

PROFESSIONAL MEMBERSHIPS

- 2020-Present National Congress for American Indians (NCAI)
- 2020-Present National Science Association Leadership Association
- 2020-Present Wisconsin Indian Education Association (WIEA)

2019-Present American Educational Research Association (AERA)

2019-Present Urban Education Doctoral Student Association, University of Wisconsin - Milwaukee

2019-2020 National Council of Teachers of English (NCTE)

2019-Present National Society of Academic Excellence

2018-Present Association for Multicultural Science Education (AMSE)

2018-Present National Association for Research in Science Teaching (NARST)

2012-Present Northwest Professional Educators (NWPE)

2011-2015 Idaho Science Teachers Association (ISTA)

2009-Present National Science Teaching Association (NSTA)

2009-Present Wisconsin Society of Science Teachers (WSST)