CENTERING THE INDIGENOUS IN SCIENCE EDUCATION: POSSIBILITIES AND LIMITATIONS OF DECOLONIZING THE ACADEMY

by

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DISSERTATION ABSTRACT

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Title: Centering the Indigenous in Science Education: Possibilities and Limitations of Decolonizing the Academy

The current public schooling system in the United States attempts to remove culture and values from science education. Science is completely entwined in the culture, art, languages, and everyday lives of Indigenous peoples; therefore it is not a discreet knowledge or entity. A narrative of failure is being produced that falsely portrays Indigenous students as 'underperforming', not 'good at' science, and that perpetuates the perception of an achievement gap. However, the real problem is the way we look at, think about, consider, and teach science in US public schools, particularly for Indigenous students. Curriculum and pedagogy that present science education out of cultural context is problematic. Indigenous students need to learn science in Indigenous ways, and then the in western paradigm.

In this study I employed a qualitative design, consisting of interviews and observations with students and their instructors. I conducted a semi-structured interview with each participant, then, based on an initial analysis, chose three students for in-depth case studies. I attended a number of science courses with the students and faculty, and conducted interviews with two main faculty members. I presented my initial analysis and invited my participants to give further feedback.

There are possibilities for doing decolonizing work within the academy. We need more Indigenous folx as professors, and we need non-Indigenous faculty to apply decolonizing and indigenizing curriculum, pedagogies, and practices. Examples of this can include bringing students together with Elders and other tribal experts, employing place-based educational practices, intergenerational learning, learning through story, and oral traditions. Supporting community and reciprocity is also important for our Indigenous students. Faculty face tensions in doing good work with and for their Indigenous students, including the challenge of how to adequately address the field's expectation of students while still being responsive to student needs. Instructors also talked about balancing their connection to students with maintaining appropriate boundaries, and one instructor shared insight regarding gender differences and imbalances. These instructors voiced the desire and need to enhance their teaching skills and requested training in how to teach effectively and in a caring way for their specific communities.

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Jacob, M. M., Sabzalian, L., RunningHawk Johnson, S., Jansen, J., & Morse, G. S. (2019). We need to make action NOW, to help keep the language alive: Navigating tensions of engaging Indigenous educational values in university education. *American Journal of Community Psychology, 25*(1), 126-136. DOI: 10.1002/ajcp.12374

Jacob, M. M., Gonzalez, K., Finley, C., & RunningHawk Johnson, S. (2019). Theorizing Indigenous student resistance, radical resurgence, and reclaiming spiritual teachings about Tma'áakni (respect). *Religions, 10*(4), 286. DOI: 10.3390/rel10040286

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TABLE OF CONTENTS

Chapter Page

I. INDIGENOUS SCIENCE AND CULTURE, THEN WESTERN SCIENCE 1

The Science and Math Problem 1

Why Does This Matter? 3

How Does This Study Contribute? 4

Research Questions 5

Who Am I Trying to Reach? 5

Summary 6

II. LITERATURE ON CULTURE, SCIENCE, INDIGENOUS FEMINISMS, AND A YAKAMA DECOLONIZING PRAXIS 7

Introduction 7

Culturally Responsive, Culturally Sustaining, and Culturally Revitalizing Pedagogies 8

Culture and Science 11

Indigenous/Native Science 12

Western Science 14

Indigenous Science and Western Science 15

Science is Cultural 17

Chapter Page

Indigenous Science: Land and Place 20
Native Feminisms 21
A Yakama Decolonizing Praxis 24
Summary 26
III. INDIGENOUS RESEARCH METHODS AND METHODOLOGIES 27
Introduction 27
Epistemological and Ontological Assumptions 27
Research Design 32
Participants 33
The Students 34
The Instructors/Faculty 37
Research Questions 38
Data Collection, Management, and Analysis 39
Role of This Researcher 41
INTERLUDE I 44
IV. STUDENT WISDOM 46
Introduction 46
Research Question 46
Instructor and Classroom 46
Centering Indigenous Knowledges 49
Non-Indigenous Instructors 50
Cultural Connection and Community 53

Chapter Page

Internships …… 57

Research Question 59

What Is Science? 59

Observation…….. 61

Oral Traditions 62

Time, Connection, and Place 63

Research Question 65

Intergenerational Teaching and Learning 65

Learning in Context 67

Reciprocity……. 69

Summary……. 71

INTERLUDE II 73

V. FACUTLY EXPERIENCES 75

Introduction 75

Research Question 76

Research Question 78

What Students are Expected to Know 79

Traditional Ecological Knowledge 80

Balancing Privacy and Connection 82

Assumptions, Privilege, and Centering Student Voice 86

Academic Security 88

Gender Differences 90

Chapter Page

Not Trained to Teach 92
Summary……. 93
INTERLUDE III 95
VI. SIGNIFICANT FINDINGS, IMPLICATIONS,
AND FUTURE GOOD WORKS 97
Introduction..... 97
Summary of Significant Findings 99
Implications for Theory, for Practice, on Policy..... 104
Place and Land 104
Relationships, Community, and Connection..... 109
Decolonization and Nation Building 114
Reciprocity……..... 118
Further Questions and Future Research..... 122
Continued Work with/for Indigenous Students..... 122
Gender…….. 124
Relationship with Research Participants..... 128
REFERENCES CITED 131

LIST OF FIGURES

Figure Page

1. Venn diagram of Indigenous science and western science characteristics..... 40

CHAPTER I

INDIGENOUS SCIENCE AND CULTURE, THEN WESTERN SCIENCE

"As indigenous scholars, it is our task to reclaim the stories and traditions of our people. Such cultural work nurtures our people, both the generations past, as we honor them, and the future generations, as we seek to carry out elders' teachings for the future generations' benefit. We have a responsibility to go about, to the best of our abilities, doing this nurturing work." (Jacob, 2013, p. 121)

The Science and Math Problem

Every day in classrooms across the US, students participate in science and math courses. This occurs in some variation from pre-school up through the university level. Teachers, administrators, parents, students, and community members often think they know what science and math are, what they mean, what students do and learn in these classes. And yet, this version of science and math is a relatively recent social construction.

Western society has taken science and math and attempted to codify them, endeavored to single them out as discreet subjects that can be taught and studied in isolation. The narrative being put forth is that science and math are objective and that scientists and mathematicians have the ability to be objective, in fact should strive for objectivity. The current system of western science, both in the public schools and in the private sector, often removes culture and values from science and math.

Math and science are not new constructs or concepts, they've been around for at least as long as people. They are part of the lifeways, knowledges and cultures of Indigenous peoples. Because science and math are completely entwined in the culture, art, languages, and everyday lives of Indigenous peoples, they are not discreet knowledges or entities, everything is connected, and it all starts with and goes back to land and place (Barnhardt & Kawagley, 2016; Cajete, 2000). Therefore, Indigenous people have unique knowledges based on the place they call home, what that place and its inhabitants have taught them over many, many generations.

It is compulsory in the US for all children to attend schools, and the majority of these children are students in the public schooling system. Trends over the past few decades, fueled by legislation such as No Child Left Behind and the Every Student Succeeds Act, have moved the public education system toward accountability as measured by standardized testing. These type of accountability benchmarks only serve to further colonize curriculum, and subsequently test-label students who are underperforming in science. A narrative is being produced that falsely portrays Indigenous students as 'underperforming', not 'good at' science and math, and that promotes and perpetuates the perception of an achievement gap (Faircloth & Tippeconnic, 2010). We see news stories and articles that describe this gap, and in effect blame the students and their communities for being somehow deficient. They seem to say that these students are not, and perhaps that they cannot be, 'doing' these 'subjects' properly.

This is a false narrative of failure for Indigenous students, and the problem is not the students nor the communities they come from and go back to. The problem is the

way we look at, think about, consider, and teach science and math in US public schools, particularly for Indigenous students. The students are not deficient, their communities are not unsupportive. Our educational system is the problem. Our curriculum and pedagogy that presents science and math education out of cultural context is the problem.

Numerous Native scholars have considered the need for Indigenous students to have an understanding of western science in addition to Indigenous science, notably Cajete (2000), Brayboy (2008), and Bang (2014). These scholars tell us of the importance for Indigenous students of learning in both paradigms, as well as the importance to science of having Indigenous thinkers and contributors. Indigenous students should learn science and math in both the western ways and the Indigenous ways. Indigenous scientists support and encourage this idea.

To fully consider the scientific knowledge and experiences of Indigenous students, let's flip the narrative. Let's center the Indigenous points of view on science and math and culture and education. Let's think about the school and university curriculum and pedagogy as the problem, not the students. We can continue to recognize that western science provides us with valuable contributions while viewing its institutions and developments through a lens of colonization. Let's educate our students in Indigenous, place-based ways, and see the solution as centering the Indigenous ways of knowing and being.

Why Does This Matter?

Tribal nations are sovereign nations. In order to make decisions about natural resources, currently, Tribes need resource professionals that have a degree from a university in a science field. I argue that we need Indigenous people to hold these natural

resource positions. To earn one of these degrees, one must do well in science and math courses, both at the middle/high school level and then at the university level. The way that science and math is currently taught is creating barriers for Indigenous students, and this needs to change. Indigenous students need the opportunity to learn in Indigenous ways and from Indigenous teachers, in addition to learning in the western tradition.

Science is cultural. Students live and learn within and through cultures. Schools, teachers, students and classrooms create and have cultures. Schools and science teachers should recognize and honor different cultures, including Indigenous cultures and knowledges, ways of knowing. If our Indigenous students are recognized and valued, they will have better experiences with school, they will be more interested in the subjects of science and math, and they will feel as if they belong both in school and in science.

We also see a preponderance of natural resource professionals who are men. There is a significant gender imbalance in the workforce and in science and math degree programs. In Yakama traditions, as in many other Indigenous lifeways, a gendered balance is something to strive for. "Across the examples of Yakama decolonizing praxis is an understanding that our people are healthy when we build movements with a gendered balance" (Jacob, 2013, p. 110). This is also something that needs to be addressed in our educational institutions and systems.

How Does This Study Contribute?

The purpose of this study is to listen to Indigenous students about how and why it is important for them, important to them, to learn science and math in Indigenous ways and from Indigenous instructors. Through listening to these students, and analyzing what they and their Elders have to say, I can begin to inform educational policy and practice in

the arenas of science and math education. Perhaps we can begin to acknowledge and honor the knowledge and wisdom these students and communities bring to science education. In doing so, we must also acknowledge and address the inequality that is rampant in our current system of education. Changes in educational policy and practice that center Indigenous knowledges and ways of knowing can and will have a positive impact on the educational experience, classrooms, and schools of students.

Research Questions

My overarching research questions revolve around the importance of teaching and learning in Indigenous ways for Indigenous students and communities. Specifically:

- What are the limitations and possibilities of decolonizing science education in the western academy?
- What are students/participants conceptions and understandings of Indigenous science?
- What are the opportunities and constraints for Nation building within place-based educational practices in the western academy?
- What are the primary tensions for non-Indigenous instructors teaching Indigenous students science?

Who am I Trying to Reach?

With this study, I hope to influence university scholars, university instructors of science courses, high school and middle school teachers, Tribal members, and those with an interest in Indigenous education. My hope is that it can influence the way that science and math are thought about, as well as taught, encouraging the view that Indigenous knowledges and ways of knowing are crucial, particularly for Indigenous students. I

hope that teacher educators read on this topic as well, because I believe there is work to be done at the middle and high school level in the ways that we think about and teach science and math to our Indigenous students, and perhaps all students.

In Indigenous ways of being, reciprocity and relations are integrated in all aspects of life (Cajete, 2000). Because of the importance of reciprocity, and because it is ethically the right thing to do, I also need to ensure that this information gets back to and is approved by those participating in my study. It needs to somehow be of benefit to the community that I work with. It needs to do good work for the Yakama Nation and Indigenous communities. This is first for them, and secondly for the academics and policy-makers of the world.

Summary

The way we think about and teach science and math in the US is problematic for our Indigenous students. These students need to be learning in both Indigenous and western ways, with the Indigenous taking precedence. We should center and honor Indigenous ways of knowing and being, recognizing that land and place are our teachers, that science and math and learning are cultural, and that these knowledges will be different in each place and for each Tribal Nation. This will encourage more Indigenous students to be interested in science and math, and ultimately support tribes in their sovereignty.

CHAPTER II

LITERATURE ON CULTURE, SCIENCE, INDIGENOUS FEMINISMS, AND A YAKAMA DECOLONIZING PRAXIS

"Indigenous, especially in settler colonial nation-states such as Canada, the United States, Australia, and New Zealand, is a racialized category, but more importantly, Indigenous is a collectivized political identity." (Tuck & McKenzie, 2015, p. 126)

"Indigenous women understand that our struggle for autonomy is related to the total need for structural change in this society. We realize that indigenous people in industrial society have always been and will always be in a relationship of war, because industrial society has declared war on indigenous peoples, on land based peoples." (LaDuke, 1994, p.7)

Introduction

I draw from three main bodies of literature and scholarship to inform this study. I will look at and pull from work done on culturally responsive pedagogy (Gay, 2013), culturally sustaining pedagogy (Paris, 2012; Paris & Alim, 2014), and culturally sustaining/revitalizing pedagogy (McCarty & Lee, 2014). After reviewing the literature around the importance of teaching science in an inclusive way pedagogically, I will review the central tenets of Indigenous science. Finally, I will use Native Feminisms and a Yakama decolonizing praxis to take a specific critical analysis of my findings.

Culturally Responsive, Culturally Sustaining, and Culturally Revitalizing Pedagogies

The work that Geneva Gay has done on culturally responsive teaching gives western educators a way to work with and view their students that is respectful to their cultures and the knowledges they bring with them to school and the classroom. "I argue that the education of racially, ethnically, and culturally diverse students should connect in-school learning to out-of-school living; promote educational equity and excellence; create community among individuals from different cultural, social, and ethnic backgrounds; and develop students' agency, efficacy, and empowerment" (Gay, 2013, p. 49). The themes of connecting in-school learning to life outside of schools, as well as developing students' agency both reflect ideas found in Indigenous writers' thoughts on education. Gay goes on to further highlight the point, writing that "a key mandate of culturally responsive teaching is accessing this internal strength of ethnically diverse students and communities, and using it to improve their personal agency and educational achievement" (Gay, 2013, p. 68). Our Indigenous students bring with them strengths that need to be nurtured in order to support these students in improving conditions for themselves and their communities.

Gay's concept also works well when considering the place-based educational needs of Indigenous students. "Culturally responsive teaching, in idea and action, emphasizes localism and contextual specificity. That is, it exemplifies the notion that instructional practices should be shaped by the sociocultural characteristics of the setting in which they occur, and the populations for whom they are designed" (Gay, 2013, p. 63).

We can use this framework to support the argument that Indigenous students need to learn from the place in which they live, and that the way they learn should be shaped by their home cultures, knowledges, and practices.

As Paris and Alim (2014) write "we, like countless teachers and university-based researchers, have been inspired by what it means to make teaching and learning relevant to the languages, literacies, and cultural practices of students in our communities" (p. 88), and have a great appreciation for the work Gay has made possible. We do, however, have a responsibility to go farther than just culturally responsive teaching. In response to Gay's work, Paris has presented us with the concept of culturally sustaining pedagogy(CSP). Paris (2012) has taken this next step because

> we need a new term and a new approach that will not only more accurately embody some of the best past and present research and practice but will also offer pre-service and in-service teachers a way of both naming and conceptualizing the need to meaningfully value and maintain the practices of their students in the process of extending their students' repertoires of practice to include dominant language, literacies, and other cultural practices (p. 95).

There is a need to go beyond simple responsiveness to student's home cultures and values.

Culturally sustaining pedagogy aims to "perpetuate and foster – *to sustain* – linguistic, literate, and cultural pluralism as part of the democratic project of schooling and as a needed response to demographic and social change" (Paris & Alim, 2014, p. 88). In addition, it requires "that our pedagogies be more than responsive of or relevant to the cultural experiences and practices of young people – it requires that they support young

people in sustaining the cultural and linguistic competence of their communities while simultaneously offering access to dominant cultural competence" (Paris, 2012, p. 95). Students ought to be provided an education that assists them in sustaining their cultures and their values, and CSP may provide a way to help teachers with creating classrooms and educational communities that further this goal. Students need and deserve access to the dominant cultural norms, but not at the expense of their home cultures, practices and identities. Paris and Alim (2014) assert that "CSP, then, is necessary to honor and value the rich and varied practices of communities of color *and* is a necessary pedagogy for supporting access to power in a changing nation" (p. 90). Paris and Alim's work supports, and provides avenues for, teaching students in ways that sustain their home cultures and values while simultaneously providing them access to dominant and mainstream power structures.

Our Indigenous students deserve, and are owed, an education that centers their culture, their knowledges, and their ways of knowing and being. This can only be accomplished by centering Indigenous educational practices. McCarty and Lee (2014) assert that " education for Native American students is unique in that it implicates not only issues of language, "race"/ethnicity, social class, and other forms of social difference, but also issues of tribal sovereignty: the right of a people to self-government, self-education, and self-determination" (p. 101). Since educating Indigenous students is unique in this way, we must go beyond Paris's concept of culturally sustaining pedagogy for our Indigenous students. Again turning to McCarty and Lee (2014), they "argue that in Native American contexts, CSP must be understood to include *culturally revitalizing*

pedagogy" (p. 103) and provide the next step as being critical culturally sustaining/revitalizing pedagogy.

McCarty and Lee (2014) "propose critical *culturally sustaining/revitalizing pedagogy* (CSRP) as an approach designed to address the sociohistorical and contemporary contexts of Native American schooling" (p. 103) which is exclusive to Indigenous communities who have been exposed to colonization. In addition to the concepts of CSP, CSRP has three additional components, including attending directly to asymmetrical power relations and the goal of transforming legacies of colonization, recognizing the need to reclaim and revitalize what has been disrupted and displaced by colonization, as well as recognizing the need for community-based accountability (McCarty& Lee, 2014).

Culture and Science

In my work I spend much time thinking about and writing on culture, science, western science, Indigenous science, science education, and how culture affects, contextualizes, and interacts with science and education. In order to think through these concepts most clearly, and to have productive conversations, I believe that it is important to define these terms. I lean on the work of Douglas Medin and Megan Bang, Vine Deloria Jr., and Daniel Wildcat in defining and clarifying my thoughts on these notions.

I particularly appreciate beginning my discussion with a working definition of culture, as it permeates all other topics and concepts that I work with. Medin & Bang (2014a)

> tentatively define culture as the knowledge, values, beliefs, and practices among a group of people, usually living in geographical proximity, who share a history, a

> language, and cultural identification. Importantly, we view knowledge, values, and beliefs as causally distributed patterns of mental representations, their public expressions, and the resultant behaviors and practices in given ecological contexts (p. 86).

This is most certainly a working definition which is not perfect, but gives a platform for further discussion, understanding, and analysis.

Defining the concepts of Indigenous science and western science are also going to be important for my work, and at the same time are not strictly bounded entities that can be easily captured in a sentence or two. I look to begin my brief discussion with Medin & Bang's (2014a) statement that the two are competing narratives, wherein "one sees science as some objective thing, and assumes either implicitly or explicitly that cultural/ethnic differences in learning and taking up science have nothing to do with the science side and everything to do with the cultural side" (p. 9) and the other that "the practices associated with science and science education reflect the cultural values and orientations of the practitioners" (p. 10). Each idea deserves its own discussion, much more than I have space for here, but I will again lean on other scholars to attempt to outline the basic ideas of each in the following sections.

Indigenous/Native Science

One of the main hallmarks of Indigenous science is the idea that science and culture cannot be separated, indeed science cannot be separated from any aspect of everyday life. Deloria and Wildcat (2001) begin our discussion by offering to us that there are "widely shared tribal views in which humans understand themselves to be but one small part of an immense complex living system" (p. 12). Indigenous science is built

on the assumption that all things are connected and related, human and non-human, including the land, water, earth, plants and animals, and that this relationality is important to understanding the world around us. Deloria and Wildcat (2001) write that perhaps the "best description of Indian metaphysics was the realization that the world, and all its possible experiences, constituted a social reality, a fabric of life in which everything had the possibility of intimate knowing relationships because, ultimately, everything was related" (p. 2) while they contrast Native science as being "a far cry from the disjointed sterile and emotionless world painted by Western science" (p. 2). Deloria and Wildcat (2001) also make clear for us that Indigenous science is taking into account the larger fabric of life, the reciprocity and relatedness of all things. "The teachings of the tribe are almost always more complete (than information dispensed by colleges), but they are oriented toward a far greater understanding of reality than is scientific knowledge" (Deloria & Wildcat, 2001, p. 4). Indigenous science teachings are about far more than a 'subject', they are about all of life and it's intricate connections.

Another aspect of Native science is the way in which it was and is communicated. The ways that Indigenous science was traditionally taught were through stories and everyday life experiences. "The non-Western, tribal equivalent of science is the oral tradition, the teachings that have been passed down from one generation to the next over uncounted centuries. The oral tradition is a loosely held collection of anecdotal material that, taken together, explains the nature of the physical world as people have experienced it and the important events of their historical journey" (Deloria Jr., 1997, p. 36). Keeping the overall experiences of many generations in mind, and the relationships between all, is a critical component of Indigenous science.

Medin & Bang argue that these concepts and principles, of course, are also present in contemporary science education. The way science is taught carries the culture and values of the scientists and teachers with it to classrooms and students. Medin and Bang (2014a) assert that "the answers to scientific questions depend on who's asking, because the questions asked and the answers sought depend on who's asking, even when all parties adhere to rigorous research methods" (p. 10). While they are not claiming that science is subjective, they insist that we take into account that science practices contain the values that scientists and educators bring with them. These perspectives are affected by factors such as social class, gender, and culture. Taking this specifically to classrooms and students, the "argument would be that science instruction emphasizes those practices that are common in white middle-class communities, if only because the teachers themselves are typically white and middle-class" (Medin & Bang, 2014a, p. 11). This highlights the importance of bringing Indigenous science to classrooms, particularly those classroom with Indigenous students.

Western Science

The most common currently held belief about science in the US, and certainly the one that is taught in US public schools, is that science is unprejudiced and impartial, and that there is one truth that science seeks and can find. This includes the idea that "science is objective, value-neutral, and acultural. Although individual scientists may have biases, the sociology of science and the associated competition of ideas lead science eventually to the truth" (Medin & Bang, 2014a, p. 3). Many people who hold this western view of science believe the "story of the development of science according to which it basically started in Greece, was nurtured in Europe during "the Enlightenment" and the associated

triumph of reason, and eventually grew into modern science (a.k.a. "Western science")" (Medin & Bang, 2014a, p. 3-4). This view excludes any Indigenous knowledges and only legitimizes knowledge obtained by white men 'discovered' in relatively recent times.

Western science attempts to take the person, the scientist, out of the equation, to claim that any scientist would ask the same questions and find the same answers. It presumes that how a scientist might like the world to be is irrelevant and that science simply aspires to describe how the world is. This view promotes that "scientists believe that there is one correct account of how things are in the world (and what makes it correct is that it *is* how things are)" (Medin & Bang, 2014a, p. 3). To further elaborate on this point, Deloria Jr. and Wildcat (2001) tell us that most of western science is reductionist in nature and "seeks to force natural experience and knowledge into predetermined categories that ultimately fail to describe or explain anything. The whole process of Western science is that of finding common denominators that can describe large amounts of data in the most general terms" (p. 4).

Also important to this conception of science is the idea that ethics are not involved in doing science. "(Western)Science is also a quest for truth… It tells us the way things are and perhaps how they could be, but science does not tell us how things should be" (Medin & Bang, 2014a, p. 17). Deloria and Wildcat (2001) take a stronger stance on this matter, writing that "Western science has no moral basis" (p. 4), and that therefore it cannot help answer human problems.

Indigenous Science and Western Science

Indigenous communities face a difficult dilemma. "Although our communities have a critical perspective of universities and what they represent, at the same time these

same communities want their members to gain Western educations and high-level qualifications. But they do not want this to be achieved at the cost of destroying people's indigenous identities, their languages, values and practices" (Smith, 2012, p. 135). This, then leads to the thought that Indigenous students need both the Indigenous science and the western science, something that many Indigenous writers believe to be quite possible. Cajete (2000) gives us a way to think of the two as complementary, writing that "science provides the empirical information and rational insight from which we fashion our sense for affiliation with and sanctity of the land, yet it is our personal and cultural cosmology that guide both our perception and our response" (p. 305-306). Medin and Bang (2014a) write that in Indigenous science the "unity of science is not assumed – scientific models, theories, and representations highlight some aspects of reality but may ignore or conceal others... In this view, each theory is only a slice or perspective, and different aspects of reality may be relevant to them" (p. 4). Cajete contends that Indigenous science incorporates ethics in a way that western science does not. Simpson (2004) goes on to state that "how you learn is as important or perhaps more important than what you learn, and Indigenous educational programs must use culturally inherent ways of teaching and learning Indigenous Knowledge (IK)" (p. 380). An Indigenous perspective, along with culturally sustaining/revitalizing pedagogies, can address ways to create access for Indigenous students to a western education while honoring their Indigenous culture.

If we are to teach and learn in Indigenous ways, we must focus on placed-based education and Indigenous Traditional Ecological Knowledge (ITEK). These types of education are rooted in the concept of reciprocity and the relatedness of all things. Cajete (2000) writes "in the Western mind-set, getting from point A to B is a linear process, and

in the Indigenous mind-set, arrival at B occurs through fields of relationships and establishment of a sense of meaning, a sense of territory, a sense of breadth of the context" (p. 81). In Cajete's conception of scientific knowledge, Native science is about reciprocity and a relationship with the natural world. It is also about a relationship with each other. Kyle Whyte (2013) argues for Traditional Ecological Knowledge (TEK) as a collaborative concept that "serves to invite diverse populations to continually learn from one another about how each approaches the very questions of "knowledge" in the first place, and how these different approaches can work together to better steward and manage the environment and natural resources" (p. 2). TEK inherently informs Indigenous epistemologies, ontologies, cosmologies, learning and knowledge, and comes from the place in which an Indigenous community has lived for generations.

Science is Cultural

Reciprocity and relatedness lead us to the fact that science and science learning is cultural. "In Native science, sanction of knowledge through appropriate ritual and tribal society acknowledgment is important, because knowledge of the natural world and how best to relate to it is not just a matter of individual understanding but is gained and shared for the benefit and perpetuation of the community" (Cajete, 2000, p. 72). In Indigenous ways of knowing and being, science learning is not an individual endeavor, nor is it a discreet subject. It is, instead, entwined with other people and all aspects of life. Science learning should not, in fact cannot, be disconnected from everyday life, from connection and community, or from land and place.

Indigenous writers demonstrate that science is cultural, that we cannot, and should not attempt to, remove the culture of the students from the subject matter, or from the

students, in our classrooms. "If all artifacts are cultural and if science communication employs artifacts, then science communication necessarily employs cultural artifacts. That is to say, there is a cultural side to science communication" (Medin & Bang, 2014b, p. 13625). Medin & Bang (2014a) also tell us that science is "a cooperative enterprise drawing on many different approaches and strategies. Each science-related activity embodies perspectives and values" (p. 233). While the western version of science attempts to portray science, science learning, and scientists as objective and value-free, Indigenous science and scientists recognize this is not the case. There most certainly are values in science education, and in the current US public school system white and western values are privileged while Indigenous values are marginalized. This marginalization contributes to the barriers experienced by Indigenous students in our schools. "We believe that one important factor in the underrepresentation of minorities in the sciences is that science education may recognize and value practices that white, middle-class scholars bring to the classroom, while ignoring or even overtly discouraging the science-related practices that other cultural groups bring to the classroom" (Medin & Bang, 2014a, p. 240).

Changing this way of viewing Indigenous knowledge changes the experience Indigenous students have in school. Medin & Bang (2014a) give evidence "supporting the idea that children come to school with knowledge, orientations, values, and practices that are relevant to science learning and that reflect their culture. When these orientations are supported, students are more engaged, identify with, and are more successful with science than when these orientations are ignored or discouraged" (p. 5). This is another strong argument for the centering of Indigenous science for Indigenous students.

Indigenous sciences itself gives us a way to include both the Indigenous and the western. Brayboy & Castagno (2008a) promote the idea that there are multiple ways of obtaining knowledge, and that "a Native or Indigenous science allows the possibility that there are multiple ways of obtaining knowledge" (p. 736). Brayboy & Castagno (2008a) also call for a revisioning of the goals of science education to "encourage students to learn both Aboriginal and Western science and technology in a way that empowers them to make everyday choices between (1) participating in a First Nations cultural setting, and (2) participating in a dominant cultural setting" (p. 740). Both science paradigms are useful and necessary, centering the Indigenous values can protect students from the western paradigm which attempts to erase their culture and therefore their identity.

Changing the educational experience for Indigenous students can result in improvements for Indigenous communities, in addition to a better encounter with schooling. "To improve the circumstances that affect indigenous communities in ways that are likely to have a sustained impact required that we improve the educational experience and attainment of Native peoples, especially within STEM education" (Medin & Bang, 2014a, p. 6). A further key point in Brayboy and Castagno's (2008a) argument is that "science education for Indigenous youth must be to assist in the goals of tribal communities' efforts towards economic development, environmental responsibility, cultural survival, and self-determination" (p. 741).

This project is about improving the conditions for not just students, but for all Indigenous peoples, and making part of that move through science education. In fact, having a wider array of knowledges and ways of knowing can benefit all of society, not just our Indigenous students and communities. "Differences in values provide different

perspectives on nature, each of which may yield useful insights…diversity in researchers and research perspectives makes for better science" (Medin & Bang, 2014a, p. 68). And shouldn't we all want better science?

Indigenous Science: Land and Place

Indigenous science is rooted in the land and is specific to each place and tribe. Michael Marker (2018) tells us that from an Indigenous worldview there "is no sense made in questioning the *place of nature* in human history; there is only the *nature of place* that is to be understood as a way to recognize the meaning of history, time and space, and the structure of reality" (p. 454). He goes on to write that inquiry, and this includes science and science education, "must begin with an awareness of the interconnectedness of plants, animals, and humans, geologic forms along with the stories that tune and shape cognition of a landscape that is also conscious of human beings" (Marker, 2018, p. 454). The land, the place, and the our more-than-human relatives are all knowing teachers for Indigenous peoples

Angayuqaq Oscar Kawagley gives us an elegant example of what this looks like for one Tribe, the Yupiaq Nation. He first reminds us that the "worldview of the Yupiaq people has enabled them to survive for thousands of years. We contend that knowledge embedded in that worldview is scientific in nature, and that it remains relevant to today's world" (Kawagley, Norris-Tull, & Norris-Tull, 1998, p. 134). The members of the Tribe currently alive today need the knowledge that has been collected over many generations, all as an integrated lifeway and worldview. He further reinforces that "in Yupiaq culture, science is not separated from daily life. Their science is interspersed with art, storytelling, hunting, and craftsmanship" (Kawagley, Norris-Tull, & Norris-Tull, 1998, p.

137). And then he links this type of knowing from place to education today. "The importance of linking education to the physical and cultural environment in which students and schools are situated has special significance in Indigenous settings, where people have acquired a deep and abiding sense of place and relationship to the land in which they have lived for millennia" (Barnhardt & Kawagley, 2016, p. 19). While the knowledge and culture is very specific to place, the idea that education should be linked to land and a relationship to the natural world is much more generalizable. It can even be argued that this type of education can be a force for decolonization. "As an Indigenous scholar with long and sustained relationships to Coast Salish territory, it has always been apparent to me that landscape contains paths to understanding both ecological minds and the dis-placing methods and mechanisms of colonizing forces" (Marker, 2018, p. 453).

Native Feminisms

To understand how a Native feminist analysis will help this study, we must first understand what Indigenous includes and what a Native feminist framework focuses on. Million (2013) begins to clarify by telling us "the meaning of Indigenous as it is defined by all those cultures who identify themselves as such has always been in their relationship to a "land", that place they were in relationship to without anthropocentric bias, relationships that disciplined action and cohered Indigenous persons and societies" (p. 116). This definition importantly includes the connection to a pre-colonized relationship with land and place, and is characterized by how Indigenous peoples define themselves. She also helps us by writing that "Indigenous peoples understand their knowledge as inextricable from their lived experience in their distinct places, in spiritual

relationships with land and life, and from traditions that change but are millennial" (Million, 2013, p. 13).

When thinking about how Indigenous feminist analyses can help articulate the importance of TEK now and into the future, as well as to take a critical view of an educational system, it is necessary to first consider what Indigenous feminisms are. First, they focus on "compound issues of gender, sexuality, race, indigeneity, and nation" (Arvin, Tuck, & Morrill, 2013, p. 11). We cannot concentrate on one of these issues in isolation, but must attend to them all, as well as how they interact. Second, as Rowe & Tuck (2017) explain, "indigenous feminist theories attend to the intersections of settler colonialism and heteropatriarchal gender violence. They are an intervention on White feminism's erasures of Indigeneity, land, and the violence of ongoing occupation. They are also an intervention into Indigenous studies, which may not adequately address gender or sexualities, or can rely on binary notions of gender or heteronormative notions of sexualities" (p. 5). And third, "Native feminist theories offer new and reclaimed ways of thinking through not only how settler colonialism has impacted Indigenous and settler communities, but also how feminist theories can imagine and realize different modes of nationalism and alliances in the future" (Arvin, Tuck, & Morrill, 2013, p. 9). Using Indigenous feminist analyses allow us to take into consideration intersectionalities, to intervene in both White feminist and Indigenous studies analyses that leave out important aspects of each other, and give us hope for the future.

Native feminist writers give us ways to think about our educational systems, our communities, our teachers and our students, in ways that are profoundly different than what the western paradigm offers. Simpson (2017a) reflects on this, writing that

"Indigenous resurgence, in its most radical form, is nation building… This resurgence creates profoundly different ways of thinking, organizing, and being because the Indigenous processes that give birth to our collective resurgence are fundamentally nonhierarchical, nonexploitative, nonextractivist, and nonauthoritarian" (pp. 22-23). Different ways of thinking are important in making changes, and this lens gives us a way to make improvements for all students, to decenter the colonized and to make a move toward decolonization, perhaps even Indigenization.

Using an Indigenous feminist lens to take a critical look at our educational system, specifically our science and math programs, also allows a different possible outcome.

> Founding Indigenous Environmental Education programs within Indigenous Knowledge systems is one of the most important ways of strengthening our cultures, promoting environmental protection, the realization of sustainable local economies, and supporting students through healing and decolonizing processes. It requires… a constant decolonization process for both instructors and students (Simpson, 2002, pp. 16-17).

This is something we should strive to continuously reach for and keep at the forefront of our educational efforts. Indigenous feminisms require "a strong commitment to educating students in not just culturally appropriate ways, but culturally inherent ways" (Simpson, 2002, p. 17). We owe this to our students and to our communities.

Native feminist writers are critical, and they are hopeful. This hope is important in attempting to move forward, to create change that is lasting and powerful and that supports and continues Tribal sovereignty. Million (2013) writes on Indigenous women,

how "we speak to, and from, life, an ancient position of vitality that has surprising alliances in these neoliberal times. We speak from a vital imaginary for a different politic for our times, for our nations, for worlds" (p. 25). In many ways, I find this to be a hopeful point of view, and why do this work if we don't believe that we can create some sort of change for the better. "Indigenous women articulate a polity imagined in Indigenous terms, a polity where everyone – genders, sexualities, differently expressed life forms, the animals and plants, the mountains – are already included as the subjects of the polity. They are already empowered" (Million, 2013, p. 132). We need to empower our Indigenous instructors, students, and communities, and Indigenous feminisms give us a mechanism to do this.

A Yakama Decolonizing Praxis

Since my study is on Yakama homelands, and will invite Yakama participants, I must use a framework for analysis that is relevant and respectful. I believe that attempting to perform this study through the lens of a Yakama decolonizing praxis provides a suitable and dignified structure. "I found that, ultimately, indigenous decolonization is about reclaiming traditions, in addition to moving forward in the complex social, political, and economic realities colonization brought to our peoples and homelands" (Jacob, 2013, p. 6). Jacob uses this framework in a more general sense, however I believe this can also be a way to reclaim traditions specifically in and through the education of Yakama students in what we think of as the subjects of science and math. These subjects, after all, are really about culture and language and stories and knowing and being, because in an Indigenous world view these are all connected and inseparable from science and math.

Getting Yakama students into science and math programs, and teaching them in Indigenous ways relevant to them and their land and place, is a decolonizing move, and a critical one. "My analysis of Yakama cultural revitalization efforts contributes to indigenous studies theories that recognize the importance of our communities' resilience to understand and address our own problems – that the power needed to heal our soul wounds already exists within our people and traditions" (Jacob, 2013, pp. 11-12). The Yakama people can, and want to, take care of their homelands. They already have the knowledge and the abilities to do this. The education system Yakama students participate in needs to recognize and honor these students, communities, elders, and the knowledge they have and bring.

Women in the Yakama community are already doing decolonizing work, and in a Native feminist fashion.

> Through their everyday actions in and around the Yakama Reservation, in their travels to other institutions and gatherings, activists articulate a praxis that can inform feminist and anti-racist work. By drawing from traditions to undermine settler-colonial-imposed hierarchies and reasserting the importance of spiritual relations between humans and our surroundings, Yakama cultural revitalization efforts represent a distinctive indigenous feminist approach to "making power" within our community (Jacob, 2013, p. 12).

These women need to be part of the educational process, as "a central tenet of Yakama decolonizing praxis is that women are important as culture bearers and teachers" (Jacob, 2013, p. 108). These beautifully capable women are already doing good work in their

community, which should be recognized and then built upon with their guidance and blessing.

Summary

The sociopolitical turn in education gives me a way to step into the conversation about student identities, the ways in which culture is important in school, and how power is recognized and used in educational systems. Culturally responsive teaching gives a basis for making sure that all students are respected and valued for the knowledge, values and sense of self that they bring with them to school. Indigenous students learning science and math in both the Indigenous ways as well as through the western paradigm is important, and encouraged by Indigenous scholars and leaders. Science is cultural; we cannot take out the culture as western education attempts to do and still have interested and invested students. Indigenous science, indeed all Indigenous learning, is based in land and place and is specific to each Tribal Nation. Indigenous feminisms can help us to critically analyze our educational system, as well as offer a hopeful and productive way forward. In this study it makes sense to collect and view my data within a Yakama decolonizing practice, which offers a relevant analysis and a hopeful forward direction for action.

CHAPTER III

INDIGENOUS RESEARCH METHODS AND METHODOLOGIES

"Across the case studies covered in earlier chapters, major lessons of Yakama decolonizing praxis are: the importance of Native women elders as culture bearers, the need to reshape educational institutions to serve our people, and the promise of grassroots activism for bringing about important forms of social change." (Jacob, 2013, pp. 108-109)

Introduction

In conducting research with Indigenous peoples, it seems only right to attempt to employ Indigenous methodologies. While the methods and methodologies that Indigenous people use are varied and many, there are a few themes and similarities among most of them. The focus on place, relationships, reciprocity, and decolonization seems to be common, and are the ones I will use in this study.

Epistemological and Ontological Assumptions

In Place in research: Theory, methodology, and methods (2015) Eve Tuck and Marcia McKenzie highlight four epistemic touchstones of Indigenous methodologies, which I will use for this study. The first touchstone is that "Indigenous methodologies both are enacted by and seek to study relationships, rather than object-based studies that typify Western sciences. Among the most primary relationships, upon which all other relationships are configured, are relationships to land and place," (Tuck & McKenzie, 2015, p. 94). This works to decenter the western science that is so often thought of as the

'way to do things' and instead to flip the narrative and center the Indigenous in science. This touchstone also supports the study's focus on place and land as educators, and as the source of knowledge for Indigenous science. In this study I assume that the relationships between human people, more-than-human people, land, and place are all important and should be attended to.

A second touchstone that is found in many Indigenous methodologies is reciprocity, because "Indigenous knowledges emerge and exist within a universe that is relational and responsive" (Tuck & McKenzie, 2015, p. 95). Cajete (2000) also helps us understand reciprocity as "a give-and-take relationship with the natural world, and which presupposes a responsibility to care for, sustain, and respect the rights of other living things, plants, animals, and the place in which one lives" (p. 79). This is particularly relevant when considering science education, especially Environmental Science, and it's focus on the land and place. The whole point of the degree/coursework could be to care for natural resources, to be in good relations with land and place, if looked at through an Indigenous lens. Reciprocity is also "concerned with maintaining balance not just between humans, but with energies that connect and thread through all entities in the universe" (Tuck & McKenzie, 2015, p. 95). This is another concept that is most often overlooked in western science, but is critical when doing a study with Indigenous methodologies.

In addition to the notion of reciprocity as a relationship with the natural world, it is also a relationship and responsibility between humans. This is not an either/or understanding, rather the approach includes and intertwines both portions of this concept. Heather Shotton, in her work with Indigenous women seeking doctorate degrees, helps to

explain how the concept of reciprocity is particularly relevant in an educational setting. Shotton (2018) writes that many students motivation for earning a degree comes from a desire to give back to their communities and that these students "recognized the importance of receiving a doctoral degree and what that meant for their communities" (p. 490). She goes on to say that these students "understood that their PhD came with great responsibility – responsibility to their families, their tribes, their communities, and other Native people. They were humbled by that responsibility, and they viewed it as a place of honor" (Shotton, 2018, p. 490). It is also important to understand that "reciprocity as discussed in the current literature is viewed in the context of giving back not only to individual tribal communities but to the larger Native community, including other tribal nations and people" (Shotton, 2018, p. 493). Reciprocity is about a responsibility to all our relations, human and more-than-human, and is a motivator for Indigenous students as they pursue a degree in higher education, as well as in their K-12 educational careers.

Indigenous methodologies are not focused solely on the here and now, as so much of western science and western society seems to be. Rather, they consider the past, the current situation, and look to the future as well. "A third epistemic touchstone of Indigenous methodologies is a notion of something like the long view" (Tuck & McKenzie, 2015, p. 95). This view likely comes from Indigenous peoples relationship with their land and place over many thousands of years, and includes the idea that land and place are dynamic and changing, "animated", powerful, and productive. It also connects to the way that Indigenous students are focused on and motivated by helping their communities.

Decolonization is an almost universal feature of Indigenous methodologies, and it is absolutely critical to employ a decolonial lens to education if we are to make actual change that improves schooling for Indigenous students. Tuck and McKenzie (2015) emphasize that "a final epistemic touchstone of Indigenous methodologies is concerned with decolonization" (p. 95). Jacob (2013) writes that "decolonization is about empowering indigenous communities" (p. 121) and she gives us an example of what this might mean for the Yakama Nation. Jacob writes, in regard to her theory of a Yakama decolonizing praxis, that "ultimately, indigenous decolonization is about reclaiming traditions, in addition to moving forward in the complex social, political, and economic realities colonization brought to our peoples and homelands" (p. 6). In doing a study with and for Indigenous peoples, decolonization can never be far from the center of our considerations, analysis, design, and work.

Smith (2012) offers 25 Indigenous research projects, one of them focusing on connecting. "The importance of making connections and affirming connectedness has been noted by other minority group researchers. Connectedness positions individuals in sets of relationships with other people and with the environment. Many indigenous creation stories link people through genealogy to the land, to stars and other places in the universe, to birds and fish, animals, insects and plants. To be connected is to be whole" (Smith, 2012, p. 149). I wish to draw on this concept as well, to employ connection as an important assumption in my research and analysis, to center connection and relationship. "Connecting also involves connecting people to their traditional lands through the restoration of specific rituals and practices" (Smith, 2012, p. 149). This ties in to a

Yakama decolonizing praxis, to Yakama peoples using their stories, their rituals, and their place to strengthen their communities and the education of their students.

In doing this research with and for Indigenous peoples, I also rely on Timothy San Pedro and Valerie Kinloch's work in, and theory of, Projects in Humanization (PiH). San Pedro and Kinloch argue that "to decolonize and humanize educational research in the next 100 years, we must center and sustain relationships in our work" (San Pedro & Kinloch, 2017, p. 374S). They write that to do so means that research must be "more expansive than that which is taken up by specially trained researchers whose primary purpose is to measure validity in terms of an imagined neutrality" (San Pedro & Kinloch, 2017, p. 374S). They further argue that in order to "move beyond such normalized Western constructs of social science requires that educational researchers willingly center the realities, desires, and stories of the people with whom we work. We must situate their stories in relation to our stories, lives, and research projects in humanizing ways" (San Pedro & Kinloch, 2017, p. 374S). In doing my study, it is important to be in relationship with my participants, to share my stories with them as they are sharing with me, and to use all this to form a context in which to collect and analyze data.

They further insist that when knowledge is shared and created, it is never in the absence of relationship, but rather is based in the development of them. Doing research in this way is important because of the need for "humanizing and decolonizing research approaches that do not *other* and oppress people but that value stories, dialogic listening, and self-determination" (San Pedro & Kinloch, 2017, p. 375S). Using this theory of Projects in Humanization, "we listen not to extract; rather, we listen to build, develop, and share our own stories with those who have shared their stories with us. In so doing,

we contextualize storying as research and knowledge production, which allows us to forward social justice, educational equity, and positive social change through PiH" (San Pedro & Kinloch, 2017, p. 378S). Sharing stories and building relationships is a critical part of doing research with and for Indigenous peoples.

Research Design

In this study I employed a qualitative design, consisting mainly of interviews and observations with students and their instructors. There was also work on sharing stories with each other and creating relationships between myself and those with whom I conducted this research project, both the students and their faculty members. I conducted an initial semi-structured interview with each of the eight student participants. Based on an initial analysis of these interviews, I chose three students to do a more in-depth case study with. As a graduate student mentor for the iNATURE program, I attended a weekend-long retreat with the students and one faculty, during which we went white water rafting, spent time with Elders learning about historical and contemporary fishing and changes the Elders have witnessed, visited a site where a dam has been removed and restoration work is being done in conjunction with tribal experts, and spent time eating, talking, and laughing together. I then attended a number of science courses with the students, after which I conducted the second interview with the three students chosen for a deeper case study. I also conducted interviews with two of the main faculty members for these iNATURE students. After an initial analysis of my data, I was invited to present at Heritage University, after which I invited the students, the faculty members, and a few Elders to give further feedback on my data and overall study.

Participants

The main participants in this study were the eight students enrolled in both the iNATURE program and the Environmental Science undergraduate degree at Heritage University, as well as two of the main faculty members for these programs. I would like to make quite clear that the group of people who I interviewed and research with is very limited. I am talking with Indigenous students who have made it, 'successfully', through the secondary system of US public schools, and who are now in a small group of Indigenous students going on to work toward a science degree at the university level. I am missing any and all of the students who were made to feel that US public schools were not for them, the students that were discouraged by the barriers put in place for them to continue with math and science courses, the students that are simply not interested in these 'subject areas'. I am a single researcher working at a single research site, and while this allows me to situate my study in deep cultural practices, something I find highly important, it is also something of a limiting factor.

While the number of research participants in my study is relatively small, the work is done with great care to build and center the relationships with my participants. To do ethical, responsible, and respectful research with and for Indigenous people, I must use decolonizing methods and methodology. These methods, and this methodology, takes a significant amount of time and requires much effort to give of myself as well as learn from my participants, and it is simply not possible to have a large 'data set'. This research is important and meaningful because it is complex, powerful, and deep; it promotes decolonization, Indigenization, social justice, and social change.

The Students

Here is a little bit about each of the students and instructors that I interviewed, whose names have been changed to maintain their anonymity, and who were kind and generous enough to share with me their time, their stories and their thoughts:

Billy

Billy grew up involved in Tribal events, and told me about hearing and learning from stories that his grandmother would tell him. This grandmother was an important figure in Billy's life, and she lived in the longhouse until she was 105 years of age. As a young teen, Billy experienced family distress, pulled away from traditional culture and values, and dropped out of high school. He eventually decided to get his GED through Heritage University, and then chose to continue on with college-level courses and pursue a degree. At this point in time, Billy has done multiple internships through iNATURE, from one close to home on his reservation, to California, and most recently a summer in Costa Rica. Billy expressed to me that he wants to get back to traditional ways, now that he has been re-exposed to them as a result of his time and fellow Indigenous students at Heritage.

Rainie

Rainie is somewhat unusual among my participants in that she went straight from high school to university. She had a baby her senior year in high school, and decided to go to Heritage because it was close to home and would keep her close to both her son and her mother. Rainie's mom is a big influence in her life and teaches her traditional things, which Rainie appreciates and wants to pass to her own child. She told me that she is potentially interested in graduate school, and while not fully certain of her educational

course, intends to investigate this possibility further. Rainie has strong connections to traditional teachings, talked about them as her own, as well as how to keep them alive and well.

Francie

Francie comes from a family that farms and has a ranch, which is part of the reason that she is interested in a science degree. She is also very interested in going on to graduate school, possibly in veterinary medicine. Francie's family is religious, a fact that came up a couple different times during our talk, and which seems to have strongly influenced many of her views and values. She didn't particularly like science as a school subject before attending university, and attributed this, at least partially, to the fact that she feels her high school education was lacking. Francie went to university right out of high school, and in fact started at a different university but didn't like being so far away from home, so transferred to Heritage.

Leslie

Leslie attended the local Tribal high school, and expressed that because of this experience she felt she didn't have as much science experience as many of her peers at Heritage. She does have quite a rich traditional background, and told me stories of learning traditional knowledge and values from Elders and grandparents, aunties and uncles at the longhouse and at feast. Leslie decided to go to college because she didn't want an office job. She is now becoming interested in graduate school, although what that might actually look like for her is still vague. Leslie very much hopes to work with and for the Tribe, specifically with the Natural Resource department, once she is finished with school.

Mya

Mya talks about how much she loved science as a kid, loved being outside and learning about nature. She told me many stories about her time as a child spent playing outdoors. Mya didn't go to a traditional high school, and because of this feels as though she is a bit behind some of her peers. She expressed some struggles she is having with some of the 'tougher, more technical' courses she is required to take. Mya is older than 'traditional college age', and has her own children that she is raising. Mya is a member of a tribe that is not close by, and that initially caused her some concern when she started at Heritage. However, she feels that her time at Heritage has been a good experience and that she's learning from her classmates because 'they grew up traditional and I did not.'

Nicole

Nicole, unlike any of my other student participants, is not majoring in Environmental Science. She is a Business student who also has an interest in science and natural resources and became part of the iNATURE project almost accidentally. Nicole took time off from school after she graduated high school, she has about a decade between high school and when she started college. Nicole told me about her grandmother, who is very traditional. As a child, Nicole spent a month every summer with her, and it is obvious how much that has influenced her life. She is now focused on getting her education in order to help her tribe, her family and her community.

Janice

Janice graduated high school in mid-1990's and immediately attended community college, focusing on fire science. She is now at Heritage and working on her Bachelor of

Science degree. She has had many jobs and a variety of experiences in her life, not all of them easy or painless. Janice told me how she has learned traditional knowledge from her tribal Elders, and she talks about herself as a food gatherer and 'an Indian person.' She has children and grandchildren, whom she is obviously very proud of. Janice told me that she chose to attend Heritage so that her children and grandchildren could maintain their cultural connections.

John

John grew up in the general area of Heritage university, attended the local high school, and seems to know many of the people in the community. He did do some coursework at the community college previous to his time at Heritage, but was unfocused at the time. Now, John hopes to be an example for young Native students, so they can feel confident about doing research and science. He is currently working on a project with Elders in the community to record and preserve some oral histories and knowledges. John also works at a youth camp for Native students, and has done this over the course of numerous summers, helping to teach them traditional ways and values.

The Instructors/Faculty

Brian

Brian is an assistant professor at Heritage University, specializing in aquatic sciences and fisheries. He completed his own education at large universities, and is professionally young (four years as a professor) and still learning how to navigate the structures and systems. Before becoming a professor, Brian taught English as a second language and worked in the guide industry and outdoor education. Brian considers himself a 'citizen of the world', holds multiple citizenships and has lived in 12 different

countries. However, admittedly, he is learning how to work with Indigenous students as a white man. Brian struggles to make sure that students are exposed to the content the field requires while trying to teach in a way that is culturally relevant to his students, and expressed that he is becoming critical of scientific 'objectivity.'

Camille

Camille is an associate professor at Heritage University, with a background in geological sciences who also focuses her time and energy toward issues of equity and inclusion for historically marginalized and underrepresented students. She was a professor at Heritage before the iNATURE grant was put in place, most of the beginnings of the grant proposal were her ideas. Camille identifies herself as an Hispanic woman, and has made sacrifices in her personal life in order to further herself as a professional and to support her students. As many students told me, Camille has become part of the community in many ways, yet she still feels a bit of an outsider at times. She has started most of the intergenerational programs currently in place, she holds her students accountable in a loving way, and most definitely has the students best interests at the heart of her actions and decisions.

Research Questions

The research questions I address with this study are:

- What are the limitations and possibilities of decolonizing science education in the western academy?
- What are students/participants conceptions and understandings of Indigenous science?

- What are the opportunities and constraints for Nation building within place-based educational practices in the western academy?
- What are the primary tensions for non-Indigenous instructors teaching Indigenous students science?

Data Collection, Management, and Analysis

During the 2018-2019 school year, there were eight students enrolled in both the Environmental Science degree program, as well as the iNATURE program, at Heritage University in Toppenish Washington, located on the Yakama Reservation. According to their website, in the fall of 2017, when many of my participants were attending, Heritage enrolled a total of 89 Native American students and had graduated 23 Native students in the previous two years ("Possibilities", n.d.). This university was piloting a program to teach science in both the western way and in Indigenous ways, and included students having the opportunity to work with Indigenous instructors. I invited all eight of these students to participate in one semi-structured interview. This first interview was conducted at the beginning of the study period during November 2018. After each of the initial interviews were complete, I chose three of the students for a second interview, a more in-depth case study. During the second interview, the students and I used Figure 1 as part of our discussions. During March 2019 I attended a weekend-long retreat with the students and one of the faculty members, learning on and from Yakama homelands, as well as each other. During April 2019 I observed classes and field work with these students and their instructors, as well as conducted an additional set of interviews with the three case study students. Each of the interviews was scheduled to last approximately one hour, although a few of the interviews were shorter than this, and one lasted almost

two hours. I also asked instructors in the program to do an interview with me, one was completed in April 2019 while the other was finished in October 2019. After I collected my data, and did a preliminary analysis, I received a request to present the work I had done to the community of Heritage University. After this presentation, I invited all the students that did interviews with me to come together and ask questions as well as give me feedback on my work thus far. I also shared my data and analysis with the faculty members that I interviewed as well as a few Elders that advise the iNATURE project, for their thoughts and feedback as well.

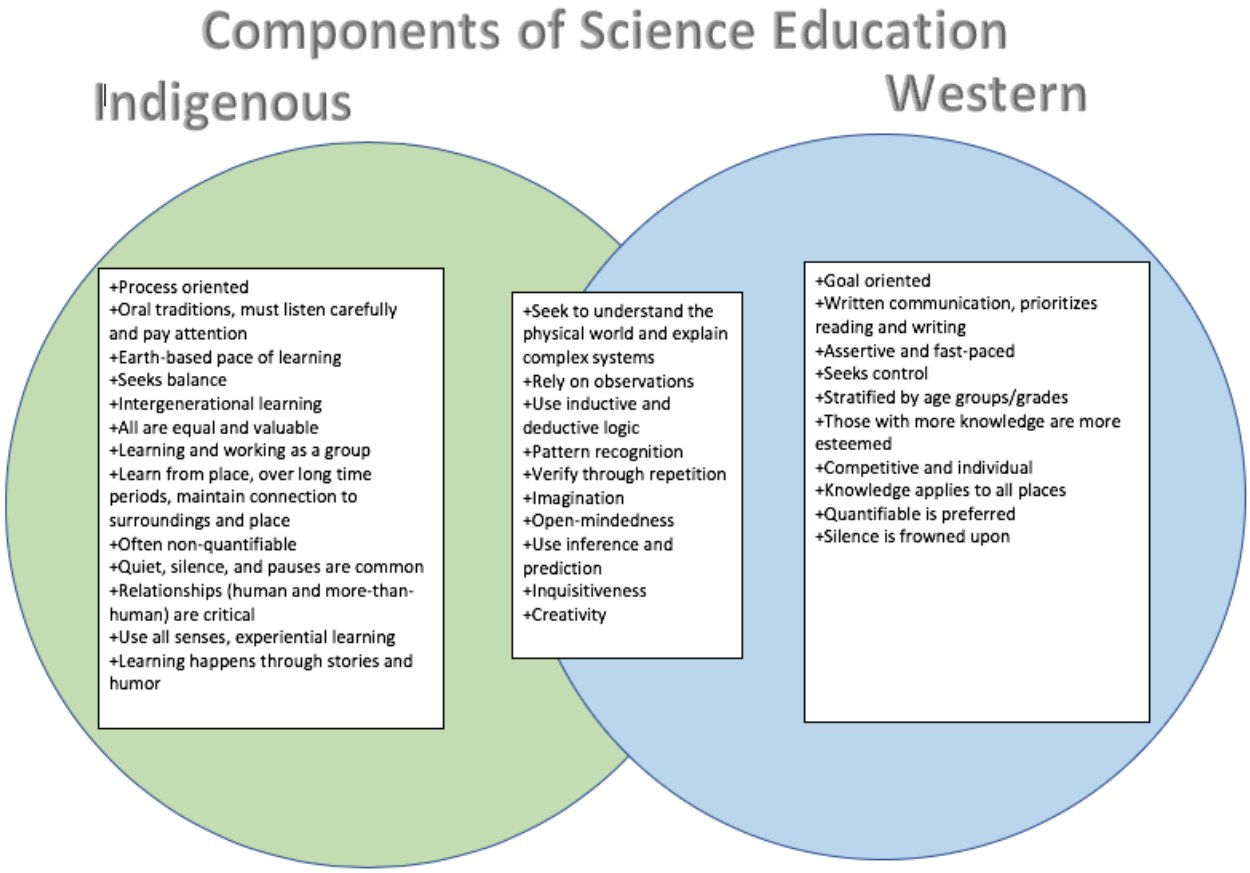

Figure 1. Venn diagram of Indigenous science and western science characteristics.

The analysis of the data collected with these students and instructors are case studies, and have been analyzed focusing on the research questions, looking for commonalities and discrepancies, among the students, the instructors, and the students and instructors. By coding the responses to interview questions, along with the classroom observations, I explore how students experience science education from non-Indigenous instructors compared to how they experience it from Indigenous instructors teaching in Indigenous ways. Is there evidence of any processes of decolonization occurring in any of these courses or interactions? If so, are they recognized by students and instructors? I looked and listened for the themes of relationships to place and land, connectedness, reciprocity, community, decolonization, and how these themes can be found, or are absent from, science education within the academy.

Data analysis was done by listening to the recordings and reading the transcripts of interviews with my participants, as well as the notes taken during course observations. I coded the data to look for themes, commonalities, and unexpected or unique items. I am keeping the recordings and transcripts of the interviews on my password protected computer, and a paper notebook of my observations and thoughts. I use an Indigenous feminist framework for my analysis, as well as lean on Michelle Jacob's (2013) work on a Yakama decolonizing praxis.

Role of This Researcher

I am an Indigenous scholar. During the time I worked on this research I finally became an officially enrolled tribal member. To my surprise, my mother told me one day, quite by accident, that she is an enrolled member. I had not known this my entire life, and because of this thought that I could not be enrolled. I always knew that my grandfather

was an enrolled member of the Oglala Lakota Nation, he is listed on the Pine Ridge Indian Reservation census ledger, according to the official paperwork. But what does paperwork really mean for Indigenous peoples? As a child I spent many hours with my grandfather, learning from and with him. He showed me how to do so many things, he let me try and fail and try again, he encouraged me and rarely became irritated or frustrated with me, he made me laugh and laughed with me. He told me stories, all the time, and I loved each and every one of them. I feel most at peace and my spirit connected with the world when I am outside, alone, in the forest. And yet, my grandfather's homeland is the plains. I have never been to what is now called South Dakota, or the Pine Ridge reservation, never visited my aunties that must be there or the vast beautiful land that is home to my ancestors.

I intend for my scholarship to work toward decolonizing science and math education for Indigenous peoples. And yet, I work within one of the most colonized spaces we can find. The United States, and other colonizing forces, have used education as a way to assimilate and annihilate Indigenous peoples. This continues today. My own family history includes my great-great-grandfather being stolen from his family and sent to Haskell Indian Boarding School. My great-grandfather and grandfather both bore the name Lawrence as a result. And yet, by that same grandfather, I have been taught that education is important and I hold out hope that it can be decolonized and used for the self-determination of Indigenous communities. I know that he would be proud of me for what I am doing now.

People look at me and they see a white woman, and in some ways I am. My father was half Scottish and half German, the son of first generation

immigrants/colonizers. As a child attending school, and as an adult, even though I looked similar to my classmates, I knew that I was different in some ways from those around me. I would always listen intently, and I had a hard time taking notes. Teachers always wanted to know why I didn't have questions. My classmates had questions, and they knew that I was bright. However, for me, it was better to listen, and see and then do, as I did with my grandfather.

I do my work as carefully cognizant of the colonial forces working around and through me as I can, and I will resist. I can promote a decolonized science and math education for our Indigenous students. I look for and admit my mistakes and missteps. I will ask Indigenous communities with which I am in contact for advice, if they are willing. I bring an Indigenous feminist analysis to my work.

In this study my role is to listen to the voices of the students in this Environmental Science program, and to analyze their words in a way that furthers the process of decolonization. I share of myself just as I am asking these students to share with me, and I honor the stories and the knowledges they bring. My role is to always listen to the Elders and to respect them. I will be on Yakama homelands, and so I must honor that place and the teachings that it may offer me.

INTERLUDE I

As I finish my drive to Heritage University I travel through terrain that momentarily exists only in faded shades of white and grey, the fog difficult to see through and on the verge of freezing. These fields are dormant now, but in the spring and summer they are green and flourishing with hops, apples, pears, and other fruit crops. I reach the university itself, and my first impression is that it is not much bigger than the high school I attended as a teen. I easily find a parking space, which I am not required to pay for, and prepare myself for the brisk walk across the parking lot and the grassy area in between the café and the main science building. The doors to the café open and the air is warm and inviting, in stark contrast to the cold and fog outside.

I find a spot to sit in the university's café, and again I can't help but make a comparison to the cafeteria from my own secondary school experience. I can hear the sounds of dishes clinking, conversation and laughter, the occasional cell phone ring or chime; it smells of food being cooked, cinnamon and bread and coffee. One entire wall of the café is windows, the opposite wall contains the line of food options available for purchase. This is the first time I am going to meet most of these students, a few I have said hello to previously. I have to admit to myself that I am nervous. I have so many questions, so many uncertainties. I am both excited to begin this research and scared that there are so many things that I could do wrong with it. So far, all the students have agreed to meet with me, and that brings its own set of insecurities: Will they talk to me? I mean, really talk with me, not just give me the answers they think I want to hear? Will they like me? Can I build relationships with these folx? Can we put our stories in context with each other? Am I going to be any good at this interviewing thing? How are these students

going see me? Will they accept me as an Indigenous person? Will they accept me as a researcher? What does that even mean?

CHAPTER IV

STUDENT WISDOM

Introduction

This chapter contains the words and stories shared with me by the students in this study. It is focused on, and organized by, the following research questions: What are the limitations and possibilities of decolonizing science education in the western academy? What are students/participants conceptions and understandings of Indigenous science? What are the opportunities and constraints for Nation building within place-based educational practices in the western academy? The students speak on and to the importance of their faculty members, intergenerational learning, including Indigenous science in their western classes, getting outside to learn in and from their homelands, oral traditions, keeping education in context, and why they are pursuing their degree. Their words are thoughtful, insightful and inspiring, and allow us to dig deeper into the ways that science education can be decolonized and improved upon for Indigenous peoples.

Research Question

What are the limitations and possibilities of decolonizing science education in the western academy?

Instructor and Classroom

The inclusion of Indigenous instructors is both a possibility and a limitation within the western academy. There are not many professors who are also Indigenous, or perhaps I should say that there are not many Indigenous people that are also professors, so that is a limitation. In fact, in the fall of 2017 less than 1% of US professors were American Indian/Alaska Native (National Center for Educational Statistics, 2019). While

work can, should, and is being done to increase the number of Indigenous people who hold a doctorate degree and teach and research in public institutions, there is currently an underrepresentation of Native Americans in the professoriate. But it is possible, and in fact is happening in some cases, to bring an Indigenous person, such as an Elder or other community member/expert, to a class to work with Indigenous students.

Many of the students told me about experiences in classes with Brian and Camille where these instructors had brought Indigenous experts into their classrooms, or had taken the students out to the field to interact with these folx. When I asked Leslie about a good experience that she had in a class, she spoke about Brian's course. "He wouldn't just teach about the science part of it, he would also, he had an Elder come in and talk to us, and then we would go out in the field and do stuff, like at the rivers, and he talked about TEK in there too, so I really like his teaching style." In this case Brian brings Indigenous experts into his classes and invites these folx to be part of the academy. He also takes the students out to the field, out onto their homelands and connects them with their land and their Elders. This also highlights the possibility of non-Indigenous instructors potentially doing decolonizing work in their classes, which I will include in another section below.

Mya spoke to wanting to have Indigenous instructors, and that her educational experience would probably be different if she had someone to help her keep the knowledge she is gaining in context. She spoke about how the instructors she has do indeed "refer to the area a lot in our courses, this place, the Yakama Valley" but that having an Indigenous instructor would make it more interesting. Mya said "they wouldn't have to give out all the secrets, but just tell you a little bit of how we use this land, how

we protected it, and maintained it, and took care of it, and what we gained from it and how it helped us in our survival." Mya makes it clear that while her non-Indigenous instructors can begin the process of including the land and place as teacher, having an Indigenous instructor would make that instruction much more complete and meaningful. Francie did have the experience of learning from an Indigenous instructor, although at another university. She said it was "completely reverse from a typical science class" and that this instructor had placed the choice and responsibility of learning into the hands of the students. "Doing the research put it on you, you had to go out and learn it and it wasn't forced on you, but then you could pick your own topic that you were interested in anyways." Francie emphasized the importance to her of not having knowledge forced upon her, but instead of being offered knowledges and being allowed to integrate those into her ways of being in her own way and in her own time. She also noted that "the books for that class were, it was stories of how they had learned to use the medicine, and the whole story going back to creation about the plant. So that wasn't your typical class at all." This is another way her instructor was making this course different, decolonizing it, and for Francie this made the experience more than her 'typical' western classes "because you get the whole story behind it, and that sticks in your head, it's not just a name." Keeping the knowledge in context with the land and place offer a way to decolonize curriculum and make the experience more valid and relevant for Indigenous students.

Getting out of a traditional classroom and into the outdoors is also both a possibility and a limitation. The instructors feel some pressure is placed upon them to teach in a classroom and at the university. Additionally, when they make the effort to get the students out to the field there are logistical issues that must be faced and overcome.

This is a systematic limitation that currently exists. However, what I heard from the students emphasizes the importance of learning in and from place, their words reinforce the relevance of this strategy and way of learning/knowing/being. John told me why he believes that being out in the field more is important:

> Elders speak of the land singing a song, and we sing these songs, because we've learned them over generations, you know we've heard those same songs that come from the air, from the river, from the plants, from the animals, these songs have been signing to us for generations and hundreds of thousands of years so we know these songs and when we sing with them, it's a beautiful communion. So we must be out in the field more.

The science learning happening here is interdisciplinary, is in the context of the culture and the place that the students live and are spiritually connected to, and I will argue is more rigorous than what the western learning tradition offers them. This also speaks to the fact that non-Indigenous instructors can do decolonizing work. John demonstrates that the students notice these efforts, and he mentions his appreciation for Brian's willingness to commit time and money to making this happen.

Centering Indigenous Knowledges

Another possibility of decolonizing science education is to center Indigenous knowledge in the classroom and in the curriculum; place the cultural scientific knowledge that students come with, as well as that found in their communities, at the front, talk about and teach that aspect first, before introducing the western. Rainie told me it is important to her, as an Indigenous person to "talk about the cultural aspects first. Talk about why lamprey are important, for example, to our people…even if you don't like

certain things, it's important." Even something that could be viewed as simple or basic in a culture can be used as a way to ground curriculum. However, because the concept or topic is common, that helps give students a way to have a shared starting place, and to teach other, non-Indigenous students something safe in order to create and build connections. Nicole also spoke on the importance of centering traditional knowledge. She said that "making science more real life I would think would be more interesting. Because it's all around us, the plants too, like traditionally has applied since time immemorial, so it's just, um, I guess, yeah, I feel like it could be more real life and more pertain to this area. I'd be interested in that." Using place-based educational practices is one way to center Indigenous knowledges and to create an environment wherein the Indigenous students, and their communities, hold knowledge that is honored and valued. By using a place-based system of education, the science curriculum is kept in context, makes sense to the students, and is more interesting and valid for them. At the same time, science is not being compartmentalized away from culture, it is being kept in relation with the land and place and others. This is another argument for bringing in Indigenous experts and taking students out to the field, as these practices center the Indigenous knowledges that are so often marginalized in the western educational system.

Non-Indigenous Instructors

Another possibility in making a decolonizing move is to include the non-Indigenous instructor learning with and from the Indigenous community they serve. Many of the students gave me examples of their instructors doing this, and told me how much they appreciated the effort, even if it was not a perfect situation. Billy said that "going out to the field with Brian, you know, we still met Indigenous people. We still had

all that culture and we also learned western science." Here is an example of doing both the Indigenous science and the western science, with the Indigenous centered and presented as the primary learning practice. This statement also speaks to the fact that Brian is creating connections and relationships within the Indigenous community so that he can have his students meet with and learn from Indigenous experts in the area. Billy also told me that "we also went out to the field with Camille, and I think of her as a adopted tribal member. Because she knows lots of people and just how she addresses too, she does incorporate Indigenous culture to every day." For Camille to do this work has taken a lot of time and deliberate effort, and for a student to say that he thinks of her as a tribal member is substantially meaningful. He went on to say "I feel like Camille, she's around the Yakama Nation, she knows people in Oregon, the tribe down there, Spokane Tribe, Coeur d'Alene … and I feel like she learned a lot of Indigenous science from all those tribes put together, all the traveling she does, and I feel like she's real mindful of Indigenous culture and values … she put a lot of time in to understanding Indigenous culture." Having non-Indigenous instructors take the time and make the effort to learn some of the local traditions and ways can make a big impact for their students who are Indigenous to that place.

Many students also had good things to say about these same non-Indigenous instructors centering around their supportiveness, their willingness to show genuine fondness for their students, and their sincere efforts to work with them. Francie told me that "I think having the advisor, and like, Brian as a person of contact for questions, is a big plus, especially trying to go to grad school, having advice from people who have already done it is helpful." While this statement may seem simple on the surface, the fact

that it is coming from an Indigenous student speaking about a white professor complicates Francie's words and the meaning within them. I asked her to explain a bit more about why she felt this particular professor was helpful, and she said "Brian is awesome. He's really laid back, which is cool, most professors aren't … You can just go ask him any question, unlike any other professor." Francie points out that other professors are not nearly as approachable, and that Brian is different in some way. She continues with "I think all the environmental professors are way more laid back and friendly to students … which actually makes it comfortable to go and ask them something when it's confusing." Brian, as you will read in the next chapter, makes intentional effort to connect with his students, to work with them, to let them know he cares, and this matters to students. It particularly matters to Indigenous students who feel that many of their professors are unapproachable, unfriendly, and uncaring. Adding to this, Leslie said that "Brian, even though he's not Native, I really like that he's supportive of it, like a lot. When I was in his class … he was really supportive of TEK and I just like how open he is, and how he also wants TEK in school." Again, the seemingly simple statement of 'even though he's not Native' is indicative of a complex set of circumstances and events. These students are Yakama Tribal members who live and learn on Yakama homelands. Both the people and land/place have been subjected to colonialism, to white supremacy, to Indigenous dispossession, to cultural genocide, and to assimilation through schooling and other means, for centuries now. Leslie's comment reveals that Indigenous folx do not come with the assumption that white professors are necessarily their allies, or that they are there to help and support these students. Her statement also shows the potential ability of non-Indigenous instructors who are allies for and with their Indigenous students, to do

decolonizing work in the academy. Additionally, John reported that "Camille, she did the geology course here, and it was one of the main classes I remember really liking, do you know what I mean? Because she took us on three or four different trips, just to bust rocks open, look at lava flows, side walls, and explore the local story of the basalts and the floods and everything. I think she chose really good literature, she was very excited to talk about those things." What John alludes to in this comment, and that Camille makes clear in her own interview, is that she is excited to work with these particular, Indigenous students. She chooses to take them out to the field, on their homelands, to learn from the land and the place and with tribal experts, as well as share her own expertise in the topic. Camille does this with purpose, with a sense of responsibility, and a genuine caring and love, for her Indigenous students.

While having mainly non-Indigenous instructors at the university level is definitely a limitation to the amount of decolonizing work that can be done, it also shows promise as a possibility, given the right instructors.

Cultural Connection and Community

Many of the students spoke about the importance of community. Most felt strongly that keeping their connections to their homelands and home communities were critical for them and for their families, particularly if they had children of their own. A few mentioned specific internship opportunities they participated in with organizations related to their Tribe. They also talked about the significance of creating and supporting Indigenous communities within their degree program, on campus more generally, as well as within the larger educational context. For these students, maintenance of their cultural connections needed to be in effect for their academic learning to be successful.

I asked Janice why she had chosen to study at Heritage and she told me that "if I were to go somewhere else, my kids aren't going to get the cultural connection that they are if I'm just here." It is important to her to maintain those ties her children have to her family and Indigenous community, as well as to the land. In other parts of our conversation, Janice talked about being a gatherer and about the knowledge she holds of her traditional ways and how she wants and is responsible to pass this on to her children. She cannot do this important work if she is not on Yakama land with Yakama community members. Francie said that she "actually moved away, and I didn't like being far away, so I came back here. Heritage was the only option for a science degree that was close." When she says 'close', she means close to her parents and family and their lands. Again we hear the importance of maintaining a close connection to home community. Rainie also spoke about staying close to her homelands and family. "I wanted to go to OSU, but it's so far, and like, my son wasn't even one yet, so I decided to just stay here." For many non-Indigenous students, being a six hour car ride away from home would not be considered that far away or a hardship. But for Rainie, this is out of the question, she needs to be in close proximity to her mother, her son, her other family members, and her homelands.

I also asked Rainie why she believes the iNATURE program exists. She told me she thinks it is "to inspire everyone, to show them that they are more capable than what they think, and that there's more people like them in science." John and Mya both made very similar comments. One way in which I believe these statements can be interpreted, this idea that the students want to show that there are 'more people like them in science', is that they are creating and fostering a sense of community for themselves and other

Indigenous science students. Rainie also added that "you don't feel alone, that you feel like there's a community out there that supports you and can relate to you, because we all come from the same background pretty much." It is important for Indigenous students to see themselves represented in science and in the academy, so that they feel they have a place there and belong there. Additionally, it is critical for science to have a wider range of perspectives, viewpoints, and contexts, and Indigenous scientists contribute greatly to this objective (Medin & Bang, 2014a).

Within the cohort many of the students have created their own community for themselves, and often talk about how important that community is to each of them. Mya in particular talked about how influential this aspect is for her. "I come to school and I go to work, and I go home and I'm very isolated in my own life, but you need those interactions with other people, and that's what, I feel, helps us grow." Having support and community in the form of her fellow students makes her a better learner, and a better human. Mya insisted that knowing she has encouragement and assistance surrounding her school work is deeply meaningful for her and that "I feel a lot of it comes from your classmates." Billy reinforced this concept, and added that working together has "been consistent, we've worked together for the past four years." In the same conversation, Mya said "I feel like I depend on my network of people for help. You know, Billy is one of them … The group encouragement and support we give each other, to me it means a lot. I'm getting ready to finish and it's kinda sad." Emphasizing just how important these connections among her student community are to her, she told me that "the connections and bonds, it's huge. I don't, honestly, I don't know how I would have done here if I didn't have bonds and connections."

In addition to knowledge and reassurance around academic issues and topics, Mya also said "I feel like I'm learning a lot more from my classmates because they grew up very traditional and I did not." She spoke about how one particular classmate, Janice, has been willing to invite her to participate in traditional practices. In talking about Janice, Mya said "she's a classmate and she goes hunting and she goes out a lot, here on the reservation, and she's invited me." Mya expressed a desire to go out with Janice, to build that sense of community with another human as well as to be in relation to Yakama homelands. This example of Mya and Janice shows how these students support each other in their personal lives as well as their academic ones. More broadly this demonstrates that community among students is not just for academic purposes, but encompasses greater aspects of personal well-being and identity development.

When I asked Leslie what advice she might have for incoming students, she also touched on connection and community, and recommended that they "try and find a cohort on campus of other students, especially Native students, I think it would be helpful just to, because you guys kind of have similar backgrounds." Having a group of students with comparable backgrounds, knowledge bases, and interests can be one crucial step in students feeling as though they can be successful at the university level, and can potentially impact their decision to remain on campus and complete their degree. Another piece of the iNATURE program, and another way to support and retain Indigenous students, is connecting the undergraduate students to a mentor that is in graduate school. While this did not work out perfectly for all the students, Leslie said "I feel it's probably the mentor/mentee thing because just having, seeing someone else that's a Native that's in graduate school, that gives me hope that I could do it. Like if they could do it I could

do it." Having tangible, accessible examples of other Indigenous students successfully navigating the educational system can increase students belief in their own abilities. Leslie further explained that "the mentors help us with education, but also they're there for emotional support also. They're not just there to help with school, but other stuff, and I really like my mentor so far." Leslie's words reinforce the idea shared by many of my participants; having a strong community of like-minded advocates can make or break their university experience. Therefore, professors, programs, departments, and universities need to be implementing supports for Indigenous student communities.

Internships

All the students were required to do at least one internship, and most of them greatly appreciated these opportunities. Francie took the importance of connections with others one step further, outward from the university, and she did this using her internship experience. She said that "it was another good connection that the internship, and that's another thing too, the internships helps build that. You get connections outside of the school to help get in to degrees and graduate programs." With internship programs helping students connect with the local community, you can see ties being made that start to widen the student's circle, while still demonstrating the importance of community and Indigeneity. Many university degree programs either recommend or require their students participate in an internship experience. These iNATURE internships are different, however, in that they encourage students to sustain and enhance their connections to the local Tribal community, the community from which these students come from and go back to. These are paid internships, an intentional and thoughtful decision on the part of the iNATURE administration made to attempt to increase equity between the students in

the program and their more privileged (white and of higher socioeconomic standing) counterparts outside of the program. Internships done in this manner allow and inspire the students to strengthen their community ties and connections, not simply gain an internship experience for their resume. Leslie told me "if that internship wouldn't have happened I would still been just like, just get through school and not actually think about having a degree in it." The connections that both Leslie and Francie built in the community through their internship experiences were of value, both with reassurance that they can and want to finish their degree, as well as in building community and cultural connections. Francie went on to say that "it was another good connection that the internship, and that's another thing too, the internships helps build that. You get connections outside of the school to help get in to degrees and graduate programs." The positive aspects of these type of internship experiences will persist with the students as they begin their careers, and allow them to remain connected to their homelands and home communities, creating the potential for greater good works to happen.

The fact that these students are in their home community holds profound meaning for them, and has potential consequences as well. John believes that "the community should know what the students (at Heritage) are doing, why they're doing it." He, and the other students, want their tribal community and their families to know what they are working on and how they are doing. At the same time John acknowledges the gravity of this knowing. "I know that when I had that tough decision to make, like, putting my name on stuff that's being recorded, that was a huge issue for me. Especially when, after I graduate from here, I have to go back in the community, I am going to live here the rest of my life, these are the people I'm going to be around." While community is a big part

of potentially decolonizing the academy, it must be done carefully and with consideration.

Research Question

What are students/participants conceptions and understandings of Indigenous science?

What is Science?

When considering how students define Indigenous science, it was also important to understand how they define science in general. As I got better with the interviewing process, I realized that asking the students to compare the two for me was enlightening and brought out their thoughts that they perhaps wouldn't have shared otherwise. One common theme among student responses to the question of "What is science?" was questioning. Mya said that "science to me is questions, asking questions about things, trying to find the answers to things." She remarked that this is the same whether she is doing Indigenous science or western science. When I asked Billy, he told me that science is "getting to know how things work. And why. Just the who, what, where, how, why. Just those five questions is science." Interestingly, when I asked him about Indigenous science more specifically, his response was "science is science, and just because a race is different doesn't mean science is different. It all boils down to those same questions." While I heard a range of points of view on this question, a few of the students, including Billy, seem to have accepted the assimilated notion that western science is science. However, these same students also talk about parts of the scientific process, like questioning, that are similar to both scientific paradigms. This does not seem to be

something Billy is particularly aware of, at least not at this point in his learning processes.

Other responses that I received were similar. Rainie said "I feel like it's having a better understanding of the world," while Francie explained science as "knowing how and why something does what it does, that's the basic definition." Both of these definitions are applicable to Indigenous science and western science, although the processes and procedures would likely be different. Leslie told me "science, to me, would be like having a hypothesis, being able to test it and get results, and stuff like that. And also I guess the TEK also." It is fascinating that even in a program such as iNATURE which is trying to promote and honor Indigenous ways of knowing, the students will center the western science, and then add on the traditional ways of knowing and being. They talk around the idea that there are many aspects that are shared by both science paradigms, but rarely say that explicitly. The students seem to have taken on the idea that western science is the 'real' science, while also knowing in some ways that their traditional cultural knowledges and practices are important. How must this struggle with the internal dissonance of these two types of science learning effect these, and other, students identity both as Indigenous people and as scientists? I believe this gets at the heart of why we need to change the way we teach science, these students need to have their traditional cultural values and knowledges centered, taught first, and the western science needs to be the add-on to their educational experiences.

Observation

An important part of science, both western and Indigenous, is observation and learning through repeated observation over time. It's also about asking questions and seeking answers.

John spent some time during one summer internship in a particular stretch of a local stream. "I started seeing all these different things, and it's like, the entire community, it, that stream got to know me." This is important because while John was observing the stream community, including the water, the plants and animals, the air, the ground, and more, the stream community was also observing him. In his observations, John said that "the five senses are involved, and I got to see the entire system, how it changed and how it moved, in the water, along the banks, in the air, you know what I mean? So I took a lot away and I did become smarter, I became a better person." The time spent with this stream, the connection John made with this place, taught him things and helped him to be a better person. "So you get to know the entire, how things work, just by observation and it was the perfect spot, just a little stream, but there's a lot of life there." Taking the time to observe and be observed, to create a relationship with a place, taught John about more than just the place he was in, it taught him about himself and how to be a better human.

Janice spoke on the importance of observation as well. She told me that "just being observant of nature and learning to observe when certain triggers in nature come about then you know other things are happening. Like the changes of seasons, and when certain foods are ready, like if there's a bird or if a plant down here is blooming then you know that berries in the mountains are ready." For Janice, an Indigenous person living her traditional ways and values, observation is incredibly important. She learned this

from her mother and grandmother, and much of the knowledge she uses and feels is essential has been passed down for many generations. Mya related making observations to recognizing patterns. "Indigenous science to me is like a general understanding of the system of something…what you learn from Elders, or you learn from other people. It's being observant and recognizing changes and patterns and effects, causes and effects of things." While she was speaking specifically on Indigenous science, this applies to western science as well.

Oral Traditions

Part of what these students feel defines Indigenous science is the oral tradition within which Indigenous knowledges are passed on. Leslie said that "Indigenous science is oral traditions about the land and how the people who lived here used to work with it, and I think it's different because with this one it gets passed down through oral traditions, stories, and I feel like it's more, to me it's more important that real science." Again, we see the notion that western science is the 'real' science, even though Leslie is saying that for her, the Indigenous ways of knowing are more critical. After a bit more thought, she added "I guess to me Traditional Ecological Knowledge is also science … just hearing oral traditional about how the landscape used to be before it is now … they would just know the times, the seasons when the land changes and stuff, and when the plants, the berries come, and the bitterroots." As did many of the students, Leslie seems to be thinking of Indigenous science as the add-on, that it comes after, or in addition to, the western version of science. I went on to ask her how she heard these oral traditions, who told them to her. "I think, going to the longhouse, Elders there would talk about it, like at feast. Or I would hear my grandparents talk about it, aunts and uncles." This type of

scientific knowledge, that passed down by Elders and community experts, should be the primary science learning for Indigenous students.

John also touched on this topic, in fact made the connection between western and Indigenous science prior to me asking about it. He said that "something I discussed in my own head was both traditional knowledge of Yakama and the scientific method are more, are, rely on repetition." He is recognizing and naming that there are correlations between the two scientific paradigms. John went on with "some of the oral traditions, even from my grandma and beyond, my great-grandma, and some of my uncles even today, they say things to you until you're totally sick of them, they drill things into your head. That's a component of the oral tradition, repetition, and then also the scientific method, reproducing an experiment and doing it over and over and over, so there's a similarity there." While some of the students recognized and named that there are both similarities and differences between Indigenous science and western science, many are still trying to tease apart how they overlap, where they are different, and what this means for them as an Indigenous student in a science degree program.

Time, Connection, and Place

The time we give/allow to learn something looks different in western science education as compared to Indigenous educational practices. John told me that, when thinking about Indigenous science, "there's no time frame, with all the elderly people I've worked with, there's no limit, there's no set time that you can expect to sit there, or there's no limits on what you can talk about, it's just a conversation, but their knowledge." Learning and teaching in this way is obviously very different than the way

that the western academy puts time constraints around education. It also connects back to learning in and from a place, as well as intergenerational learning and teaching practices.

Many of the students also made the connection of how important place is in Indigenous science, and particularly Indigenous science education. Nicole made this quite clear when she stated "why do I want to know something maybe in the city, or on the other side of the planet when I could be learning something that would actually help my real life and my tribe, my people. I think it's important for me to know things related to science here." When we were speaking about place, Rainie told me that "I think of the word TEK, Traditional Ecological Knowledge, so, we believe everything is sacred, and so everything has deep meaning so you want to take care of it and respect it." The concept of reciprocity shows up here, and is connected to the land and place and why these students feel such a deep connection to their homelands. They have a desire to learn with and from their place, and for the purpose of caring for the land and resources as well as all the inhabitants found there, human and more-than-human alike. This notion is inseparable from Indigenous science, and therefore should always be integrated into Indigenous science education.

When I asked Nicole what advice she has for incoming students, she said "I would suggest taking what you learn and also trying to make that into something from home." She feels that this applies to Indigenous folx all over the world, not just from Yakama Nation. Nicole further explained that

> I went to, on People of the Big River, the Environmental Science course over the summer, we got to travel to different tribes, and a thing that I was impressed with was, overall, was there are so many different tribes working insanely hard … and

so even if, as an Indigenous person, often, more than often we are set up to learn things that are not, maybe, like something in the city also, but like, how could I take that and how could that apply here?

Her feeling was mirrored by many of the students; they want to make their learning applicable to their community, their tribe, their homelands, and themselves.

Research question

What are the opportunities and constraints for Nation-building within place-based educational practices in the Western academy?

Intergenerational Teaching and Learning

One opportunity to promote Nation building within the western academy is to provide the time and space, as well as other supports, for intergenerational learning. Learning from Elders is critical, and can potentially be a part of educational practices in the western academy. There are existing examples of what this can look like and how it can be set up, such as how Dr. Virginia Beavert, a Yakama Elder, works with linguistics and other students at the University of Oregon, or Elders in Residence programs such as those found at the University of Wisconsin and the University of Victoria, among others. Working with younger students, such as K-12 students, is another way that intergenerational learning can be nurtured, as well as mentoring and peer support strategies for undergraduate and graduate students.

All the students in this study commented on the importance of learning from Elders in one way or another. I have already provided a multitude of student quotes that refer to the role Elders play in their lives, but there are many more. John told me about how the Elders have come to share some of this knowledge, remarking that "the way that

elderly Native people lived, almost in complete balance, like I said, because they were in it every day, they were on the river every single day…In that system, that's their home, that's where they live, they have to take care of everything." He is speaking to one reason that listening to and learning from Elders is essential; they have lived with and on the land and know it better than anyone. Billy told me that the "main person I get stories from is my Gramma, my mothers' mother, she lived in the long house and she lived up to 105… I was just like hey Gramma, how are you doing, give her a hug, and ask her, you know, about history, and the general area, and where she's been, and she would, indirectly it would be scientific." He expands on Elder knowledge, and how living in a place and interacting with it so intimately gives these Elders knowledge in context, scientific proficiency in relation to the needs and actions of everyday life. Rainie made a similar comment, stating that she likes learning from the Elders. When I asked why she said "Elders tell you stories about their Elders or what they went through or history, or what to do with this, or how to do things." The expertise the Elders provide is varied and comes in the traditional oral format, all of which make it critical for Indigenous students to have this resource in their educational experiences.

John also talked about the importance of youth as well as Elders in his traditional ways of learning. He told me about a lesson he helped to facilitate, focusing on building a sweat lodge and given by an Elder. He told me "all the kids were there, all the kids were right around us watching. It was really beautiful, it was a really beautiful lesson." John also told me that during this lesson, and many others, that "everything had a purpose and a meaning, maybe that's why these kids have a tough time getting up and going to school,

because they wonder what that purpose is." The Elder was able to connect with both John and the younger folx, as well as weave in the importance of community and connection.

I spoke with almost all of the students about the influence and relevance of Elders to their education, the quote from John just above is one example. Nicole also told me about how important it is to get out of the classroom to learn, as well as her experience with Elders. She said "I've heard elders say here, you know, if I'm going to teach you about bluebirds I'm not going to put a book in front of you I'm going to actually take you out to the hills and show you and teach you about bluebirds." Nicole's statement reaches to many of the themes that come from these student interviews. Learning from Elders, from place, being outside of a classroom, and learning in context all show up in this one simple, yet complex, sentence.

Learning in Context

Janice talked about her roles as a learner and as a teacher, while also touching on her purpose and reason for pursuing this degree at a university. She said "as I was growing up and then as I was becoming a woman, and having children and becoming a food gatherer, teaching my children all these things and being attentive towards nature, and the huge shift we had when our gathering times were, which kinda scared me as a food gatherer and as an Indian person here." Janice identifies herself as a Native person and as a woman, as well as someone who is being observant of the world around her and paying attention to what the land and the place are telling her. She knows that being fully present in her physical world is essential, and she is looking and listening for the stories being shared by land and place and her more-than-human relatives. Janice went on "I thought, well, you know, somebody's going to need to do some research in to the kind of

stuff, and what's going on, instead of us just going along and wondering what's going on. I wanted to learn for myself and for my children." Janice is talking about the concept of reciprocity, both her responsibility to land and place as well as her responsibility to her family and children.

John also combined these two topics when I asked about the similarities and differences between western science and Indigenous science. "The concepts are the same. I think there's so much knowledge in these elderly people, it's traditional environmental knowledge…I have this drive to combine them, you know, so I can explain, communicate to our people, Native people, what's going on, and use the environmental chemistry as backup, but also use the traditional knowledge as backup. But really they are better when they're combined." He recognizes that learning and teaching in the context of place and time is more effective and makes more sense than attempting to 'do' science as a discreet subject. He also recognizes that western science has value and a place in his studies. Billy told me that "there's a lot of knowledge to be gained through Indigenous communities, but it's a difficult task to have them integrate to a scientific understanding. So to be able to gain more traditional ecological knowledge, this program is placed to be able to assist Indigenous peoples to be able to, into understanding that more people can come to terms." This combination and this understanding could potentially be used as a tool for Nation building.

A couple of students made a connection between science and religion. This correlation is significant because in Indigenous science, you cannot disconnect the two, everything is linked and related. Billy talked about the connection between science and religion, and told me that "you gotta treat education like how you treat your religion. A

lot of religion is being respectful, being kind, just your basic love thy neighbor. And, then treat the same thing, do the same thing with science. Be kind to it, treat it with respect, be kind to others with your science." Billy is making a link here to how people can and should interact with each other and with their land and place, he is saying that science exists within the context of relationships. Janice also made a similar connection when she said that "to me it (science) makes my religion and who I am and where I come from, it's even stronger, It's like all these connections and how we believe, you know, we are all, everything's in a cycle, or in a circle, you know, even to the smallest atom, to me it's so enriching." These students are making the idea of the connections and relatedness and relationships come to the forefront; they are centering their Indigenous knowledges.

Reciprocity

All of the students, in one way or another, talked about the concept of reciprocity. This came through most strongly when I asked them why they chose to participate in this degree program. John talked about wanting other Indigenous people, particularly young folx, to see someone like them and have confidence. He said "I want people to see the work the way I see it. Especially Native, the ones that are going to come through Heritage and, and be like me, and think that Natives are so different, I'm so different, they're not going to understand, nobody's going to understand who I am." For John, the significance of seeing other Natives in scientific fields reaches to issues of identity, and hopes that his participation will show that Native folks are scientists. He went on to say "the scientific research, like Native ways of knowing, I want young Native students to see my work, so they don't have to feel confused or unsure or hesitant about wanting to do research and

science." John wants to show others that they can do this work, if they want, and they can do it in a way that honors Indigenous folx and Indigenous knowledges.

Mya spoke about the students at the middle and high school levels in the local area and the work she did with them. "I feel we need more programs like that, especially where it's so secluded and rural. To expose the younger generations to all these neat things that are out beyond what they know." She recognizes that many of these students have limited resources and opportunities in their current educational experiences and wants to help them widen their thinking while honoring their Indigenousness. As she is thinking about what she wants to do after she finishes her degree, she said "I really like the outreach that can be done, especially teaching youth about our environment and what our world is going through today and how we can minimize our impacts and why that is important." As with most of these students, her plan is to give back to her community.

Francie talked specifically about how the iNATURE program is helping her balance western science and her traditional Indigenous values and ways of knowing. She told me that "what's kinda cool about it, so, it takes people who want to have something to do with, like, nature and all that, and brings in the science perspective, along with keeping you, I guess, connected to the past and your heritage. But then also pushes you to get, to go to grad school, helps you have advisors to do that, get their experience through the process." Multiple students expressed their hope and eagerness to work with and/or for their tribe once they earn their degree. Leslie told me that she feels "it's important for Natives to get their advanced degree so they can come back and take back over our programs, especially the natural resources." This is another example of how Nation building can be accomplished and expanded through science education, if we can center

the Indigenous students and Indigenous knowledges in that educational process. Further, she wants to "work with my tribe to, with the Natural Resource department, to hopefully, so that the future generations will be able to continue practicing our ways." Leslie recognizes the importance of, and is working toward, supporting her tribe by doing western science along with practicing traditional values and lifeways. Both Francie and Leslie, along with other iNATURE students, expressed their desire to maintain and honor their cultural worldviews and lifeways, while integrating western scientific knowledge, and doing so in order to help and benefit their families and tribal communities.

Summary

The students in this study were thoughtful and insightful, and shared with me pieces of who they are, where they come from, and what they hope to do in the future. They expressed that their instructors can be quite effective in decolonizing science curriculum, pedagogies, practices, and science education in general. To do this good work, we need more Indigenous faculty and instructors, and we need to guide and assist non-Indigenous faculty on how to practically and respectfully do decolonizing work. Students also stated that learning outside the classroom and from the place in which the university and students are located is important. They conveyed the need to center Indigenous knowledges and ways of being. These students want to be close to home, they need to have their cultural connections and community ties be supported and maintained, and they are requesting supports for on campus Indigenous-focused communities and groups, particularly in their specific degree programs. These students spoke on their understanding of science, western science and Indigenous science, including the components of observation, oral traditions, time, connection, relationship and place. They

told me that intergenerational learning is good and necessary, as is learning in context. These students expressed a deep sense of responsibility and reciprocity, showing a desire to get this degree in order to do good work for their family, their community, their tribe, and other Indigenous peoples.

INTERLUDE II

As I step out of the van and put my hat on, I look around the parking lot. It's really more quasi-campground than simple parking lot, and for a minute I think "this is it?" Because we've come to learn about traditional fishing practices and the changes that have occurred in the fisheries on these rivers in the last century or so. There are dilapidated trailers parked, probably permanently, in this parking lot, and there are small buildings made up of corrugated metal scraps and ply wood painted and faded to all sorts of colors. There is equipment that I can't identify, and a number of boats of all shapes and sizes. It smells of motor oil and fish and cooking grease, and river above all. As we wait, I'm not really sure for what, a train rolls by, only maybe 50 feet away, and it's loud and disruptive and I can't help but think how awful this must be for the fish, the river, and the folks that live here.

Two old men walk toward our group, and I immediately feel a connection to the smaller of the two; he reminds me of my grandfather. He wears well-worn denim pants, a t-shirt with a pocket holding a pack of Marlboro's, a Pendleton vest, too-big aviator shaped glasses, and a black ball cap that indicates his military service in Vietnam. The taller of the two also wears denim pants, but he has a plaid button-up shirt with those pearlized snap buttons, and a blue ball cap with a tribal logo on it. These men are Elders and they deserve and command respect. I can tell those in my group feel this too; we all become quieter and watch more closely. We greet these men as respectfully as possible, and honestly, I'm trying to look and listen to make sure I don't do or say something stupid. We give them our names and tribal affiliations, our relations if they might know them, we thank them for allowing us to be here and for talking with us.

We stand at the confluence of the White Salmon and Columbia Rivers, as we know them in the English language, the settler colonial language. Earlier today I went with my fellow iNATURE mentees and mentors, and Brian, rafting on the White Salmon, perceived it's power and beauty and maybe a glimpse of what it's supposed to look and feel like. We also visited a site of dam removal and saw the beginnings of restoration work, learned about some of the damage done to the river and the fish and the tribes.

We try to make these Elders as comfortable as possible; find them a place to sit in the shade and get them water. They are willing to gift us with stories, for which we are all grateful and humbled. They tell us of what these rivers were like when they were young men, how they ran in the spring and in the fall, where the good fishing spots were, the traditions around catching and cleaning and preserving the fish, that they always shared their catch and how that is the way it is supposed to be. They tell us about the loss of the fish, the loss of their language, the loss of traditional ways and stories and values. The loss of their young people to colonization and assimilation. How this place, the one we are standing in, used to be a beautiful and bustling center of wealth and tradition and culture. How it's now just an ugly parking lot, and even at that how the governmental authorities are trying to kick them out. And yet, it is still teaching us.

There is much wisdom in these old men. They are Elders. They have done and continue to do important works in their communities, and they are much respected. I can feel this, both from the men themselves and from the students around me who know of these legends. These are true teachers and educators, and ones that we all need to be listening to and learning from.

CHAPTER V

FACULTY EXPERIENCES

"Young people are the future of caretakers of this country. It is essential that they obtain an education in science and linguistics to keep pace with the modern world, to protect their natural environment and preserve their identity." (Beavert, 2017, p. xi)

Introduction

This chapter examines and explores the responses given to me by two of the primary faculty members in the iNATURE program. Although I begin by briefly touching on the question of: What are the limitations and possibilities of decolonizing science education in the western academy?, I focus primarily on the question: What are the primary tensions for non-Indigenous instructors teaching Indigenous students science? These faculty talk about the tensions they experience around educating in a culturally responsive and responsible way while still attempting to teach the western science that the students will be expected to know once they earn their degree, how to advise on Traditional Ecological Knowledges that they themselves do not hold, balancing their personal lives and giving of themselves to and for their students, academic security, and the fact that they have received little training in how to be teachers. Their care and concern for their students, as well as their desire to do good work for and with them, is easily apparent. What is less immediately obvious is *how* they should do that good work.

Research question

What are the limitations and possibilities of decolonizing science education in the western academy?

While almost all the quotes and thoughts coming from my participants could potentially be used to answer this research question in one way or another, a few of their responses fit very particularly into this category, and not so nicely into one of the other questions I'm investigating. Camille talked about a project that she has done, with different iterations, over the last few years. In it, students from Heritage University mentor students at a local high school. She told me that "finally what I built into that one was that we would bring Heritage students, they would be the mentors, we would pay them and bring them up. And do you know that every single one of those students, I mean they didn't know much more about the science than the high schoolers (laughter), let me just tell you how many posters I've made over those years!" She had tried to involved community members and local business folx in the past, but found consistency and time commitment to be an understandable challenge. So Camille decided to get her university students involved as the mentors, and while they may not have had a lot of technical knowledge, they were dedicated to the project and adept at creating and maintaining relationships with the high school students. She went on, saying "it has been profound, the impact of those students mentoring the high school students, with us here, relationships built, getting the posters done. It has, I honestly think it has changed the trajectory of what most of those students want to be part of their professional careers." She found that the impact of having her university students be the mentors for the high schoolers was beneficial for all the students. Many of the students that I interviewed

talked about this aspect of Indigenous learning as well. Working with other students, intergenerational learning, can be a very important way that decolonizing work can be done, even within and through academic institutions. Camille continued, saying that "the two speakers we had last year both of them had done EnvironMentors, they had been mentors, both of them mentioned it in their graduation speeches. I was like, damn, EnvironMentors cleaning up!" Having folks graduating from Heritage with their Bachelor of Science mention EnvironMentors as a significant part of their educational experience shows just how deeply it has impacted them, and the potential intergenerational learning programs have to continue, advance and support decolonizing works.

> Because it is that act of giving back, that reciprocity, that is so critical. And now they know how, and they know how imperfect it was, and they know how crazy chaotic it was, because it was me doing it, and disorganized, and all of these things, and yet the students all had posters. And yet, they went to DC, and yet it all worked out in the end. And by doing that, it's not just a one-time thing, it's every week, that, it had a huge impact on our students.

Camille undeniably asserts here that nurturing the continuity of the relationships being built is necessary, and that it takes time and deliberate effort to make this happen.

Camille goes on to say that

> they all want to give back. This is providing the avenue for them to do it, they get paid for it, to varying degrees, but still they're getting paid, it's being recognized. And they're, the students are looking up to them. And the students themselves, they love kids, you know what I mean, because it's more their age group. So it's

been, that's, I really like this model, it's been extremely effective all around, and especially for developing our students.

These students, in talking with me, made it clear that often times they want to do good works but don't have the financial means to volunteer their time. Camille is giving them a way to do the good work they want to do, and by paying them, at least a little something, makes it possible for them to meet their family obligations, to provide for their children and their parents, while also working in and for their community. "Because it is community based, impact on our local community, it may be the school that they went to. They, because of their own backgrounds they recognize what these kids are probably going through, and so they recognize how important it is to show up, and they always do. They don't show to class, but they'll show up to this! (laughter)" While many of the students I spoke with expressed being aware that they are seen or interpreted as being disengaged from their academic obligations, in this situation those same students thrive, they flourish when their educational opportunities are relevant and culturally respectful. Projects such as EnvironMentors bring together university and high school students, and allow the university students an avenue to give back to their community, to demonstrate their sense of reciprocity, as well as to make connections and relationships. This is a beautiful example of decolonizing work.

Research question

What are the primary tensions for non-Indigenous instructors teaching Indigenous students science?

What Students are Expected to Know

One tension that was present for both faculty members was feeling pressure to make sure that their students were equipped with the skills and knowledge that others in the science fields would expect them to know, while also being responsive to student needs. Brian told me that "we're giving them a Bachelor of Science degree, I have to just know there's certain things to cover and that they'll be expected to have if they go to grad school or in their jobs." And he is not wrong. There are topics, skills and processes that all students with a Bachelor of Science in Environmental Sciences are expected to know or be able to do once they finish their degree and go on to a job or further education. These expectations are centered in white male middle class values about education and individualism, as that is where western science resides. This structure is kept status quo partially because there is such a large percentage of white middle class male scientists and science faculty. But, to Brian's credit, he also expressed frustration with this system, in that he feels it limits and hinders his instruction. "My thought is that for them to succeed in this world that I had to succeed in they need to cover x, y and z, and that's where I don't feel like I have as much freedom." Brian wants to teach his students in ways that work for them, but at the same time feels that there are just so many things he must cover in a particular course. However, this is a tension, and is something he continues to work with and attempt to find solutions for. "I feel like every time I run a class I cut more and more and more so I can focus more on the, I guess, depth rather than breadth. There's some classes that lend itself better than others, like my more policy or social science side." Brian obviously feels that depth in his courses is important, and he expresses that this is easier for him to do with certain types of courses than others. And

while this is a tension, it is a tension because of his care for his students. “I know our students come from, they’re underrepresented minorities, they have an uphill battle already, they’re from a very lacking K-12 system, so I feel like if they’re not up to speed in all those aspects, then you’re not going to get taken seriously…but then I get away from what I think is, maybe, the best way to teach, so it’s a struggle with science curriculum.” Brian wants to do what is best for his students, both in the content he provides them and in the way he delivers that content. He is expressing a twofold critique here, one of the social inequalities that he sees his students are subjected to, as well as another of the ways in which the structure of higher education does not work for his students, and which, in this case, is not working for him either.

Traditional Ecological Knowledge

While there are multiple ways to define Traditional Ecological Knowledge (TEK), it can commonly be described as “a living, land-based knowledge which belongs to a community of knowledge holders of great longevity” (Kimmerer, 2012, p. 319), and as “systems of responsibilities that arise from particular cosmological beliefs about the relationships between living beings and non-living things or humans and the natural world” (Whyte, 2013, p. 5). In my interviews and other discussions with both Camille and Brian, it is evident that they see a huge value in TEK, and in teaching their students with and through TEK. There is some question on their part, though, of how to best incorporate it into their classes. Brian attempts to begin his courses with this type of knowledge. “I start more with Traditional Ecological Knowledge, which I was saying, and then since I’m not an expert and we have these prescribed points that I feel like I should cover for them to say they have an ecology course, I don’t spend as much time as

I would like." This shows that he feels less than comfortable teaching TEK, which is understandable, as Brian did not grow up living and learning the traditional knowledges of this place; he grew up learning western science and values. The tension here, however, is that this discomfort can also lead to TEK being left out of the curriculum as the semester goes on. He told me that he thinks "we need more of it, and since I don't feel the luxury, or the freedom necessarily, to include as much as I'd like, as much culturally responsive content as I'd like in the regular classes, I feel like maybe adding classes that really can cover that." Brian wants to have TEK as an integral part of his courses, which are science courses, but struggles with how to make this happen in a way that is authentic and respectful to the Indigenous peoples of the area and the Indigenous students in the classroom.

There is also a tension between the conventions of western science and Indigenous ways of knowing and being. "Then there's this, you know, objectivity, or pseudo-objectivity as I've kinda started to call it… Above everything, and then that minimizes these other ways of knowing, rather than incorporating them." Brian can feel that the objectivity required by western science minimizes, at best, and more often erases, the knowledge that comes with our Indigenous students, and that this expertise is valuable and should be honored. He goes on to say that "we need to teach students how to think, not how to recall a bunch of facts, and knowledge and history and theories and this that and the other, just like critical thinking, but without ignoring their culture and their ways of knowing and where they come from." Brian sees and feels the need for Indigenous students to have educational experiences that are respectful of their culture and their Indigenous values, but without the support and resources of the university or his

peers finds it difficult to adequately provide the culturally responsive teaching that is essential.

Balancing Privacy and Connection

Balancing privacy and personal life against a connection with students was an enormous tension for both of these instructors, although in profoundly different ways. Camille started out very involved in her students' lives, as she herself would say, perhaps excessively so and to the detriment of her mental health. For Camille, the dedication and love she provided to her students was critical for them; therefore she felt compelled to support them in as many ways as possible, as well as dedicate large amounts of her time and space to her students when she started working at Heritage. She says that "means that you are working crazy hours, and it means that you are so exhausted when you get home, because it's emotional, you have to give of yourself or you will get nowhere with this population of students. And not just Native students, all of the ones at Heritage, it's a broken community." This is another example of how the system of higher education does not work for Indigenous communities, as well as most marginalized communities, nor their faculty members that care and work so hard to make a difference. These faculty members, and other folks who work in higher education and do this kind of work, end up giving far more of their time, energy, and of themselves because the system is set up based on white male middle class heteronormative values. The system needs to be changed so that this type of work, the work that is valuable to the students and that needs to be done, is valued, recognized, and supported. Camille goes on to explain that

> the kind of attention you're giving them is all about their achievements, about their mind, it's about their potential, you have a safe space for them and they feel

like you can be honest with them, and when you make mistakes they let you know. Maybe not directly, maybe indirectly or whatever, but then you talk about it and the world doesn't end. And you're still there. And that's a big part of it.

Being a part of her students' lives, as more than a mere faculty member teaching a science class, was truly meaningful for Camille and her students, because simply being an instructor was not and is not enough for many of these students to succeed in college.

However, Camille also realized that she needed to create a boundary, so that her work could be sustainable in the long-term. She works within a system that is not set up to support the work she does with her students, certainly not to the extent to which Camille has dedicated herself, and which can be particularly hostile to women, especially women of color. She told me that "like I said there was some very large life sacrifices to do that. I was single forever, because who has the energy? Right? That's all I did for years. Those were the last years that I could have had a family, because, you know, biology. It catches up with you." Camille's dedication to her university students came with an inattention to her personal life; it caused her to neglect goals and dreams and hopes that she may have had for herself. While I think Camille would tell you that she is still working on this, she has also made some changes.

One of the things that I have, I think which is much healthier developed, and I'll tell you how that happened, is a little bit more of a boundary for me. Between the students and myself. I'm not sure if they really notice, but I notice, that the first ones, the first five years or so, those students, they were the first. The emotional toll is profound, exhausting, it's a beautiful thing but it's also devastating. The sacrifices that it required to do that, me paying that for as long as I did, and still

> am to a degree. The students needed that relationship, they needed somebody who would care, they needed somebody who understood, to a degree, understanding that I was different in my experiences, but understanding that I was really open to them. And they needed advocates. They still need advocates, people that will fight for them, people that will not adhere to rigid rules, but at the same time calling them out.

You can see the tension here, that Camille is compelled to help these students in whatever way she can, but at the same time this creates a personal sacrifice and is ultimately unsustainable.

On the other hand, Brian came at teaching and working with students from a different perspective, and one that is pervasive in academia, particularly in the science fields. He told me that "I think another thing that I'm trying to break out of personally, I've always, professionally I've never wanted to get close, so, and with students I wanted to have that wall, personally how I would prefer it to be, and that's just ineffective, and that's just changing as I develop more and more relationships and it's really helped with everything." This is something that scientists are trained to do and to be – objective and impersonal. Brian recognized that this is not a particularly good way to interact with students, particularly Indigenous students. He shared with me some reading he was doing, a draft of a dissertation exploring what Indigenous students, and all students, need from their teachers, as well as his thoughts on it. Brian said

> there was a need to include spirituality in the curriculum as a means of providing balance in the lives of students, that was like a direct quote. And then other things like warmth and emotion and all these things that really scare scientists, yeah,

> warmth, caring, sensitivity, humor, and trust characterize student-teacher relationships. But you can combine that with high expectations.

As he was telling me about this he seemed excited that someone was writing about the experiences he was having with his students, and that perhaps there was a resource to find more information on becoming a better teacher. He went on to say "that's like, so anathema to my training. Literally, my training was to minimize that. Minimize all those things that would make me a good educator to make me a good scientist." Brian is coming to terms with the fact that he feels that he may have to learn to be a different kind of educator than he thought he would need to be. "It's like, trauma victims often are the perpetrators later in life, so it's like, our traumatic education experiences we might perpetrate that on to our students and that will shut off these populations, or shut them down completely, so…" Brian learned to be a teacher by experiencing the example that his teachers, instructors, and faculty presented to him. And he is finding out that the white, male, middle class, western scientific set of values that was passed on to him is not serving him nor his Indigenous students well.

While Camille and Brian came at this issue from very different perspectives, and both feel the tensions around it, they each clearly have their students best interests at heart and are struggling to find their way through balancing personal life and professional teaching responsibilities. Camille summed this up by saying

> It's important to have, you can't work in these communities unless you give of yourself and you make yourself emotionally available. But it's about how to do it in balance, so that they still get the love and support that they need. And there has

> to be love. Even if you don't always like. (laughter). There has to be love there, and they feel it and they know it.

This is another way we decolonize, and indigenize, education.

Assumptions, Privilege, and Centering Student Voice

One of my favorite moments in interviewing for this project was when I asked Brian "what have you learned?" He thought a moment, gave a weighty sigh, and said "I mean, I'm *unlearning* a lot of things." Brian recognizes that he came to this university with an open mind, but that even so he needed to be ready and willing to receive and learn from what his students would bring.

> I think one thing that maybe helped from the get-go was the admission that I don't know this world, and just being fully clear about that and trying to surround myself with experts. But the more I've learned, the more I've learned that I knew even less than I thought, you know, about these problems and about how to be effective, and navigate these cultures here… I've lived in twelve different countries, I work with communities all over the world. And *nothing* prepared me, honestly, for the experience of the Native Americans in our backyard.

We all come with assumptions and having learned our own way of 'doing things', and this can cause some discomfort when we are faced with a different way of knowing or being. Brian came to teaching and to Heritage with a myriad of life experiences, and perhaps that background had prepared him to be open and willing to learn more. He also remarked that "I have this power position and I think that caused a lot of problems in the beginning, not realizing my own authority and power." Brian was very upfront about

these issues, and the fact that he is trying to learn with his students says a lot about him, and about why he is successful with these students where others are not.

Brian also shared some of his thoughts on the importance of lifting up student voices, of putting them in the center where white male academic voices have historically been dominant.

> I think having their voice there is so important, like with, now that I've been going to the diversity and inclusion seminars at all the big societies, at least related to my work, and that's the message I give them, I'm just like, our students don't feel comfortable here, how many Native Americans, we're in Alaska, did you have an Elder come bless, give his blessing to this?

Brian is doing the work of making Indigenous voices more obvious and centered in his academic world, and is calling attention to the fact that those in positions of power need to listen. He is thinking about and promoting what his students, as well as their Elders and community members, already bring to academics and the academy, and which is not always heard or appreciated, but that is important and needs to be listened to. He is also thinking ahead. "I think my goal is to get a student in my position down the road, so I'm not part of that community and I think the best thing we can do is create our own replacements." This statement shows attention to the importance of having Indigenous folx taking care of each other and their land and place, cognizance that the knowledges and ways of being that the land has taught them will sustain them and should be recognized and valued, while also considering intergenerational responsibilities as Brian looks to the future.

Academic Security

Another tension that both faculty members felt, in one way or another, was security within the academic setting. Camille was telling me about the beginning of the iNATURE grant, and said that "the reason that we did that was we knew that if this faculty member received a grant like that, they would be safe. Their job was secure, especially if it was related to building relationships with the tribe." She, along with a few others, were worried about hiring a new faculty position and then having it cut again within a relatively short time frame. Camille also knew that if there was a significant amount of money being brought in by the person in this position, they would be safe, or at least, safer; their job would be less likely to be cut. Also in relation to grant monies, Camille experiences those higher up in the university structure questioning her decisions. "Well, and everything I end up saying, every time that they throw up these huge barriers, they're always like, oh yeah, every single thing I do they question, and in the end they're like yeah yeah, because it's all above board. Everything. But it gets tired, I get tired of the fight with it all." So in the end Camille is doing the things she feels she needs to do, but there is certainly a toll taken by always being questioned, by the constant scrutiny, and knowing that this is what will happen when considering a new project.

Camille also talked about helping other faculty members. "You know, I had a lot of materials from different grants and he certainly knew that, fisheries was going to be the focus, and that's how I brought in all my connections, bring in these folks to try to agree to be on it, and a lot of the structure actually came from me." Camille had experience writing grants for Heritage, and she was more than happy to share her knowledge and connections with a new faculty member, to assist them in getting their

career and projects up and running. She also knew that, while she could certainly provide assistance and advice, the new person was still going to need to pick up the grant project, make it their own, and run with it. Camille told me that

> it's one thing when you, because I've done this since and I'd done it before, you can hand over all your materials to people, you can help them, you know, put the general ideas in place, but they're the ones that have to write it. And they're the ones that have to craft it, and in the end it's going to be in their voice.

She seemed very willing to help others, not put off by it at all, and at the same time perceived that for as much effort as she could put in, that other faculty had to, in the end, be the one to put the pieces together and finalize the project. She didn't mention it specifically to me, but there is a tension here of spending time, valuable time, helping others when perhaps that time could be spent working on one's own projects and courses.

Both Brian and Camille expressed a tension around wanting to do good work for and with their Indigenous students, and having a push back response from their peers at the university, as well as the academic world more broadly. Brian expressed this when talking about courses he would like to teach. He told me that "I know I'll get a good reception of it from the humanities and all that, but, like, within my own peers they are going to think it's ridiculous and they'll never send their students." This is a real worry for him, and he seems to be trying to find a way to resolve this issue, but it's not easy. Camille talked about advocating for students more broadly, how injustice is rampant and insidious.

> When you're having to fight, and fight so hard, against all these odds, apparently, to stop just profound exploitation of our students, you do that fight,

> because I was one of the few people that could. I was really truly one of the few people that was in a position that, because it was the last president when this was, that he would never fire me, I was in a position of strength, so I could and I had to, and I had to speak out.

Camille clearly feels compelled to protect her students, to fight for them when necessary, and in this instance she felt that she was one of the only people on campus that could do so effectively and without being fired from her job. Camille's advocacy comes at a cost, however. "I became a massive target, and to this day there's, you know, but we did stop what needed to be stopped, you know what I mean? It woke up a lot, but it took a lot, it wasn't just me, but I took a lot of hits for that." She reminds us here that doing the right thing for students, for human beings, for Indigenous peoples, may not be easy and can certainly have personal and professional ramifications. She chose to risk her job and some of her relationships in this situation, but one can understand the tensions inherent in doing so, and the questioning of what to do the next time something like this might happen.

Gender Differences

Perhaps not surprisingly, as a woman of color, Camille was the faculty member that talked about the gender differences she sees and experiences in the academy. I will argue that she sees and recognizes these differences to a greater extent because she is subjected to the oppressions of being a woman of color in the academy, whereas Brian has the unearned privileges that come with being a white male. Camille pointed out that gender matters to students, that students do, at times, respond differently to an instructor based on their gender.

> I think one of the reasons why it's so important to have diverse faculty in terms of gender is that many times, not always, but many times it is easier for women to be able to do this than men. I am in no way saying men can't, we have tons of examples. But from what I've noticed, it does, the maternal thing, and it is a maternal thing, it, they respond to it. Like Billy, first it took him a while with me, and then he just totally, and then he felt good about moving on to Brian.

She obviously sees and feels that students respond to her in different ways, because she is more accessible, or is perceived as such, as a woman. At the same time, she feels the gender barrier put in place by officials at the university. "I'm not demure. I'm not accepting and soft spoken and respectful in the ways that women should be. I don't dress sophisticated, or apparently well, I don't wear makeup, I'm fat. (laughter) But it does matter." Perhaps this quote should be in my section on academic security, but this is very specific to gender. Camille is seen, and interacted with, differently than her male counterparts, as a woman in a science field, and as a woman who does not conform to academic and institutional gender norms.

Camille also talks a little about gender differences that she sees among her students. In the program, in the years that I interviewed students, there were six women and two men. In a science field, this gender split is the reverse of what we would usually see. Camille observed that in this community "men are just being left behind. Where you see that across these cultures, where the men are being left behind. And that is tragic for the women because it's the women who are trying to make themselves, if they don't have a partner to, it creates this massive…" While it was difficult for Camille to fully articulate her thoughts here, she seems to be alluding to the fact that on the Yakama reservation,

like many reservations across the US, a gender imbalance has occurred as a result of colonization and the years of trauma that Indigenous people have experienced because of it. The imposition of heteropatriarchal values and norms upon Indigenous people has created a situation in which the men are oftentimes no longer performing their societal roles the way they traditionally would have. And as we see here, many of the women are attempting to revitalize their communities as well as continue their traditional practices, while suffering the loss of their partners in the process.

Not Trained to Teach

Both faculty members talked about how they are very highly qualified and experienced scientists, but that they received very little or no training on how to be teachers. This is very common among university professors. Camille talked about this in multiple ways, both as an instructor and as someone who works with folx who have been through and/or are experiencing trauma. "Because we don't, I mean, we talked earlier today that science, especially faculty, we do not get trained at all how to teach." Camille's experience is another piece of evidence that while most faculty do not have training in how to teach students, particularly students that come from marginalized populations, they most certainly should receive that type of guidance and instruction on a regular and ongoing basis. But this issue goes deeper, as Camille points out as she continues in saying

> we also don't get trained about how to emotionally deal with very serious situations with our students. And when you're working with a population that has such crazy statistics for all kinds of disfunction, abuse, and all of these things that are, that you can't assume that everyone but your students, it doesn't work like

that. And they'll tell you things, they'll reveal things to you because they trust you and, we don't get trained with how to deal with that, how to carry that.

And carrying some of those burdens and worries with and for students, is heavy and hard.

Brian also talked about the lack of training to teach. He said that "literally, my training was to minimize that. Minimize all those things that would make me a good educator to make me a good scientist, and so, kind of deconstructing that is also, I don't know…" The academic system within which Camille and Brian and I all work and teach is a colonizing institution. It is based on, promotes, and advances a white male middle class set of values. These values do not make a person a good teacher, and there is no system in place to assist professors and faculty members to become better instructors and educators. Furthermore, Brian said that "what makes a superstar faculty has absolutely nothing to do with what the job is supposed to be. It's like teaching gets in the way, you know." The academic system is set up to reproduce scientists in the same model as they are now, to maintain the status quo, and effectively reaching students is not a value that is at the forefront of these organizations agendas. Unless we change the system, effective teaching practices will continue to be shoved aside and devalued. In talking with Brian, he obviously wants to be a good instructor for his students, and is feeling the tension of not having learned how to do that in his own preparatory work at universities.

Summary

The two faculty members in this study, Brian and Camille, were generous with their time and thoughts, and gave me much to think about. They are showing the importance of having university students work with high school students, and provide an excellent example of intergenerational learning, creating and maintaining community and

connections, and a way to do decolonizing work through the structure of an academic institution. They show how white male middle class values define science education which create barriers for faculty and instructors to also practice culturally responsive and culturally inherent teaching. Both Brian and Camille want to teach TEK, to have it be part of the curriculum, but struggle with how to do so appropriately and respectfully as non-Indigenous folx. Each faculty member shared their tensions around balancing personal and professional lives, letting students in and showing their concern and care, while also taking care of their own health and needs. I heard the importance of unlearning and relearning, of promoting Indigenous voices in the academy, and of job security and supporting other faculty. Gender differences for both faculty and students was talked about at length. Camille and Brian both highlighted how they have been highly trained as scientists, but have received little to no training as educators, and that this is an issue for them as well as most other faculty at universities. Much of what these two faculty told me emphasizes a critique of the structure of higher education, and demonstrates the tensions educators who want to support, reach, and advocate for their students, as well as do decolonizing work, face in the academy.

INTERLUDE III

I am sitting on the couch in Camille's living room, one leg tucked underneath me, turned sideways so that I can look at Camille on the other end of the couch as we talk. We have both spent most of the day at the university, some of it together and some doing our own work and projects. I gave a talk today highlighting some of the findings from the research I've done with the folx here. The talk went well, the majority of students from the local Tribal school attended, as well as many people from the university, and an Elder even gave me a gift of thanks at the end. We also had a couple of meetings together, getting started on the next project, or perhaps really continuing the same project in another way. I did some work on my job search, and Camille taught a class and worked with a few students. I've been asking Camille to do this interview with me for quite some time now, and it's just finally happening because things kept getting in the way – work, distance, too much going on, life. On the coffee table sits white Styrofoam take-out containers, holding the remains of our mostly devoured dinner. We stopped at a local hole-in-the-wall place on our way to her house, grabbed some teriyaki chicken and rice and vegetables. As I sit here, the house plants almost take over, they are prolific and they help to create a calm and comfortable atmosphere. The dog keeps coming over to set his head in my lap, wanting to have his chin and ears scratched. Toward the end of our conversation, I ask the same question I always ask at the end of an interview: "What should I have asked you, or what did I miss that you want to tell me?" And this time, the answer is a humbling surprise, and is especially meaningful as it comes from someone that I have come to consider my friend. Camille says:

> I think what you have done is one of the most important things that has ever been done at Heritage, and I mean that. This is the first time we have this level of research into who we are and what we are doing, where we've been, where maybe we need to go. I mean, all of this, it's just so incredibly important, and I'm super grateful that you decided to, you know, come to this crazy quirky place.

Doing this research, this work, is important. This work is an act of relationship, of connection, of love. It is Indigenous knowledge. This is research done *with* and *for* the folks at Heritage. She goes on:

> It's so meaningful to them that you're here, you're not just anyone. It's a big deal, you're not just doing research on them, you're one of them. And its, you are an inspiration, because you're getting your doctorate… And they like you, and that's the other thing. That you're doing all this but they even like you! (laughter)

In this next chapter I write about the students doing their work because of their sense of reciprocity, that they are doing this work for their family and community, for Indigenous students and Indigenous people, for others. And I understand that, because those are the same reasons I am doing this work.

CHAPTER VI

SIGNIFICANT FINDINGS, IMPLICATIONS, AND FUTURE GOOD WORKS

"To move beyond such normalized Western constructs of social science requires that educational researchers willingly center the realities, desires, and stories of the people with whom we work. We must situate their stories in relation to our stories, lives, and research projects in humanizing ways." (San Pedro & Kinloch, 2017, p. 374S)

"as Indigenous people and decolonizing educators, we have responsibilities that require/urge/direct/instruct us to be good ancestors to future generations of human and non-human entities, to the earth and sky, to land and water, to the stars and the molten crevices of the earth, to the past and the future." (Smith, Tuck, & Yang, 2019, p. 23)

Introduction

In the processes of meeting, interviewing, spending time and building relationships with students and faculty at Heritage University, these folx were gracious enough to share with me many of their thoughts and feelings on education, science education, and Indigenous education as well as many other related and pertinent topics. The students spoke about how they value learning in and from land and place, intergenerational learning opportunities, caring and supportive faculty, centering Indigenous knowledges in their science classes, oral traditions, community and connection, reciprocity, and keeping science education in cultural context. The faculty talked about balancing their care and concern and the amount of themselves they give to

their students with taking care of their health and well-being as well as having a personal life. They also spoke to the tensions around teaching the skills and content that students will be expected to know when they graduate while also being culturally respectful and responsive educators, the lack of training they have received on how to be good teachers, and what it means and looks like to incorporate TEK into their classes as non-Indigenous instructors.

I came to this research in the hopes of investigating the following questions:

- What are the limitations and possibilities of decolonizing science education in the western academy?
- What are students/participants conceptions and understandings of Indigenous science?
- What are the opportunities and constraints for Nation building within place-based educational practices in the western academy?
- What are the primary tensions for non-Indigenous instructors teaching Indigenous students science?

My participants are helping me to address and answer these questions, and they have helped me to think more deeply about Indigenous science education, as well as how to better prepare educators to teach Indigenous students and Indigenous science. There is a wealth of information that my participants provided, and it much of it falls into the following themes: place and land; relationships, community and connections; reciprocity; and decolonization and Nation building. This chapter takes the information these wonderful folx have shared, and uses it to delve into the issues of what needs to change within the western academy to improve the educational experience of Indigenous

students as well as what universities and other educational institutions can and should do to support and honor Indigenous students and communities.

Summary of Significant Findings

In our current educational systems, both k-12 and higher education, there are not many Indigenous instructors. In recent years, across the US about 0.4% of elementary and secondary teachers are American Indian/Alaska Native (AI/AN) and less than 1% of college/university professors are AI/AN (National Center for Educational Statistics, 2019). While this is an issue that demands to be remedied by having more Indigenous folks as teachers and professors, we also need to find other ways of decolonizing and indigenizing curriculum, pedagogies, and practices. It is urgently necessary to give non-Indigenous teachers, instructors, and faculty members ways of doing the work of decolonization in their classes, to provide them with examples of respectful practices that promote and honor Indigenous knowledges. This can include bringing Elders and other tribal experts to classes, as well as taking students to those Elders and experts. Another critical piece of this is learning with and from the land and the place in which students are Indigenous. Place-based educational practices can improve the learning experience for Indigenous students, and for all students and teachers/instructors. Intergenerational learning is another aspect that can be foundational for decolonizing science education. This can and should include college students, elementary, middle and high school students, graduate students, community members, Elders, and others. All of these types of instruction need to include learning through story, and a deep respect for oral traditions.

Community is also highly important for our Indigenous students, and in the context of education this means learning with, from, and for their families, Tribes, and other Indigenous folx. These students need and want to keep their community and cultural connections alive and well, to use their education at a university as a way to strengthen those bonds. The instructors in this study felt and saw the importance of connection and community to the students, and to their own lives, in their work with Indigenous students. Students and instructors alike spoke on and to the importance of the communities that they come from, and they also noted that creating a sense of unity within the group of Indigenous students in a program, at the university, created a better educational experience. This was, in fact, critical for some of the students to persist and succeed in their chosen degree. And, as noted by all the participants in this study, the students need their instructors to be accessible to them, to be a part of their network of collaborators, friends and allies.

In my interviews with the students, they all identified ways in which Indigenous science and western science are both similar and different. In particular, they noted that keeping the context in which science is 'done' is important for them as Indigenous folx. One way to move forward with attempting to decolonize the academy revolves around students own view of western science and Indigenous science. With the students in this study, we see that many of them make a distinction between the two, and even some that prioritize western science over Indigenous science. The possibility here lies in centering the Indigenous knowledges that these students bring with them, as well as the knowledge that the Elders in their community hold and care for. The place in which they live, and the land that is their teacher, also needs to be prioritized. If the instructors of these

students, all of them, can focus on the Indigenous knowledges and science as being more important, as taking precedence, as having been in this world for much, much longer than the western, then a decolonizing move can potentially be made. For the students to understand and know that their Indigenous knowledge is meaningful and necessary, is imperative. Exploring the way the distinction between Indigenous science and western science is understood may give us a way to support students in valuing their traditional histories and knowledges, while also learning and having respect for the western science, and furthermore may carve out space in the western academy for Nation building to occur.

Something I heard over and over again, from each of my participants, is that their reason for pursuing a science degree at a university is not for their own personal gain. Yes, they may be quite interested in science and the things they are studying. But they are getting this degree, working hard at something that doesn't come easy for many of them, in order to build, support, enrich and help their children, families, communities, Tribes, and other Indigenous peoples. They plan to do this by earning their degree and then going to work for a Tribal entity, by working with and for the children in their communities, and by infusing their work with traditional knowledges and practices passed down to them by their Elders. Reciprocity is a strong theme that runs through all their words and stories, as is the importance of Elders and children. Academic programs need to have intergenerational learning components, as well as opportunities for students to give back to their communities, built in to their foundations. Teachers, instructors, administrators, and all those working with our Indigenous students need to recognize, respect and promote the importance of relationships.

One of my research questions was focused specifically on the non-Indigenous instructors and tensions they face in working with and for Indigenous students. One pressure these folks are feeling is that there are simply certain things students are going to be expected to know and do if they earn a science degree. And while this sense of strain is not unique to their Indigenous students, in fact they feel this for all their students, the challenge of how to adequately address this, while still being responsive to student needs, is more complicated with their Indigenous students. Along with this sense of pressure, the concept of objectivity and the western desire for scientists and teachers to be objective, is contrary to the Indigenous students sense that all learning is contextual and the instructors therefore feel a tension around how objectivity minimizes and erases Indigenous knowledges. Perhaps connected to this idea is the desire that these instructors voiced for pushing student voices to the forefront, not speaking for their students but opening a space for the students to speak for themselves. The instructors also expressed feeling that there are risks they take to do this work, professionally and academically, that their peers don't always appreciate the work they do when it is different from the scientific standards and norms of the field, and that they may face some negative consequences at times because of this. A substantial tension that these instructors talked about is attempting to balance their connection with students, allowing students to know them and therefore to come to trust them, while still maintaining appropriate boundaries. Each of the instructors in the study had differing views and experiences with this tension, but both felt it acutely.

One of the instructors in my study, perhaps not surprisingly the female instructor, had a lot of insightful things to say regarding gender differences and an imbalance. Camille is a woman of color working in an institution which holds white male middle-

class heteronormative values, as do most universities and educational institutions, and is exposed to these oppressions on a daily basis. She spoke to the level of discrimination she herself feels as a woman in a science faculty position. Camille also talked about the effect of these institutional values on being a teacher working with students, and in particular her Indigenous students. She shared with me her insight into the community and the tragic events that she has witnessed, as well as how a gender imbalance exists within this group and the effects it is having on her students, both in their lives outside of school and how those consequently carryover to the university setting.

In this study, the instructors are university faculty members and are highly trained as scientists. As with the vast majority of their peers in the higher education setting, they have little to no training in how to be effective as teachers, let alone culturally sustaining/revitalizing teachers. Any education they have done on how to work with specific populations of students, such as their Indigenous students, has been voluntarily sought out by them and done in their own time. They also have no guidance on how to deal with the difficult situations that can and do happen in traumatized communities such as this one. These instructors voiced the desire and the need to enhance their teaching skills and to be better teachers specifically for their Indigenous students. These faculty, and all faculty and instructors, need and deserve to have instruction and direction in how to teach effectively and in a caring way, as well as in working with and for their specific communities. This training should be done at the university, during paid work time/leave, and must be done in consultation with Indigenous community experts.

Implications for Theory, for Practice, on Policy

To discuss the implications my study has for theory, for practice, and on policy, I am focusing on the themes that I started with, and that continually came through when talking with my participants. These themes are: place and land; relationships, community and connection; Nation building and decolonization; and reciprocity. I will examine each theme alongside my data that illuminates and interprets this theme and discuss how the data relates to, informs and extends the current theory in the field. I also discuss practical implications, indications and suggestions arising from this information, as well as propose policy additions and changes that academic institutions ought to implement based on this data.

Place and Land

All the students in this study reported on the importance of land and place for learning. This might have been learning about the land and place in which they are Indigenous, learning from and with the land and place that is their home, or simply being outside for a class. The faculty also talked about the importance of taking students out to the field to learn, learning from Tribal experts about the land and place, their experiences with doing so in the past, and thoughts on how to better incorporate land and place into their future courses. These non-Indigenous instructors already recognize the need for place-based educational practices. Making these types of connections is crucial for both students and instructors because "in much indigenous teaching and learning, and in virtually all TEK, place plays an essential role. In contrast to Western knowledge traditions, indigenous worldviews start with the assumption that all things are connected

and related" (RunningHawk Johnson, 2018, p.88). Indigenous students need to learn with and through the connections and relations of their land and place.

We can find writings and theory of how critically central land is for Indigenous epistemologies and ontologies (Barnhardt & Kawagley 2016; Cajete 2000; Kawagley, Norris-Tull, & Norris-Tull 1998; Marker 2016; Medin & Bang 2014; Million 2013). There is also a rich body of knowledge around place-based theories of education and Indigenous knowledges as well as why they are critical for Indigenous educational practices (Kimmerer 2012; Marker 2016; Marker 2018; Medin & Bang 2014). These authors provide excellent examples of how land and place-based educational processes and methods can be included in the western academy. This study supports these theories, and gives further evidence of the significance of including the land and place in learning mechanisms for our Indigenous students, as well as why place-based educational practices need to be an integral part of science education for Indigenous students.

Learning from and with place is connected to the culture of learning and valuing the culture the Indigenous students come from and bring to the class with them. This is important for both the students and the non-Indigenous instructors. Marker (2016) tell us that "instructors are always trying to negotiate the space between the culture of institutional education and the local Indigenous culture that supports traditional forms of identity and belonging" (p. 478). By getting the students out to the field to learn from place, especially if the instructors can bring in Indigenous experts, then the Indigenous students are learning in their traditional ways, while at the same time learning western science, and this can protect and support their Indigenous identities. The identities of Indigenous peoples are intricately interwoven with the place they live, and place is highly

relevant to science education for Indigenous students, since "the place in which one lives provides the connectedness of all things, the relationships between all things, and therefore place gives us a base for teaching about the natural world in the context of science curriculum" (RunningHawk Johnson, 2018, p.88). If this is not attended to, if the students are kept inside the classroom at all times, then western science and ways of knowing and being are once again centered, which harms Indigenous students.

Even when a non-Indigenous instructor is aware that they are trained to teach in particular ways, it is difficult to break out of that cycle.

> The science instructor was telling me that his training was toward particular sets of goals and practices-ways of thinking-in science. Underlying this problem is the condition that the science teacher, to a large extent, is, in some form, socializing the students not just toward understanding science, but toward the culture of science and the academic standards and skills that transfer into other spaces where science is performed. Ways of thinking also become ways of being (Marker, 2016, p. 478).

Indigenous students need their traditional and cultural ways of being and thinking to be centered in their educational experiences, so that their sense of identity as both an Indigenous person and as a scientist can be nurtured and sustained. Non-Indigenous instructors must include place-based education, as well as Tribal Elders and experts, in order to balance the western traditions that they themselves pass on to their students. Learning with and from land and place is critical for these processes.

In practice, instructors need to take students outside, to learn from the land and the place and the non-human relatives found there. This applies to Indigenous and non-

Indigenous instructors alike. They need to bring Indigenous folx, Elders and other experts, to the students, and take the students to these experts, to learn with and from the land and place. Robin Wall Kimmerer (2012) gives an example of what she does in her university classes. “Teaching on the land softens the dichotomy we have created between SEK(scientific ecological knowledge) and TEK(traditional ecological knowledge) as direct experience reveals in short order that knowledge belongs neither to SEK nor to TEK, but to the land. The land is the knowledge source” (p. 321). Kimmerer states clearly that the knowledge we have comes from the land, and that being on the land and in the place is the best way to learn. She goes on to emphasize that there are different ways of learning, different ways of knowing, and that highlighting these in a class can be illuminating for all students.

> Our cultural approaches and the tools we employ are both vehicles by which we query the living word in different ways, ask questions, and understand the answer that we receive. I ask my class to characterize a forest stand not only by making a graph, but also by telling a story and understanding that these are both valid ways of interpreting the landscape, each shaped by a different purpose (Kimmerer, 2012, p. 321).

In teaching this way, she is honoring and validating multiple ways of knowing, showing all students, Indigenous and non-Indigenous, that their ways of understanding the world are valued and should be included in scientific inquiry.

With students and at least some faculty recognizing and understanding the need for education to happen in and with place, there are policies that universities can and should enact that compels instructors to attend to these types of teaching and learning. It

will require a change, absolutely, but it can be done. A university policy requiring instructors to work with Elders could easily be established, along with designated funding to support this work. It is essential to make sure that any such policy includes recognizing the importance of learning from place, and that instructors and faculty have funding to take students to the Elders and the community experts for learning. This is imperative because by

> teaching that Indigenous communities and their knowledge systems position nature-culture relations as intertwined and reciprocal, teaching from a place that assumes the interconnectedness and relatedness of all, and using this concept as the base for our curriculum, we can connect our Native students much more solidly with the place in which they live, the science curriculum they learn within, and their culture. (RunningHawk Johnson, 2018, pp. 88-89)

This is especially relevant for science courses, as much of the context for and knowledge of the science comes from the land and place. Kimmerer (2012) highlights a distinction between western science learning and Indigenous science learning when she writes "in contrast, indigenous ways of learning are often based on the understanding that knowledge is held and imparted by nature itself. In the garden, students participate in indigenous pedagogy, a different way of learning which relies on a direct participatory relationship between observer and observed" (p. 321). We need our Indigenous students to engage in this type of learning, and the way to do that is to get them outside and learning from land, to practice place-based education.

Relationships, Community, and Connection

Relationships in educational settings come in a wide variety of forms. A web of connections exists between students, instructors, the land and place, Elders, more-than-human relatives, community members, resource experts, Tribal partners, and more. Relationships can be thought of as resulting in community and connections to others, and especially for our Indigenous students this philosophy and the values behind it are meaningful and significant. Of particular importance, this includes the communities that the students come from and go home to, as well as the communities created at the school with the students and the instructors. The students in this study all talked about their support systems: the group of Indigenous students that are all studying Environmental Science that have banded together in support of one another; their children and parents; and the families, communities, and Tribes they go home to. These students also talk about their consideration of the students coming up behind them and whom they know they are paving the way for. The faculty members talked about community as well, both how they are part of the community of students at Heritage, and how in other ways they are not part of that community.

This study supports the theories that all of these connections and relations are important for teaching and learning, and many Indigenous scholars have written on the importance of relationships (Brayboy & Castagno 2008; Cajete 2000; Deloria & Wildcat 2001; Kimmerer 2012). Of particular relevance to this study are works that reference relationship and connection in an educational setting. San Pedro and Kinloch (2017) tell us that "shared knowledge is never void of relationships but always located in the development of them" (p. 376S). And what is education if not a form of shared learning?

This is further relevant in that teaching and learning creates relationships and connections. “Alternatively, when we enter into collaborative relationships with others, we inherently become a part of their lives just as they become part of ours. We critically listen to their stories, share our stories, and exchange connections across our experiences that reveal vulnerabilities and subjectivities” (San Pedro & Kinloch, 2017, p. 379S). Building and maintaining relationships and connections within the educational process is something that needs to be considered and cultivated.

Community for and by the students needs to be supported by the university, its administrators and faculty members. This support can and should include events that give students the ability to be creative and purposeful in how they interact with each other, time preserved for students to imagine these events as well as to simply have time to be together, and spaces maintained for these type of activities, spaces specifically for Indigenous students and Indigenous activities. Universities also need to provide the funding to make these times and spaces happen; a generous budget for food and for bringing in Indigenous artists and scientists needs to be present and accessible. Faculty members, as well as the university at large, should work to honor and increase students sense of connection with their home community and their family, as well as their community at school. Honoring and cultivating these connections for Indigenous students may mean learning what this looks and feels like for these students, and should be done by listening to the students, their Elders, and their Tribal community. Providing the students with the resources to conceive and design something for themselves, to imagine and create events that bring them and their communities together is another step in the right direction.

Faculty members also need to have support from the university to learn what cultivating and supporting community in their classes means and looks like. As previously noted, most faculty members are non-Indigenous, and those in this study made it quite clear that while they want to support their Indigenous students in community, they do not always know how, and even when they do know how they should have more support from the university and administration.

One crucial way for faculty members to do decolonizing work and to help create community and connections with and for their students, is to make the time and take the effort to learn about the communities they serve. We already have one beautiful example of this type of work happening at Heritage University, in the creation and perseverance of a field class named People of the Big River. The folx that envisioned this class asked themselves, and then others, the questions "What kind of science education do Indigenous students need? How do tribal communities perceive culturally sustaining science education?" (Black & Jacob, 2020, p. 151). This is an important first step, as it centers Indigenous students and Tribal community needs. As a second, and critical, step "in the planning and formative evaluation processes of creating an Indigenous environmental science curricular experience, we asked Indigenous student and tribal community leaders these questions" (Black & Jacob, 2020, p. 151). Who better to answer these questions than those folx most directly impacted and with the longest history of knowledge around their own educational needs, wants, and practices?

The faculty member most responsible for the People of the Big River field class, Dr. Jessica Black, saw that relationships were and are critical when working with Indigenous students, and therefore ensured that the class was "designed to provide a

tangible link between the pursuit of education in STEM fields and cultural revitalization and cultural identity development through the sustainable management of the lands that are so central to many Native American cultures" (Black & Jacob, 2020, p. 152). Dr. Black made the effort to connect with the local community in order to create this course, and has taken the time to maintain and nurture those relationships.

> The class was based on community partnerships and networks of support established over several years amongst partners on the Yakama Reservation…A main reason why the Yakama Nation DNR continues to work in partnership with our team is because our work has a foundation of understanding the importance of embracing methodologies that work in Indian country; we understand that TEK is interdisciplinary, centers Indigenous perspectives and epistemologies, and values relationships as a primary way of advancing education. (Black & Jacob, 2020, p. 156)

This is not work that can be accomplished quickly, it takes time and sustained effort to get to know the Indigenous community in which one works, as well as to gain their trust and respect. But the end result for students and for faculty is well worth the endeavor.

Dr. Black has learned, and continues to learn, about and from the community which she teaches and loves. "The content of the field class is community-driven. Tribal community partners decide what to share, how much to share, and the preferred mode and location of teaching" (Black & Jacob, 2020, p. 156). This course is truly a community effort, and is led by a non-Indigenous faculty member. And as Dr. Black (2020) will tell you, "a major lesson learned over the course of designing and implementing the field class is that university personnel must be willing to try to reach

out to build partnerships, and being willing to adapt as part of maintaining partnerships is important" (p. 157). The People of the Big River field class is a beautiful example of a non-Indigenous faculty member being invested in and involved with her local Indigenous community.

As a matter of university policy, it would be relatively easy to determine that time, space, and funding needs to be dedicated to promoting and supporting Indigenous communities at and through the university. Michelle Jacob, a Yakama scholar, shares some recommendations for universities on how to do just this, in her book *Yakama Rising*:

1. Recognizing formally the importance of respectful partnerships with tribal communities
2. Dedicating staff, faculty, programmatic, and curricular resources to outreach, implementation, and maintenance of tribal partnership relationships, including visiting tribal peoples on their home reservations
3. Committing to ongoing involvement and visible support for the partnership from all levels (student, staff, faculty, administration) of the university
4. Sharing power with tribal partners, with the focus on applied and relevant knowledge production that benefits tribal communities
5. Hiring and supporting culturally competent university personnel who have the authority and autonomy to be flexible in their efforts to plan, implement, and lead tribal partnership work (Jacob, 2013, pp. 126-127)

This study highlights the numerous and rich connections and relationships in an educational setting, even at a small university such as Heritage. There are students,

instructors, Elders, families, communities, Tribes, land, place, and more-than-human relatives participating in these relationships, just to name a few. Working in partnership with the students and their communities is "beneficial not only for the Indigenous communities who serve as partners, but also for university personnel who are involved as faculty, staff, and students" (Black & Jacob, 2020, p. 174). There needs to be more of this type of decolonizing and Indigenizing work happening at all schools and universities across the US, and the faculty and teachers in those schools require and deserve the institutional support necessary to do this work.

Decolonization and Nation Building

Advocacy of, and support for, decolonizing efforts and building Indigenous Nations is critical, and is why I began the journey of earning a PhD and becoming a professor. This is my way of helping to assist Tribal members to earn science degrees in order for Tribes to have more control over their land, place, and natural resources. My intention here is not for this to be understood in a capitalistic sense of controlling resources and resource production, of ownership and use, but from an Indigenous worldview of relationship with land and our more-than-human relations. The purpose, in this case, of decolonizing science education and developing Tribal Nation building, is to further uphold the covenant between Indigenous peoples and their Creator, to support their responsibility to their homelands, and to honor their more-than-human relations.

In the context of this particular study, we have a theory that has been developed very specifically by and for this place and these students, which author Michelle Jacob has termed a Yakama decolonizing praxis (Jacob, 2013). She tells us that

> by drawing from traditions to undermine settler-colonial-imposed hierarchies and reasserting the importance of spiritual relations between humans and our surrounds, Yakama cultural revitalization efforts represent a distinctive indigenous feminist approach to 'making power' within our community. (Jacob, 2013, p. 12)

Drawing from traditional teachings cultivates the power of students and Tribes and allows Indigenous students to decolonize the academy simply with their presence. But by accessing the power of the land and place and the teachings they provide, we can go much further. Jacob continues, writing that the Yakama nation, like other Tribal nations and Indigenous communities, has the skills and knowledge already in their possession to heal themselves, to do this work of decolonization and Nation building. She tells us that her

> analysis of Yakama cultural revitalization efforts contributes to indigenous studies theories that recognize the importance of our communities' resilience to understand and address our own problems – that the power needed to heal our soul wounds already exists within our people and traditions. (Jacob, 2013, pp. 11-12)

In an educational sense, and instructional setting, this means that bringing in and centering Indigenous knowledges and ways of being is an act of decolonization, and that doing so can support students in earning their science degrees which then opens up further possibilities and avenues for decolonization and Nation building to happen.

Education for Indigenous folx must center Indigenous knowledges, and as an educational system we need to work on decolonizing our educational practices and

pedagogies, at a minimum. Decolonization cannot be a metaphor (Tuck & Yang, 2012). We must take decolonization out of the realm of theory and put it into practice and create policies that support and continue decolonizing practices. When examining science fields in particular, Marker (2016) tells us that "decolonizing the space between Indigenous knowledge and scientific goals requires that we hear the narratives of scientists-as culturally and historically constructed autobiographies-in complicated dialectical (read colonial) relationship to the autobiographies of Indigenous Elders" (p. 479). We must remember that the educators and their stories are situated in the context of colonization and the effect that has on science education, as well as pay attention to how they interact with the students and the community. Science education, done in Indigenous ways, by and for Indigenous peoples, is a decolonizing move. It is also a very real, and real world, way to practice Nation building. Getting science degrees for Indigenous folx so that they have greater control over their lands and resources is a vital way to build and maintain sovereignty.

> Some scholars have argued that when the attainment of skill sets and credentials is driven by a desire to serve the needs of Native people they can be utilized to engage in tribal nation building. Education then becomes a necessary component of capacity building in tribal nation building (Shotton, 2018, pp. 488-489)

In this particular case, science education becomes a necessary component of Nation building.

In practice, this means supporting students from Tribal nations to obtain science degrees. It means getting them interested in science degree programs, supporting them while they are in the programs, and teaching in culturally responsive and culturally

inherent ways in order to honor their Indigenous knowledges at the same time adding on western scientific knowledge without the erasure of their culture. Teaching in this way helps "students understand the flexibility of identity and gave students the opportunity to learn that being comfortable with contradictions was also important in forming a strong Yakama identity" (Jacob, 2013, p. 31). It encourages students to see themselves as both Yakama and as scientists. In order to be Yakama, these students must be on, learning from, and caring for their homelands. "Indigenous feminist scholarship has been especially careful to remind: there is no decolonization without Indigenous presence on Indigenous land and waters" (Smith, Tuck, & Yang, 2019, p. 1). We need our Indigenous students to be on the land, and learning with and from that land, to practice decolonial education, and this requires educational institutions and instructors to recognize this and make those practices happen. Universities and other institutions need to have policies in place that explicitly state their support for, and enforcement of, educational practices that are based on decolonization and Nation building. It is important for students to have both their Indigenous ways of knowing and being centered in their education, as well as to have the western science offered to them.

Universities, and other educational institutions must put into place policy that supports the engagement of Indigenous students while supporting their learning and their identities in their time at the university. Shotton (2018), an Indigenous scholar, tells us that "embedded in our worldview is a responsibility to ensure that we are accountable and responsive to the communities from which we come and with whom we work" (p. 640). Universities are on Indigenous homelands, therefore this responsibility is also taken up by universities and the faculty at those universities, mainly in the way they support their

Indigenous students. Many scholars agree that "it is evident that education has become a necessary and essential tool in building tribal nations and strengthening tribal sovereignty" (Shotton, 2018, p. 493). I believe it is important as science educators that we think about our decolonial work as contemporary and as urgent. As Smith, Tuck, & Yang (2019) insist, "decolonization is not the endgame, not the final outcome of a long process, but the next now, the now that is chasing at our heels" (p. 16) and the now that we are working in for our students, our Tribes, our lands, our ancestors, and our future generations.

Reciprocity

There is much written on reciprocity as a theory in Indigenous epistemologies, ontologies, and axiologies (Cajete 2000; Deloria 1997; Deloria & Wildcat 2001). A considerable amount of this literature describes reciprocity as a way of being in relation to others, a responsibility we all have to care for each other, including our families and communities, but also the land and place and our more-than-human relatives. This concept and way of being extends to education, to earning a degree as a student as well being a teacher and helping others. There exists some literature on reciprocity specifically in educational settings (Brayboy & Castagno 2008; Medin & Bang 2014; Shotton 2018). Yet there is more work to do, and the students in my study are helping me to add to this body of literature, to examine why and how reciprocity needs to be a prominent consideration in educational settings.

The students in my study shared with me the reasons that they are working toward their Environmental Sciences degree. Overwhelmingly, they spoke about their sense of responsibility to their family and their community and that pursuing this educational

opportunity is not simply a self-serving gesture. Jacob (2013) writes specifically about Yakama peoples, and says that "strong individual tribal people are collectivist-oriented, yet feel an individual sense of responsibility to work toward the collective good" (p. 115). These students reflect this traditional Yakama value and are living it out in the way they feel they are best suited for. While their individual talents and interests lie in learning about and working with natural resources, they are also thinking that this work is helpful and good for their communities and tribes. When thinking of reciprocity, Shotton (2018) explains that "individual development garnered through education and degree attainment is for the benefit of tribal communities, and native students pursue graduate degrees as a service to their tribes or Native communities" (p. 493). While her work is with graduate students, this has been true of the undergraduates in my study as well. It is also important to note, and the students in this study support the idea that

> reciprocity as discussed in the current literature is viewed in the context of giving back not only to individual tribal communities but to the larger Native community, including other tribal nations and people. Overall, the literature affirms that Native students desire to utilize their personal gain from a college education to benefit Native people, and values of reciprocity serve as a strong motivator to achieve academically." (Shotton, 2018, p. 493)

This is certainly the case with these students at Heritage University, who hold an individualistic work ethic, which has a high value in western educational systems, but is also valued in Yakama culture so long as it is also connected to a vision of collectivism.

Because reciprocity is such an important component of Indigenous students motivation for being in a degree program and at a university, this concept needs to be

supported and honored by the schools and institutions in which Indigenous students learn and teach. In practice, schools and teachers need to acknowledge and respect that Indigenous students are often not there simply to better themselves, but to support and better their families and their communities, perhaps even all Indigenous peoples. First and foremost, universities need to "work with and through tribal nations and Indigenous leaders to identify critical issues, problems, and opportunities facing their community as well as how they might be addressed" (Brayboy, Castagno, & Solyom, 2014, p. 590). This is a crucial first step in supporting Indigenous students to do good work at a university, work that is for their communities and Tribes as well as individual attainment. Working with Tribal leaders is also one of the recommendations that Michelle Jacob gives in her book *Yakama Rising* for universities that want to work responsibly with Tribal nations and Indigenous folx. For universities this may mean actively recruiting students that want to attend in order to better their communities, as well as financial support during their tenure at the school. Universities should also ask the community what educational programs they would find useful and helpful in their community, and that they would like for their students to learn within and earn degrees from. Not only that, but "institutions of higher education must ensure that their course offering are relevant to the current struggles facing youth and aid in learning about policies, rights, and the status of Indigenous peoples and their nations" (Brayboy, Castagno, & Solyom, 2014, p. 591). By taking steps toward supporting reciprocity in student populations, and in particular looking to Indigenous communities for guidance, universities and other educational institutions can actively work to support Indigenous identity, which can lead

to students feeling as if they do not have to choose between school and self/identity/Indigenousness.

> The concept of reciprocity, at least in this sense, is situated in assumptions that the health and well-being of the nation and its communities is more important than any individual achievement. Individuals seek to serve the greater good and build the health and sustainability (what some might call survival) of the whole (or the tribal nation)." (Brayboy, Castagno, & Solyom, 2014, p. 578)

The students at Heritage University that I interviewed certainly would agree with this statement, and many of their words and sentiments support and demonstrate this same commitment. The individual students are important, and they understand that

> individuals – driven by the desire and need to serve their nation and community – are vital actors in the process and can, should, and often do have individual successes. Our point there is that the primary motivation for doing work should be to serve others, rather than to serve individual ambitions." (Brayboy, Castagno, & Solyom, 2014, p. 578)

Schools and universities should put practices and policies in place that allow Indigenous students, and perhaps all students, support for exploring and growing their sense of reciprocity. In Shotton's (2018) work with Native women students, they told her that they arrived at the university viewing their work and goals with "great responsibility-responsibility to their families, their tribes, their communities, and other Native people. They were humbled by that responsibility, and they viewed it as a place of honor" (p.

490). Our universities and other educational institutions also need to view their Indigenous students earning degrees as a responsibility and as an honor.

Further Questions and Future Research

My study participants and I learned many things together, and while we have some ideas about how to improve science education for Indigenous students, we are also left with many, many questions and further lines of inquiry and research. These queries are an investigation in to approaches to further our efforts to decolonize and indigenize the western academy, to make it a healthier, welcoming, comfortable, and more productive place for Indigenous peoples. Multiple participants talked with me about gender issues. I've seen and experienced these myself, as an Indigenous woman in the academy, and this is a topic that warrants further exploration as well. Finally, I plan to delve more deeply into the way that I conduct my own research, how being in relationship with my participants, sharing stories and contexts with them, rather than doing a study on them, is more beneficial for all involved.

Continued Work with/for Indigenous Students

One area that I will continue to investigate is how I/we can help non-Indigenous folx, particularly those in direct educational contact with Indigenous students, recognize the differences between Indigenous and western science. While there are similarities between the two, as shown in this study and others, there are definite differences as well, and these differences are important to recognize and to respect, in regards to creating a welcoming and hopeful environment for Indigenous students in the educational setting. I also want to find more ways of acknowledging and honoring the value of Indigenous science. Much of this work can be done by being in conversation with Indigenous leaders

and Elders. We see examples of this type of work already in progress, but it needs to continue and to be disseminated much more broadly to those at universities and other educational institutions with the power to use the information. In this study alone, we see good examples of this work happening at Heritage University, in the form of the People of the Big River field class, as well as more generally through work in Traditional Ecological Knowledge and Scientific Ecological Knowledge. How can that work be expanded upon and brought to a wider audience?

Another way forward is to find strategies and trainings in order to help non-Indigenous teachers and faculty center Indigenous knowledge in their classes. The faculty in this study talked about their desire to do this, but being non-Indigenous themselves, in some ways they were unsure of how to put it into practice. We have seen that working with Tribal Elders and experts is one strategy that is successful for centering Indigenous knowledges, as are partnerships with local high schools, particularly Tribal schools and schools with a high population of Indigenous students. Again, the field class at Heritage can be an example of how to work with community members to create and direct the content of a course that has an intergenerational audience. How do we build upon these ideas to create more, and more wide-spread, availability?

Reciprocity was a major theme that I found within my student participants, and is something that I hope to learn about and research with Indigenous participants in the future. Specifically, what are the possibilities within the western academy for honoring, supporting, and building students sense of reciprocity? How can educational institutions build in to their programs and their ways of working with Indigenous students a support system for the concept of reciprocity? While we could once again make an argument that

the People of the Big River field class gives us one example, I think there are relatively few cases currently available and we need more. What would a program or initiative that specifically focused on generating, encouraging, and promoting student's sense of reciprocity look like? What effect would/could it have on Indigenous students?

A further research inquiry accompanies the ones I have just posed: If we can implement the changes listed above, effectively answer some of these questions, put into place policies and programs, how will that affect Indigenous student identities and support Indigenous sovereignty and Nation building? In my own experience, my career path has been significantly influenced by the Sapsik'^{w}ałá Indian Education Program at the University of Oregon, a program by and for Indigenous folx, to increase, support, encourage, and improve Indigenous educational practices, as one example/case. This program provided me with tools, skills, resources, and mentors to be a teacher, learner, and researcher working with and for Indigenous students, to increase Indigenous sovereignty and to support students in their Nation building practices. What might this type of learning do/mean/be for Indigenous students if we can make it more ubiquitous?

Gender

In this study we see gender imbalances made clear in multiple ways, and by both the students and the faculty. We know that within universities "at every faculty rank, men outnumber women, with the proportion of women being lowest among full professors" (Pyke, 2011, p. 85). This affects both the women who are professors, as well as the students they work with, who see and experience this difference as normalized within education. In addition to being underrepresented, women are often expected to do more work than their male counterparts, partly because "the need for gender diversity and the

small pool of female full professors means that women often serve above their skill level as the most junior and least experienced members of committees with heavy and specialized workloads" (Pyke, 2011, p. 86). Women also tend to care for students in different and more labor intensive ways than their male counterparts do. Women do more of the " 'care work' associated with teaching, mentoring, and advising – the meetings with students, reading and commenting on drafts of papers, writing letters of recommendation, forwarding research or job opportunities to advisees, and providing general advice" (Social Sciences Feminist Network Research Interest Group, 2017, p. 231). While women are expected to perform this valuable service to their students, at the same time universities and other institutions tend to view this "service labor as optional and undeserving of recognition, reward, or remuneration" (Pyke, 2011, p. 86). The students that are being served by these women faculty members certainly do not see this work as optional, they need these services, as well as the love and care they receive, and the women faculty recognize this need.

Faculty of color also experience greater 'care' demands in their work. Padilla (1994) explains about this phenomena writing that

> what I will refer to here as the 'cultural taxation' that is so prevalent in academia and in organizations that employ ethnic scholars…poses a significant dilemma for ethnic scholars because we frequently find ourselves having to respond to situations that are imposed on us by the administration, which assumes that we are best suited for specific tasks because of our race/ethnicity or our presumed knowledge of cultural differences. (p. 26)

This puts extra work on scholars and faculty of color. It also suggests that "faculty of color experience increased expectations to address diversity-related departmental business and the theoretical perspective that social processes and institutions are deeply gendered and feminize male faculty of colors' work" (Social Sciences Feminist Network Research Interest Group, 2017, pp. 228-229). Faculty of color are often expected to do more of the invisible 'care work' that is asked of women faculty members as well.

When you combine the greater demands on women and on faculty of color, and look at the intersection of these identities for women of color in faculty positions, the consequences may be even more dramatic. "Not only do women of color faculty have to contend with demands that they serve as diversity representatives within universities, they are also expected to nurture their students in what can best be describes as 'mother figure' roles" (Nicol & Yee, 2017, p. 152). The work overload adds up. "Overtime, however, this type of gendered cultural taxation on female faculty of color without compensation or recognition can take its toll on research productivity, teaching performance, and one's emotional and physical health" (Nicol & Yee, 2017, p. 152). We see that there is literature about the burdens of 'care work' that women are expected to take up in the academy, and how this work is valuable at the same time it undermines women's careers, because the time and energy spent doing that is often invisible and unrewarded in the power structure of the university.

Among the students at Heritage, which are representative of many Tribal nations across the US and other colonized places, there is a resurgence by women to reclaim their sovereignty and to improve the conditions of their Tribe and all Indigenous peoples. Of the students in this study, six out of eight identify as female, a higher proportion of

women than one would expect to see in a science degree program in the general university population. Among these mostly Yakama students, we see a gender imbalance. We know that a "central tenet of Yakama decolonizing praxis is that women are important as culture bearers and teachers" (Jacob, 2013, p. 108). In many ways it is encouraging to see these women at this university doing good work for their community. And by seeing more Indigenous women than Indigenous men in university degree programs, at least in this one, we have another illustration showing that "women are strong leaders in these efforts, providing evidence for both the need and the effectiveness of dismantling a heteropatriarchal colonial logic that relegates women generally, and women elders in particular, as marginal" (Jacob, 2013, p. 109). Women as faculty and women as students are important, and we should be supporting them in their studies and good works. However, we also know that "a main principle of Yakama decolonizing praxis is that our people are strongest when women and men work together to bring about healing for our people" (Jacob, 2013, p. 109), as well as that "across the examples of Yakama decolonizing praxis is an understanding that our people are healthy when we build movements with a gendered balance" (Jacob, 2013, p. 110). Therefore, in other ways, the lack of male representation among the students is worrisome.

Gender balance is needed once again. We know from Yakama culture a gendered balance is expected. Yet, we also know that contemporary Indigenous communities reflect the sexism rampant in US society and in university faculty ranks. As my participants demonstrated quite clearly, we see some the ill effects of sexism in university settings, and this needs to be addressed. We need to advance our study of the effects of the current gender imbalances which are present for both faculty and students in

universities, so that we can bring balance and equity to/for our students. More specifically, I want to know how these imbalances and inequities are affecting our Indigenous students, Indigenous instructors, and non-Indigenous instructors working with Indigenous students.

Relationship with Research Participants

I learned many things in this research. My experience as a researcher has been rich, complicated, scary, and beautiful. I think that most significantly, it has clarified how essential it is for me to be in relationship with the folx I am doing my research with and for. I became an official member of my Tribe during this time, and along with that, this research has strengthened my identity as an Indigenous person, as an Indigenous woman, as a mother, and as a researcher. It has reinforced for me the importance of relationship and of land and place. As Wilson (2008) writes

> identity for Indigenous peoples is grounded in their relationships with the land, with their ancestors who have returned to the land and with future generations who will come into being on the land. Rather than viewing ourselves as being in relationship with other people or things, we are the relationships that we hold and are part of. (p. 80)

We must be in relationship in order to do good work. Wilson (2008) also writes of research being ceremony, that research is about bringing things and people together, as well as that "research itself is a sacred ceremony within an Indigenous research paradigm, as it is all about building relationships and bridging this sacred space" (p. 87). This is a lesson that I needed to learn, and one that I will continue to receive as I progress in my scholarship.

I am doing this research, in part, because I find it interesting. But much more importantly, I see it as the thing I am good at, and that therefore I have a responsibility to do, because it is my way to assist in making Indigenous people stronger, more resilient, and to give them ways forward with sovereignty and Nation building. I do this research with a relational approach, because "a relational research approach is built upon the collective value of giving back to the community" (Kovach, 2009, p. 149). Like the students in my study, I come to my education with reciprocity in my heart, with the desire that my work do something good for Indigenous folx. I am also doing this research, in this way, because "Indigenous research frameworks have the potential to improve relevance in policy and practice within Indigenous contexts" (Kovach, 2009, p. 13). And that gives me a concrete and hopeful way to make a difference for Indigenous students.

An integral part of being an Indigenous researcher is doing research *with* my participants, and *for* Indigenous communities. Research needs to be done with reciprocal recognition, which is "the act of making it a practice to see another's light and to reflect that light back to them" (Simpson, 2017b, p. 184) because doing so "forms the basis of positive identity, self-worth, and dignity in the other being" (Simpson, 2017b, p. 184). Research should not be extractive, as has so often been the case in the western research paradigm. Reciprocal recognition is a crucial element of doing good research that can be helpful and useful for Indigenous folks. Additionally, it is important to

> center the daily experiences (e.g., storytelling, story gathering, relationship building, reciprocal engagements) we have *with* people in ways that, on the one hand, emphasize our shared desires for racial, linguistic, educational, political, and social justice in schools and communities and, on the other hand, emphasize

> those same desires in our professional and personal lives. (San Pedro & Kinloch, 2017, p. 374S)

By doing so, I generate the ability for my/our research make a difference in the lives of Indigenous people, the people who are often the most oppressed in our society. As Wilson (2008) explains, "it is the forming of healthy and strong relationships that leads to us being healthy and strong researchers" (p. 86), and I have every intention of continuing on with research, and doing my research in ways that honor, support, and are healthy for Indigenous folks. Therefore, I will do my best to be in relationship with my research participants, and to continue to learn the best ways to create those relationships.

REFERENCES CITED

Arvin, M., Tuck, E., & Morrill, A. (2013). Decolonizing feminism: Challenging connections between settler colonialism and heteropatriarchy. *Feminist Formations, 25*(1), 8-34.

Barnhardt, R., & Kawagley, A. O. (2016). Indigenous knowledge systems and Alaska Native ways of knowing. *Anthropology and Education Quarterly, 36*(1), 8-23.

Beavert, V. (2017). *The gift of knowledge / Ttnúwit Átawish Nch'inch'imamí: Reflections on Sahaptin ways* (J. Underriner, Ed.). University of Washington Press.

Black, J. L., & Jacob, M. M. (2020). Indigenous environmental science on the Columbia River plateau: Traditional Ecological Knowledge and the people of the big river field class. In M. M. Jacob & S. RunningHawk Johnson (Eds.), *On Indian Ground: The Northwest* (pp. 151-177). Information Age Publishing, Inc.

Brayboy, B. M. J., & Castagno, A. E. (2008a). How might Native science inform "informal science learning"? *Cultural Studies of Science Education, 3*(3), 731-750.

Brayboy, B. M. J., & Castagno, A. E. (2008b). Indigenous knowledges and native science as partners: A rejoinder. *Cultural Studies of Science Education, 3*(3), 787-791.

Brayboy, B. M. J., Castagno, A. E., & Solyom, J. A. (2014). Looking into the hearts of Native peoples: Nation building as an institutional orientation for graduate education. *American Journal of Education, 120*(4), 575-596.

Cajete, G. (2000). *Native science: Natural laws of interdependence*. Clear Light Books.

Deloria Jr., V. (1997). *Red earth white lies: Native Americans and the myth of scientific fact*. Fulcrum Publishing.

Deloria Jr., V., & Wildcat, D. R. (2001). *Power and place: Indian education in America*. Fulcrum Publishing.

Faircloth, S. C., & Tippeconnic III, J. W. (2010). The dropout/graduation rate crisis among American Indian and Alaska Native students: Failure to respond places the future of Native peoples at risk. *Los Angeles: The Civil Rights Project/ Proyecto Derechos Civiles at UCLA*.

Gay, G. (2013). Teaching to and through cultural diversity. *Curriculum Inquiry, 43*(1), 48-70.

Jacob, M. M. (2013). *Yakama rising: Indigenous cultural revitalization, activism, and healing*. The University of Arizona Press.

Kawagly, A., Norris-Tull, D., & Norris-Tull, R. (1998). The Indigenous worldview of Yupiaq culture: Its scientific nature and relevance to the practice and teaching of science. *Journal of Research in Science Teaching, 35*(2), 133-144.

Kimmerer, R. W. (2012). Searching for synergy: Integrating traditional and scientific ecological knowledge in environmental science education. *Journal of Environmental Studies and Sciences, 2*, 317-323.

Kovach, M. (2009). *Indigenous methodologies: Characteristics, conversations, and contexts.* University of Toronto Press.

LaDuke, W. (1994). The Indigenous perspective on feminism, militarism, and the environment. *Race, Poverty & the Environment, 4*(4), 7.

Marker, M. (2016). Indigenous knowledge, indigenous scholars, and narrating scientific selves: "to produce a human being". *Cultural Studies of Science Education, 11*, 477-480. DOI 10.1007/s11422-015-9660-1

Marker, M. (2018). There is no *place of nature*; there is only the *nature of place*: Animate landscapes as methodology for inquiry in the Coast Salish territory. *International Journal of Qualitative Studies in Education, 31*(6), 453-464.

McCarty, T. L., & Lee, T. S. (2014). Critical culturally sustaining/revitalizing pedagogy. *Harvard Educational Review, 84*(1), 101-124.

Medin, D., & Bang, M. (2014a). *Who's asking?: Native science, western science, and science education*. MIT Press.

Medin, D., & Bang, M. (2014b). The cultural side of science communication. *Proceedings of the National Academy of Sciences, 111*(4), 13621-13626.

Million, D. (2013). *Therapeutic nations: Healing in an age of Indigenous human rights*. The University of Arizona Press.

Nicol, D. J., & Yee, J. A. (2017). Reclaiming our time: Women of color faculty and radical self-care in the academy. *Feminist Teacher, 27*(2-3), 133-156.

Padilla, A. M. (1994). Ethnic minority scholars, research, and mentoring: Current and future issues. *Educational Researcher, 23*(4), 24-27.

Paris, D. (2012). Culturally sustaining pedagogy: A needed change in stance, terminology, and practice. *Educational Researcher, 41*(3), 93-97.

Paris, D., & Alim, H. (2014). What are we seeking to sustain through culturally sustaining pedagogy? A loving critique forward. *Harvard Educational Review, 84*(1), 85-100.

Possiblities. (n.d.) Heritage University. Retrieved February 27, 2020, from https://www.heritage.edu/our-community/possibilities/.

Pyke, K. (2011). Service and gender inequity among faculty. *PS: Political Science and Politics, 44*(1), 85-87.

Rowe, A., & Tuck, E. (2017). Settler colonialism and cultural studies. *Cultural Studies ↔ Critical Methodologies, 17*(1), 3-13.

RunningHawk Johnson, S. (2018). Native philosophies as the basis for secondary science curriculum. *Critical Education, 9*(16), 84-96.

San Pedro, T., & Kinloch, V. (2017). Toward projects in humanization: Research on co-creating and sustaining dialogic relationships. *American Educational Research Journal, 54*(1S), 373S-394S.

Shotton, H. J. (2018). Reciprocity and nation building in Native women's doctoral education. *American Indian Quarterly, 42*(4), 488-507.

Simpson, L. (2002). Indigenous environmental education for cultural survival. *Canadian Journal of Environmental Education, 7*(1), 13-25.

Simpson, L. (2004). Anticolonial strategies for the recovery and maintenance of indigenous knowledge. *The American Indian Quarterly, 28*(3), 373-384.

Simpson, L. (2017a). Indigenous resurgence and co-resistance. *Critical Ethnic Studies, 2*(2), 19-34.

Simpson, L. B. (2017b). *As we have always done: Indigenous freedom through radical resistance*. University of Minnesota Press.

Smith, L. T., Tuck, E., & Yang, K. W. (2019). *Indigenous and decolonizing studies in education: Mapping the long view*. Routledge, Taylor & Francis Group.

Smith, L. T. (2012). *Decolonizing Methodologies: Research and indigenous peoples* (2nd ed.). Zed Books.

Social Sciences Feminist Network Research Interest Group (2017). The burden of invisible work in academia: Social inequalities and time use in five university departments. *Humboldt Journal of Social Relations, 39*, 228-245.

Tuck, E., & McKenzie, M. (2015). *Place in research: Theory, methodology, and methods*. Routledge.

Tuck, E., & Yang, K. W. (2012). Decolonization is not a metaphor. *Decolonization: Indigeneity, Education & Society, 1*(1), 1-40.

U.S. Department of Education, National Center for Education Statistics. (2019). *The Condition of Education 2019* (NCES 2019-144), Characteristics of Postsecondary Faculty.

Whyte, K. P. (2013). On the role of traditional ecological knowledge as a collaborative concept: A philosophical study. *Ecological Processes, 2*, 1-12.

Wilson, S. (2008). *Research is ceremony: Indigenous research methods*. Fernwood Publishing.