BRIDGING THE GAP: INCLUDING CULTURAL SCIENCE IN POST-SECONDARY EDUCATION TO ENHANCE LEARNING WITHIN SCIENCES FOR NATIVE AND NON-NATIVE STUDENTS

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An Abstract of the Dissertation Presented
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Until seven years ago, there were few mechanisms in place within the Wabanaki communities to keep Native students connected from middle school through college if an interest was sparked in the science, technology, engineering and math (STEM) fields. On average, less than 50 percent of Native Students graduate from high school. The past six years, the Wabanaki Youth in Science program (WaYS) has become a "bridge" for students to learn more at the secondary level about STEM fields. The next phase in the academic journey to aid student learning is to develop a model educational program that will increase Native youth learning in post-secondary education. Research has attributed some of this learning challenges to a lack of inclusion, an educational framework developed by predominately White institutions, and the influence of the dominant ideology. Utilizing qualitative and quantitative methods, this study charted the value, or not, that inclusion of cultural science (CS) enhanced learning for Native and non-Native youth to increase learning within academics and future careers. It is important to understand the short -term research followed the changes in beliefs for Native and non-Native students as it revolved around the relationship of cultural science to western science within a specific course.

Can the addition of CS into western academics, not as an add on, but as an integrated component have a significant impact on non-Native youth? Linked into this, many federal organizations require collaboration with Indigenous working groups. Can non-Native youth familiar with and understanding the cultural relevance to the environmental issue lead to a better decision-making process? This research looks at mechanisms to create the paradigm shift to benefit Native and non-Native students as it relates to inclusive ideology of learning directed at environmental sciences in college.

Keywords: Native American, cultural science, Traditional Ecological Knowledge, post-secondary college, STEM, WaYS

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This work is dedicated to my mum, Stevie Carr (1914-2008), my most ardent advocate. You always provided so much strength and support along my life's circuitous journey. You encouraged and cajoled my educational path, even if it took five years to start undergraduate school after high school and another 25 years for graduate school. Your guiding light saw me through, again.

This truly has been a team effort!

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INTRODUCTION TO DISSERTATION

'Ike i ke au nui me ke au iki he alo a he alo.'
Knows the big currents and the little current (Olelo No'eau 1209).

Background

This journey and work began in 2013, in the Orono area of Maine when a small group of mostly (two out of a group of three) Indigenous community members gathered to discuss the desire to develop something to ensure that Native youth from the Wabanaki community could and would finish high school, as well as attend and graduate from college. It seemed like a daunting task. This group was not even clear as to what that "something" was -- only that it needed to be developed and implemented in order to address the imbalance on Native versus non-Native Tribal members managing Tribal lands. The concern was the number of Tribal members working on Tribal lands that were planning to retire in the coming decade (personal conversation with John Banks, February 2013) which would further exacerbate and lower the number of Tribal members managing Tribal lands. The lack of Tribal members managing lands meant potentially a stronger lean towards western science driven management versus a more holistic approach that looks a broader approach to land management.

Locally, there had been some starts and stops over the years to help resolve this problem, but nothing had "stuck." This small group noted that there were some other groups outside of Maine that had started developing programs or camps to encourage Native youth to become involved in and persist in science studies to be the future environmental leaders but there was nothing here in Maine. It was needed, and it was needed sooner rather than later.

So, the journey began here in Maine to develop that "something." As it takes time to build a canoe (starting with finding the right wood to guide your journey from forest to water), it takes time to build an educational program that will provide students with the strength and resilience needed to traverse the land and water paths they will face.

Development of Wabanaki Youth in Science

Over the years, through a grassroots effort, a model education program was developed: the Wabanaki Youth in Science (WaYS) program. Begun in 2013, WaYS is still in its early and formative development stage. This program's primary focus is to encourage Native students to stay in school to be those future environmental leaders. As with building a canoe that requires time to bring all the right materials and knowledge together to have it last for many generations, WaYS is working towards a collective knowledge base that has strong and lasting foundational underpinnings.

WaYS is changing how Native high school students view and connect with their CS and knowledge and how this connection can enhance their learning to succeed within western academic parameters (carr, 2014; carr, Kenefic, & Ranco, 2017).

WaYS has brought success for Native youth in high school to encourage and embrace the idea of attending post-secondary education. Through pre and post questionnaires at summer earth camps, WaYS now has evidence that shows this model educational program can change how Wabanaki high school students view their culture's science and knowledge and how this connection can enhance their success within western academic settings; there is also evidence that WaYS has helped Native youth be successful in post-secondary, education pursuits (carr & Ranco, 2017). While this journey for some WaYS students has been successful and created a path to college, once there, these obstacles continue to stand in the way of achieving the endpoint of the matriculation journey:

graduation. To continue with the canoe analogy, WaYS can be compared to a canoe that is partially built but is looking with others to find how best to attach and reinforce the gunwales to the hull for strength and resilience. In other words, how do we ensure that Native youth can transition smoothly from high school to college and remain in college to matriculation.

Rationale

The research presented here addresses one of the obstacles. Native students face at a predominantly white, academic institution in the search for an answer to the question: Will the inclusion of CS within an academic curriculum enhance learning as it relates to science for Native youth? This leads to the second question, what are the benefits to non-Native youth? In other words, if all students are introduced to a more holistic approach to learning beyond the compartmentalized, quantitative western paradigm, will they all benefit from this shared knowledge? This research utilizes the WaYS framework to take this journey into uncharted waters.

Researcher's Background

It is important to understand the lens through which I view this research. I am a non-traditional student, with over 25 years of non-academic related work, much of it with students of both Native and non-Native communities, related to forests and the land. I believe this experience provides me with a unique view of the research. It also provided an interesting vantage point interacting with other graduate students and faculty. These decade long connections provided a working knowledge of community interactions that I feel has helped process some interactions within the WaYS program.

Last, I spent my formative years in Hawaii and was immersed in much of the Hawaiian culture. I understand and embrace science more from a cultural perspective rather than a western

science perspective. This dichotomy however brings its own set of challenges as I am non-Native nor Native Hawaiian. But I can understand and empathize with the disconnect Native youth describe when trying to fit into western science academia and its multitude of need to compartmentalize (Armstrong, M., Kimmerer, R. W., & Vergun, J. (2007); Robin Wall Kimmerer, 2002, 2012; Makomenaw, 2014). I, like the students, have felt the wall that one hits when sorting out how all of this college academics is supposed to work.

Throughout this work I reference the connections to canoes. I do this for a number of reasons. One is the historical relevance that canoes have, particularly within the two states I have called home, Hawaii and Maine. Second is the universal importance that canoes have to a number of communities, both Native and non-Native, on a larger landscape that brings people together. When looking to change a paradigm, drawing on connections (like the canoe) can provide that link to initiate the change. Third is the connection that to build a canoe, something that ultimately ends up floating in the water, you start with the grass roots components in the forest. To me, that says a lot about how important connections are that are often overlooked.

Problem Statement

The lack of Native American student success in post-secondary education is well documented (Akee & Yazzie-Mintz, 2011; Guillory & Wolverton, 2008; Sharik, Lilieholm, Lindquist, & Richardson, 2015). Most attempts at addressing the problem started from a deficit model approach by academic and education administrators, who studied interventions that expected Native students to achieve to the same extent, and in the same way, as non-Native students. The deficit model holds the view that minority students are "lacking in particular identities, skills, competencies, experiences, or backgrounds."(McCoy & Winkle-Wagner, 2015, p. 424). Additionally, researchers have tended to view study participants as unequal partners, thus reemphasizing their own dominant ideology within

their research (Nadasdy, 1999, 2005). Native youth themselves feel that college is not within their reach due to lack of preparation, financial barriers and other reasons, etc.(Makomenaw, 2014).

An initial start to address the problem statement within the Wabanaki community initiated over the last seven years through the WaYS program. The WaYS program is designed to encourage Native youth to persist in high school and encourage them to pursue post-secondary education to start to address the lack of enrollment in post-secondary education. Enrollment data through the University of Maine, Wabanaki Center from 2015-2018 indicates there has been a 15% increase in the number of Native youths that are attending post-secondary college at the University of Maine. Though not all of the increase can be attributed to WaYS, some of it can be based on the proportion of WaYS students. This helps to support the rational to utilize this program philosophy to address the Problem Statement. Even so, challenges remain to ensure that Native students stay in college. Little is accomplished if Native youth ultimately drop out of college.

Purpose Statement

The purpose of this paper is to determine if inclusion of Native CS in academic curriculum will enhance Native youths' learning within sciences at post-secondary educational institutions. A secondary purpose is, in the course of including CS, does this enhance a non-Native student's learning in science.

The data collection and findings of this research focus specifically on the changes in beliefs for both Native and non-Native students and their relationship of cultural science incorporated into western science. This is one part to the overarching research parameters of a National Science Foundation grant INCLUDES. This grant, depending on these findings, will develop Best Practices to support Native students' completion of degrees in science at the

university level and eventual careers in natural resources for their Tribes.

Overriding all of this research is the need to change the paradigm by creating research that follows the WaYS model - one that is grassroots and embraces equality among the participants and equal voice in the process. This is a key component to success for WaYS and one that was embraced with this research. This research seeks to create a platform for diversity of learning and listening outside of the traditional research parameters to initiate the paradigm change. This ideology is expanded upon with the Research Questions, Page 14.

Critical Definitions

Throughout this study, there may be a few terms unfamiliar to the reader. Clarification is provided for the following terms, cultural science (CS), Cultural Knowledge Keeper (CKK), decolonizing methodology, Indigenous methodology and purposeful selection. Particular attention is paid to CS because of the critical role it has within this dissertation.

Cultural science.

There appear to be as many ways to define CS as there are scholars who utilize the term (Hatcher, Bartlet, Marshall, & Marshall, 2009; G. Snively & Corsiglia, 2016; Sutherland & Swayze, 2012). The varied definitions can reflect an author's interpretation from a Native versus non-Native perspective or the context or pedagogy in which the term is being utilized. In fact, the process of defining CS seems to demonstrate the challenges faced when weaving Native science with western science.

It should be recognized at the onset that the term, CS, or the other terms utilized and described below, is one that has been conceived by western science and academia to aggregate terms within a context that can be familiar to western science authorities, create comfort levels within western science pedagogy and allow institutional power dynamics to create linear order

for many western science practitioners (Nadasdy, 1999).

The definition of CS can be complex and multi-layered depending on who and how the term is used (Hatcher et al., 2009; Sutherland & Swayze, 2012). Terms and or synonyms that also are commonly used to define CS include Traditional Ecological Knowledge (TEK) (Berkes, 1993; Feinstein, 2005; Huntington, 2000; Robin W. Kimmerer, 2002; Mazzocchi, 2006; D. McGregor, 2008; Nadasdy, 1999; Pierotti & Wildcat, 2000; US Fish & Wildlife Service, 2011), Indigenous Knowledge (IK) or Traditional Knowledge (TK) or (TKn) (Bartlett, Murdena, & Marshall, 2012; Gibson & Puniwai, 2006; Marshall, Peterson, Coverdale, Etzel, & McFarland, 2014), Local Ecological Knowledge (LEK) (Koh, 2016), Indigenous Ecological Knowledge (IEK*)* (Clapperton, 2016), Traditional Ecological Knowledge and Wisdom (TEKW) (G. Snively & Corsiglia, 2016), Integrative Science (IS) (Hatcher & Bartlett, 2010), and Native Science (NS) (US Fish & Wildlife Service, 2011), to name just a few. There are others including, "science, folk knowledge, farmers' knowledge, fishers' knowledge and tacit knowledge" (Mazzocchi, 2006, p.463).

As differing as the names given them, the terms and definitions have varying patterns when viewed through a Native versus non-Native lens. For example, one Native definition includes "indigenous science" metaphorically as a "living knowledge" that requires less dependence on knowledge transfer from books and requires "knowledge gardening with living knowledge keepers" (Hatcher et al., 2009, p. 15.). It is important to acknowledge that CS involves rigor and replicability (Nicholas, 2018).

From a non-Native perspective, Berkes, (1993) states, "TEK is a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment.

Further, TEK is an attribute of societies with historical continuity in resource use practices; by and large, these are non-industrial or less technologically advanced societies, many of them indigenous or tribal" (p.3). From a third perspective, that combines Native and non-Native lenses, there is this definition, "an intellectual foundation for an indigenous theory and practice of politics and ethics, centered on natural places and connection to the natural world, which is capable of generating a conservation ethic on the part of those who follow its principles. TEK is based upon empirical observations resulting from patient observation of the natural world and its patterns. TEK is inherently multidisciplinary because it links the human and the non- human and is not only the basis for indigenous concepts of nature but also for concepts of politics and ethics"(Pierotti & Wildcat, 2000, p.1335).

For the purposes of this paper, the term CS (rather than Indigenous Science) will be used by this writer. It encompass a range of terminology; in particular, it utilizes the Pierotti & Wildcat (2000) definition of Traditional Ecological Knowledge (TEK), but intentionally leaves behind the word "Traditional" since that term as used by a number of scholars conjures up the view that traditional information and knowledge is old, outdated and not something that is current and dynamic (Nadasdy, 1999.).

History of CS.

CS began to gain a higher level of awareness in the 1980s (Berkes, 1993), although some connection had been made in the 1950s that indigenous knowledge could enrich western science by work that Harold C. Conklin coordinated during his undergraduate days at the University of California, Berkley. His work is acknowledged in some circles (Berkes, 1993; Mazzocchi, 2006) as the initial foray into weaving indigenous with western science in the mid to late 1950s. Though non-Native himself, Conklin was adopted by the St. Regis Mohawk Tribe of the Akwesasne Nation in 1939 when he was in 8th grade (Wikipedia contributors. (2017). This may

have provided him with the opportunity to broaden his awareness, perspective and the value that indigenous science brings to western science. His research led him to study Indigenous Tribes in Mindoro and Palawan. According to Berkes (1993), "Conklin (1957) and others documented that traditional peoples such as Philippines horticulturalists often possessed exceptional detailed knowledge of local plants and animals and their natural history, recognizing in one case some 1600 plant species."

One would gather from this that the idea of CS started, in earnest, around the 1950s, but surprisingly, the "Kaswentha" (a.k.a Two Row Wampum), created from the 1619 Treaty between the Dutch travelers and the Haudenosaunee people (Iroquois) suggests that indigenous and western sciences were acknowledged as separate but important elements as far back as the early 17th century (Kimmerer, 2013). In spite of these historical events, the value of indigenous science contributions remains under-acknowledged today, hundreds of years later.

Because of the multiple lenses and constructs, along with its very definition based on western terms, the acceptance and acknowledgement of CS is fraught with challenges, particularly within western pedagogy.

Cultural Knowledge Keeper (CKK).

WaYS has been using the phrase CKK for a number of years to reference Knowledge Keepers from the Wabanaki community. It is a way to acknowledge the vast amount of knowledge and respect these community members and elders share with our WaYS students.

Decolonizing Methodology.

To frame this term within this work, I refer to Ndlovu-Gatsheni (2017) definition suggesting that "decolonising methodology, therefore, entails unmasking its role and purpose in re-search. It also about rebelling against it; shifting the identity of its object so as to re-position those who have been objects of research into questioners, critics, theorists, knowers, and

communicators" (p.4).

Indigenous Methodology.

To paraphrase Porsanger (2004), Indigenous methodology is a body of indigenous and theoretical approaches and methods that is utilized by indigenous researchers in the study to benefit indigenous peoples. This is to ensure that "research on indigenous issues can be carried out in a more respectful, ethical, correct, sympathetic, useful and beneficial fashion, seen from the point of view of indigenous peoples (p.108)." It is research with a strong "anti-positivistic stance"(Smith, 1999, p. 189).

Purposeful Selection.

To paraphrase Maxwell (2013) this strategy involves a particular setting, person or activities that are deliberately selected to provide information relevant to the question that could not be gained well from other choices (p.97).

We.

Throughout this document "we" is often used and could be considered an anomaly for a PhD dissertation. However, this is a collaborative project, based on an inclusive pedagogical framework to equalize all of the contributing players. This work is based on not just what I did or what I saw but on what others saw as well, Cultural Knowledge Keepers (CKK), faculty members, WaYS Board members, WaYS students. This was an inclusive process and is acknowledged accordingly. To that end "we" is used often. If it is not clarified to refer to someone other than those acknowledged here, that will be clarified for the reader.

Western Science.

The term western science has only been in use since the beginning of the 20th century. According to Good et al (1999), many science educators define western science as "people's attempt to search out, describe, and explain in natural terms generalizable patterns of events in the world" (pg. 201). WS validates explanation over meaning, product over process. Western

science develops and then tests hypotheses to ensure rigor and replicability to interpret empirical observations or making predictions. WS compartmentalizes nature.

Conceptual Context & Theoretical Orientation

Many underrepresented students, in particular Native American students, do not view a career within the science field as a part of their future. This includes Science, Technology, Engineering and Math (STEM) fields. More alarming is that some have not been *exposed* to STEM fields to realize these as a possibility. Many Native youth feel that this is not within their reach for other reasons including but not limited to lack of preparation and financial limitations. Compounding that, particularly within the Wabanaki Tribes (Penobscot Indian Nation, Passamaquoddy at Indian Township and Pleasant Point, Houlton Band of Maliseet Indians, and Aroostook Band of Micmac) in Maine, there is a need for more young people to be the new science leaders for their tribes on tribal lands. Currently there are only a handful of students that share a desire to pursue science fields at a post-secondary level. Adding further pressure, there are many natural resource professionals within the Wabanaki Tribes who will be retiring within the next 10 years (personal conversations with John Banks).

National trends indicate that Wabanaki participation and success in college programs may be difficult to attain. The 2007 Native American Consortium for Student Retention Data surveyed more than 400 post-secondary schools that indicated more than 4.9 million first-time, full time-freshmen (Native and non-Native) during the timeframe of 1999-2005. Although the information indicated an increase of more than 50% with regard to minority students over the six-year period that were attending four-year schools, there was only a 1% increase in Native American students over that same time period. Furthermore, 40% of the Native American students began their post-secondary careers without a high school diploma. (Hunt, 2008). Much

of this is traced back to lack of preparation in K-12 grades.

More recent data, based on information from the National Indian Education Association, shows similar challenges: ("More Recent Data," 2019)

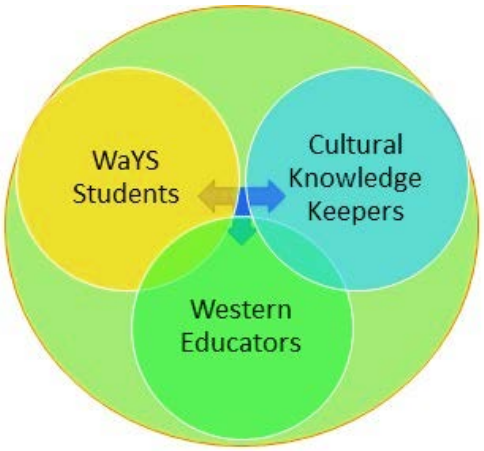
- In 2012, 39% of American Indian/Alaskan Native (AI/AN) students who started in 2005 as first-time, full-time students at four-year institutions graduated, compared to 60% of white students (Knapp, Kelly-Reid, & Ginder, 2012).

- In 2011, among students who took the National Assessment of Educational Progress (NEAP) test, 63% of AI/AN 8th graders had never talked to a school counselor during 8th grade about classes they should take in high school or about what they want to do after high school (National Center for Education, 2012).

Reasons for Using WaYS as a Foundational Base

In the past seven years, WaYS has provided that pathway for high school students to learn more about science fields that interested them. Prior to WaYS, there were few mechanisms in place in the Wabanaki communities to keep Native students on an educational path, even if an interest had been sparked in the science fields during middle and high school. This innovative program has brought Wabanaki Ecological Knowledge (WEK) and western science together through Cultural Knowledge Keepers (CKK) and natural resource professionals. Together, they have engaged high school students in science programs vis-a-vis a multi-dimensional program that has included internships, earth camps, seasonal mini camps and after-school programs. This is not a two-way transfer of knowledge (Figure 1.1). It is actually three-way technology transfer that includes the students voice to support their desires, perspectives and teachings.

Figure 1.1 WaYS Technology Transfer



WaYS was established via a grassroots, collaborative method starting with the five Wabanaki communities (four Tribes-Penobscot Indian Nation, Houlton Band of Maliseet Indians, Aroostook Band of Micmac and Passamaquoddy, which has two communities at Indian Township and Pleasant Point) in Maine. WaYS is overseen by a 10-member Tribal Board that represents these five communities with two members from each community.

Sixty-five Wabanaki students have participated in the program on a regular basis, with about equal participation by young men and women. This group of students broadly represent the four Tribal Nations (40% Penobscot, 25% Passamaquoddy, 22% Micmac, and 12% Maliseet).

The founding premise was that Native youth may be more persistent in science through post-secondary education by incorporating Wabanaki Ecological Knowledge (WEK) and values. Incorporating WEK has been shown to be an important component for success in science education for other Native American students (Huntington, 2000; Kimmerer, 2002). In a four-year period, from 2014 through 2018, there has been a 15% increase in Native youth attending the University of Maine in the science fields as first-year students (University of Maine,

Wabanaki Center data).

This background is important as it relates to preparing students for academic persistence and success in post-secondary education. This is the most challenging step, but it is also the step that could have the broadest impact for Native American students, other underrepresented populations, and even mainstream students, in science fields by utilizing an innovative, Native American middle and high school educational program as the foundation.

The benefit to mainstream students is supported by a host of scientific evidence that shows "greater diversity-related experiences are associated with positive learning outcomes for whites and people of color alike" (Holoien, 2013, p .7).

Post-secondary science curricula traditionally come from a western science perspective and do not embrace the cultural and community connections that are important components for Native American populations to succeed in science education (Akee & Yazzie-Mintz, 2011; Hunt, 2008; Reyhner, 2001; Sutherland & Swayze, 2012). The last four years of assessments from the WaYS program has shown the number one priority for Native American students is culturally relevant pedagogy and mentoring. Culturally relevant pedagogy and mentoring have been shown to be critical components for success in Native American post-secondary education (Akee & Yazzie-Mintz, 2011; Hunt, 2008; Reyhner, 2001; Sutherland & Swayze, 2012).

Research Questions

The focus of this study reflects two questions:

1. Does inclusion of Native cultural science (CS) in academic curriculum enhance Native students learning within post-secondary science education?

2. Does inclusion of Native CS (CS) in academic curriculum enhance non-Native students learning within post-secondary science education?

These fundamental questions, based on the WaYS model to extend the pipeline of Native science students through college and into science-driven professions, are a critical part of the research to provide the "proof of concept" upon which this study is based to realign science education. This research utilized the WaYS Board for thoughtful guidance to pursue and develop science education network through the research study and maintain the community-based "proof of concept" continuum. Additionally, throughout this research it has been important to reach out to the tribal community members beyond the Board to determine, from their perspective, other key components needed in post-secondary curriculum for Native youth to be successful in college.

The grassroots emphasis of WaYS at the high school level to combine cultural integration and western science has shown a number of positive by-products for Native youth over the last few years. One has been the desire by the students to have more opportunity to connect with CKK. Initially WaYS had the week-long earth camp. This expanded to seasonal mini camps (2 days) plus the week-long earth camp. Two, based on questionnaires students fill out at the end of most earth camps, the connections with CKK and western science in an integrated manner encourages student connections and a desire to learn more (carr, 2014; carr, (unpublished course work, 2018). Third the Wabanaki Center has indicated a 15% increase in Native youth attending University of Maine Orono over the last four years. Finally, I have documented positive impact (via reflections and personal communications) of a culturally-based pedagogy for Native students; acknowledgement by participating Faculty/Cultural Knowledge Keeper; a more personal connection for the Native student to the educational institution; provides a broader understanding and recognition for all students and ultimately, enhanced learning. All of these deliver a

different paradigm of critical thinking. These components afford not only a stronger and enhanced learning for the student and faculty involved, but it acknowledges that there are also different connections and inclusions that provide a broader base of understanding of one's respective science. All of which delivers the underpinning from which the research questions were derived.

Overview of Methods

Approach.

There are four facets to this mixed methods research: a quantitative analysis in the form of questionnaires (pre and post) in the School of Forest Resources (SFR), College of Engineering (COE) and Anthropology Department (ANT) ; qualitative analysis tools including reflections utilized in the SFR classes; observations within the SFR and COE class; individual interviews of current WaYS college students; focus group within ANT.

This background is provided because the parameters of the research play a significant role within the methodology. The WaYS program and the fundamental concept of this research are community-based, and grassroots driven. The community-based, grassroots driven methodology provide the success of high school students in the WaYS program and are felt to be integral components of the implementation and success of this study at the college level. The design and development of the "research instruments" was done with input from traditional knowledge holders and western scientists. Research utilizing Cresswell (2013), Maxwell (2013); Merriam (2002) as guidance, indicated that Community Based Participatory Research (CBPR) would be the most inclusive method of research to meet the short and long-term study goals. It would also provide an equal voice. Key words here being inclusive and equal. Many other forms of “research” do not provide an avenue for inclusivity and equality in the research as CBPR does. Smith (1999) points out that “[m]ost research methodologies assume that the researcher is

an outsider, able to observe without being implicated in the scene. This is related to positivism and notions of objectivity and neutrality" (p.89). This objectivity and neutrality is not inclusive nor does it provide an equal voice. Objectivity and neutrality may be beneficial when dealing with inanimate objects or research that is two dimensional.

When research involves ideas, thoughts, views and perspectives through a different lens, research that embraces inclusion will achieve stronger results. As noted by Balazs et al (2013) "CBPR entails academic-community collaboratives in which power is shared among partners in all aspects of the research process—the doing, interpreting and acting on science. This process elevates community knowledge, challenges traditional power dynamics in the research process, and can directly benefit the communities involved" (p.9).

As a subset of this methodology, I utilized the framework of Indigenous methodology by incorporating Indigenous values and beliefs (Gone, 2019). This decision strengthened the voice, involvement and equality of this work because "Indigenous research has historically been completed *on*, rather than *with* (i.e., in collaboration with) Indigenous Peoples (Drawson & Toombs, 2017, p.1). Smith (1999) suggests a framework that "involves *re*writing and *re*righting the Indigenous position in history and society" provides a key to success. So to this research.

Limitations and Delimitations of the Study

I have been a part of the WaYS program and this pedagogical process since 2013. Though I was not present at its inception -- the idea and concept for WaYS had been discussed for a number of years prior to 2013 -- development and completion of my master's in forestry in 2014 led, in part, to the creation of the WaYS program. I have continued to be a part of this growing program. I bring a tremendous amount of bias towards the benefits of WaYS which meant continually checking and rechecking as I moved through the data collection and analysis. It was important for me to have other voices during the research process to be a part of these

discussion to continually share their knowledge and perspective.

Additionally, I have worked side by side with the students at earth camps, mini camps, internships over the last seven years. This level of trust and familiarity I have with students I believe helped the research process. I have worked and continue to work with many of the Cultural Knowledge Keepers (CKK) that were a part of WaYS and this research process. My positionality throughout my efforts with WaYS and the work the CKK has been on equal footing or at least I did not come in as an expert when working with CKK at the earth camps, mini camps and internships. The CKK were clearly the experts. By extension, the research that I conducted this past year is not vastly different than what we have collectively worked on over the last seven years as we have co-created, co-developed and have seen the fruits of our joint labor with the growth of the WaYS program which provides the foundation of this research.

Even with all of this familiarity and desire to ensure that there is co-research throughout the research, analysis and write up process, I am non-Indigenous. As much as I would like to think that this has been an equal process, there still may be the perception that it is not. And that is a challenge.

I also ran into a significant challenge within the final months of the research process with the loss of a key CKK to my work. This unanticipated departure created a gap in continuity and collaboration. It has been, to some degree, filled but not to the same degree that I had hoped when we first started on this journey. Like canoe building, sometimes you need to find alternative material.

A limitation to the study was the small number of students, less than 20 Native students, involved. It is a reoccurring factor which, for some, could lead to the criticism that this work may lack statistical significance. The paradigm needs to shift to understand that it is not the quantity

but the quality. That is an important distinction within this work and should not reflect on what change can occur.

Finally, this work did not focus on racism or whiteness as a contributing component to the challenges for enhanced learning. Kimmerer (2012) concludes that inclusion of CS benefits all students by "broadening and deepening the teaching of environmental science" and "fostering intellectual pluralism" (p.317). Additionally it is argued that inclusion of CS broadens students understanding by providing a holistic approach to science to help assuage the constant need to compartmentalize science which does little to benefit any students understanding of how the balance of nature is intended (Feinstein, 2005; Kimmerer, 2012; Nadasdy, 1999; Ragoonaden & Mueller, 2017; Smith, 2014). This is supported by early research for this project that questioned the students of three School of Forest Resources classes in the Fall of 2018. Data from those classes indicated that over 97% of the students self-identified as non-Native. Preliminary results indicated that within that student population, based on the reflections, over 90% of them valued and appreciated the inclusion of CS in their classes.

Significance.

The potential impact that this research has to benefit Native youth is highlighted by Kimmerer (2012). Benefits include fostering an understanding of "respect, responsibility and reciprocity" (p. 319) not only for the resource but for each other and displace the idea that humans are at the top of the pyramid, rather than a part of the circle of life. Kimmerer further argues that the addition of IS (she utilizes Traditional Ecological Knowledge or TEK) and western science (Scientific Ecological Knowledge or SEK) benefits all students by providing a

> " (1) clear and disciplined analysis of how TEK and SEK are grounded in different worldviews; mutually respectful evaluation of the divergences and convergences of these epistemologies creates the foundation for critical examination of how

> synergy might be created between them; (2) engagement of the indigenous pedagogy of direct, experiential learning in which the land and its inhabitants are recognized as primary knowledge sources; (3) holistic engagement of multiple elements of human capacity: mind, body, emotion, and spirit, not just the intellect which is exclusively privileged in conventional environmental science education; (4) recognition that in indigenous approaches, knowledge and responsibility are inextricably linked, so the course content and approach simultaneously cultivate the responsibility that accompanies knowledge acquisition, including protection and appropriate use of cultural knowledge; and (5) recognition that the mutually exclusive duality between matter and spirit which is essential to the scientific worldview is bridged in TEK where material and spiritual explanations, the secular and the sacred, may simultaneously coexist" (p. 317).

Encouraging Native youth to complete college and to be able to manage their Tribal Lands will bring about an understanding of "respect, responsibility and reciprocity" as Kimmerer described. There are over 184,000 acres[1] of Tribal Land in Maine with only a two communities, Penobscot Indian Nation and Passamaquoddy, being managed directly by Tribal members.

The addition of CS into western academics, as an integrated component, rather than an add on, has a significant impact on non-Native youth (Armstrong et al., 2007; Kimmerer, 2002; 2012). With many federal organizations requiring collaboration with Indigenous working groups, having non-Native youth familiar with and understanding the cultural relevance to the environmental issue can lead to a better decision-making process. (Pezalla, Pettigrew, & Miller-

[1] Maine Tree Foundation

Day, 2012). Gervais (2017) notes, “[a]s students step into the roles of natural resource managers either on nontribal or tribal lands, they need to have an education rooted in interdisciplinary practices that include human dimensions such as community and cultural values” (p.495).

CHAPTER 2

REVIEW OF LITERATURE

The primary purpose of this study is to determine if WaYS, an innovative, existing Native American middle and high school educational program will provide the platform for success for Native American students in their pursuit of enhanced learning within post-secondary (college level) science education. WaYS melds CS with western science. Positive results from inclusion of this approach to benefit Native youth is supported by a host of scientific evidence (Akee, and Yazzie-Mintz, Tarajean, 2011; Armstrong, M., Kimmerer, R. W., & Vergun, J. (2007); Gibson & Puniwai, 2006; Hunt, 2008; Kimmerer, 2012; Sutherland, Dawn, and Swayze, Natalie, 2012; Reyhner, 2001; Williams, 2013). A second question is: Will mainstream students benefit from this approach as well? The latter question has not been subject to the research that the primary question has but what has been done shows that "greater diversity-related experiences are associated with positive learning outcomes for whites and people of color alike" (Holoien 2013, p.7).

In order to change the academic paradigm within a predominantly white, educational institution (PWI) to actively shift the educational framework it is important to understand what exactly CS is and to understand the barriers Native students face that limit their success in those institutions.

Cultural science

CS incorporates more than just the definition that was provided in Chapter 1. There are a number of influences that impact the role and relevance of CS within the academic paradigm and these should be understood as actual and potential barriers to the acceptance of CS within PWIs at different levels. From the start, it is important to delve into these factors as barriers to the extent that they prevent Native youth from succeeding at the college level. Just as there are a

number of different paddles that can be used on one's journey in a canoe, there are a number of factors that challenge the acceptance of CS at PWI.

Barriers to Acceptance of Cultural science.

In 1998, Kawagley pointed out that, "The curricula, teaching methodologies, and assessment strategies associated with mainstream schooling are based on a worldview that does not adequately recognize or appreciate Indigenous notions of an interdependent universe and the importance of place in their societies (Barnhardt & Kawagley, 2005, p.10).

Barnhardt and Kawagley acknowledged that "(t)he specialization, standardization, compartmentalization, and systematization that are inherent features of most Western bureaucratic forms of organization often are in direct conflict with social structures and practices in Indigenous societies, which tend toward collective decision-making, extended kinship structures, ascribed authority vested in elders, flexible notions of time, and traditions of informality in everyday affairs."(Barnhardt & Kawagley, 2005).

Kawagley found that Native Americans have a different thought process that is "carefully constructed around observing natural processes, adapting modes of survival, obtaining sustenance from the plant and animal world, and using natural materials to make their tools and implements." (Barnhardt & Kawagley, 2005, p.10). These Native views challenge the educational approach of western science and the "institutionalized forms of cultural transmissions" which is confined to the four walls (Barnhardt and Kawagley, 1999). It is little wonder, then, that formal education structures, which often epitomize Western bureaucratic forms often compartmentalized, have been found wanting in addressing the educational needs of traditional societies which are collective in nature.

Integrating CS and WS from within an academic context

Barnhardt and Kawagley (1999) made the case that to initiate change within the existing educational paradigm, one needs to look at the educational context at hand and have it explained first from the perspective of CS. This will enhance the learning for WS students as well as practitioners. According to the same authors by starting from the perspective of "everyday life" (p. 12), the Indigenous student as well as the non-Native, will become motivated to learn. This theory is supported by (Battiste, et. al (2002); Kawagley, (1995); Lipka, (1998).

Western ideology finds it necessary to either compartmentalize science (Barnhardt & Kawagley, 2005; Eckert, Goldman, & Wenger, 1997; Nadasdy, 1999) or view it as linear progression (Nadasdy, 1999; Snively & Corsiglia, 2016). If CS challenges those parameters, CS continues to be disbelieved. Snively & Corsiglia (2016) summed up the challenge that is faced when including WS with CS by stating that WS is"linear, singular, static, and objective" (p.137). Singularity often manifests itself in concepts such as the one true God, one right answer, one true science, and the superior importance of a person as an individual. Plants and animals are ranked in terms of higher and lower intelligence. If something is not measured, then often it is not scientific" (p. 137).

Often times, humans are seen on the top of the pyramid in WS or a Linnaeus system (Snively & Williams, 2008), further challenging the CS beliefs that all are connected and equal (Hatcher et al., 2009; Snively & Corsiglia, 2016; Snively & Williams, 2008; Williams, Tanaka, Leik, & Riecken, 2014). Visually, the challenges to defining CS within a WS contex can be demonstrated quickly and its dichotomous nature readily apparent through the work of Abah, et al. (2015), if one were to keep the proverbial blinders on and thus only see things in a linear fashion, as illustrated in Table 2.1 below.

Conversely,Stephens (2000) depiction allows one to visualize the overlap and strong

connection made to the value of integration (Figure 2.1). Table 2.1 shows a linear, compartmentalized view, with Figure 2.1 being one of a circle or a wheel, showing a continuous connection with no beginning and no end.

Table 2.1 Linear comparison of CS within a western science context (Abah, 2015)

Aspects of Education	Indigenous Education	Formal Education
View of Knowledge	• Sacred and secular together; includes the spiritual • Holistic and integrated – based on a whole systems view of knowledge • Stored orally, in cultural practices and artifacts • Powerful predictability in local areas (ecological validity) • Less valued in distant areas	• Secular only; often excludes the spiritual • Analytical or reductionist – based on sub-sets of the whole • Stored in books and computers • Powerful predictability in natural principles (rational validity) • Weak in local use of knowledge
Objectives	• Long-term recall • Cultural and ecological sustainability • Practical: for use in everyday life • Integration of critical thinking and cultural values in decision making	• Short term recall • Economic sustainability • Abstract: to pass examinations • Use of logical and critical thinking in making decisions
Methods of Teaching and Learning	• Lengthy period of acquisition • Learning through experience • Teaching through example, modelling, ritual and storytelling • Tested in practical life situations	• Rapid acquisition • Learning by formal education • Teaching through abstract concepts and didactic methods • Tested artificially in examinations

Figure 2.1 shows the overlap potential that brings two dichotomous ideas together, with no boxes or compartmentalization.

One would hope, with CS introduced in the 1950s, nearly 65 years ago, that from a more global perspective its inclusion would be widely accepted and embraced within the western science lens. Sadly, it continues to struggle for voice for a variety of reasons including, but not limited to power, perception and politics (C. Bartlett, Marshall, & Marshall, 2012a; Robin Wall Kimmerer, 2012; Nadasdy, 1999, 2005).

Power.

A number of Native and non-Native scholars have observed the challenges of integrating CS with WS. Nadasdy (1999) noted that after "nearly 15 years of effort by countless scientists, resource managers, aboriginal people, and social scientists to develop a method for integrating… traditional knowledge … there has been little actual progress toward achieving it. Despite the establishment of numerous co-management regimes across the North, scientists and resource

managers remain essentially at a loss regarding traditional ecological knowledge many are still not quite sure what it is, much less how to use or integrate it with scientific research" (p. 2)**.**

Recognizing that there are tools lacking within the institutional framework that led to this, Nadasdy suggests that the underlying issue is the inability of WS to relinquish power. Nadasdy (1999) wrote, "Returning decision-making power over the land to local communities, however, would provide a counter-weight to the power-centralizing tendencies of scientific resource management. This would not preclude scientists from engaging in their own set of socially useful practices, but they would be doing so at the request and direction of local communities. Thus, scientists would no longer define and drive the process of resource management, but would act as a resource, providing communities - upon request…" (p.15). Changing the power dynamic to one coming from the Indigenous community would change the often-viewed perception that CS is blended into WS rather than being equal. CS would stop being the add-on.

Nadasdy is not the only one who suggests that the struggle for CS integration into WS is related to power. McGregor (2005) states that "Although the knowledge of Aboriginal people is sought for environmental and resource management decision-making, the regimes to which this knowledge will be applied are based on Western scientific theories and management practices. This means that only knowledge that is consistent with Western science tends to be acknowledged. The language used is that of the dominant culture and puts Aboriginal people at a disadvantage". (p. 398-399). Healey (1993) suggests "Power is concentrated on the side of researchers, sponsors and consumers, whether the power is political, economic or even military. . . more often, at least in the contemporary world, the power relation is muted, masked, and benign; but not less unequal for all that" (p. 21). In 1993, this was re-emphasized by Berkes

when he pointed out that “different world views and unequal in political power base, these two systems of knowledge are certainly not easy to combine. Serious attempts at integration inevitably come up against the question of power-sharing in decision-making” (p.6). Changing the dominant power structure remains one of the challenges for CS equality.

Perceptions.

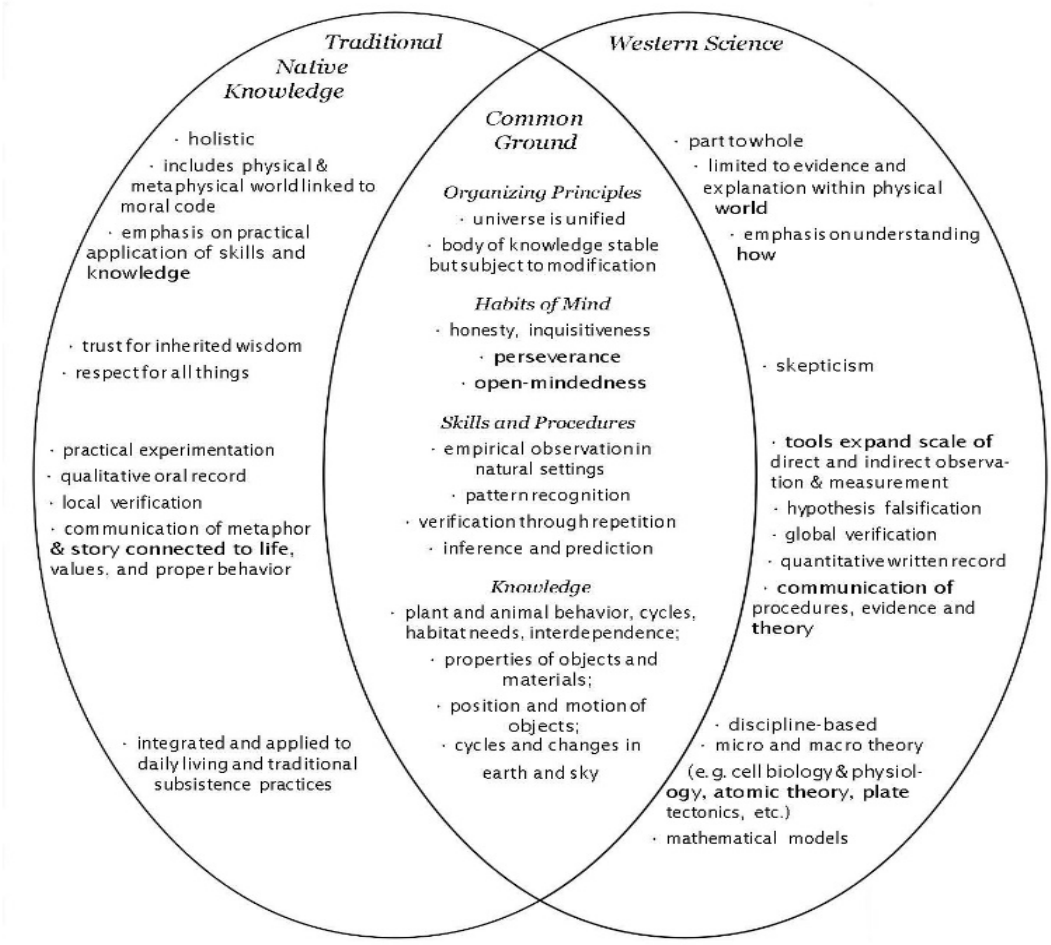
It is not just power that plays into the challenges for equal incorporation of CS and WS, it is the perception of validity (or lack thereof). Simpson (2004) states that “Most Western scientists focus on TEK [Traditional Ecological Knowledge] as a resource for baseline data in areas where Western scientific data is lacking, since a greater volume of factual knowledge is equated with the better management of natural resources, primarily because it affords humans greater control over those environments. It is this line of thinking that drives ecologists to move from their intellectually comfortable spaces and forge into the alleged “practicality” of TEK” (p.374). Smith (1999) reinforces this claim by highlighting “(a)uthorities' and outside experts … often called in to verify, comment upon, and give judgements about the validity of indigenous claims to cultural beliefs, values, ways of knowing and historical accounts” (p.84). It is this discounting by western science that contributes to the continued perception that CS is not valid, even though “ancestral knowledge is like centuries of peer review” (personal conversation with Dr. Katherine Crocker, October 18, 2018).

Peer-review journals remain a pinnacle benchmark to success for many in western science academics. For clarity, peer-review is defined for this research often consists of a board of reviewers, deemed scholarly in the subject area of the journal. The reviewers follow the editorial standards for the journal. If the article in review is accepted it is often termed as being peer-reviewed, meaning that it has been vetted and reviewed by the panel of scholars and accepted for print in that journal. (website: https://library.sdsu.edu/reference/news/what-does-

peer-review-mean, accessed 4/8/2019). In order to attain the perception of validity within western academics, one needs to be published. Numerous authors have highlighted the challenges that are faced by "others" (Abu-Saad, 2008; Smith, 1999) and the limited opportunities to publish to validate CS through western science scholarly means (Abu-Saad, 2008; Cajete 1999, 2000; Snively & Corsiglia, 2001; Snively & Williams, 2008, Smith, 1999).

The challenge for western science scholars to re-think the definition of validity and to understand that "TEK itself is timeless and predates written record" continues to be a stumbling

Figure 2.1 Integration of CS and western science (Stephens, 2000)



block (Corsiglia & Snively, 1997, p.5). The inability to acknowledge the validity of CS may be rooted within a number of colonial ideologies and their corresponding politics (Eisenberg, 2018; Lewis, Chesler, & Forman, 2000; Masta, 2019; Deborah McGregor, 2005; Sillitoe, 2007; L. R. Simpson, 2005; L. T. Smith, 1999).

Politics.

The pervasive political culture challenges incorporation of CS and WS for many of the same foundational reasons as listed above. The dominant ideology creates a vacuum for CS. When meetings are held on the home turf of the dominant ideology, it is difficult to create change (Nadasdy, 1999). This is due, in part, to the unequal power dynamics that occur between the dominant ideology and the non-dominant ideology. It is even more challenging when the two parties, CKK and western science resource professionals (RP), view the other with mutual suspicion. If a CKK only views the RP as providing "lip service" (Nadasdy, 1999, p. 3) and the RPs partner with CKK only because it is politically expedient and required (Nadasdy, 1999. p.3), multiple challenges occur and attaining mutual agreement is way-laid. Incorporation of CS and WS together requires parties to rethink and change the political landscape to include others, beyond their political sphere.

From a global perspective, success can happen when this re-thinking and re-imaging occur and is encouraged by dialogue versus debate (Issacs, 1993). An example of this is the Indigenous Methodologies Research (IMR) that has recently gained a foothold within the academic realm. IMRs are "designated approaches and procedures for conducting research that are said to reflect long-subjugated Indigenous epistemologies (or ways of knowing)" (Gone, 2019). The exciting aspect of IMRs is that it is "a hybrid, a blend of existing research methodologies and methods that has been increasingly anchored within epistemologies, experiences, languages, cultures and spiritual traditions that are specifically indigenous" (Jordan, 2014. p. 2) and that IMRs initiate around "Indigenous lens" (p.3). Noting that this work is very current, 2019, Gone shares his success with incorporating CS within the WS "university-based knowledge production" (Gone, 2019, p.46). It is interesting to note that his prior experience led him to initially believe that "that epistemological differences between Indigenous and academic

ways of knowing might be fundamentally irreconcilable in the context of university-based knowledge production for almost any academic field of inquiry" (p. 46). Through the process of IMR, Gone now believes that some in-roads to change can occur. It is interesting to note Gone's initial skepticism helps add authenticity to the potential that this form of research can have success when viewed with an open lens. The vision of IRMs unites with the WaYS program as it relates to innovative ways to bring about change towards CS and WS and speaks more to the ways of shared learning through a cultural lens.

Another part of the institutional challenge to incorporate CS with WS is addressed in work by Barnhardt & Kawagley (2005). The researchers shared the challenges that some in the Native and non-Native educational institutions have with regards to the "monocultural educational system" (p. 10). They acknowledge that "(t) he tendency in the earlier literature on Indigenous education, most of which was written from a non-Indigenous perspective, was on how to get Native people to acquire the appurtenances of a Western scientific worldview" (p.9).

Barriers to Native American Students in College

It is well documented that, nationally, less than 1% of Native American students pursue postsecondary study in the science fields and that, when they do, they are less likely than their non-native counterparts to achieve success(Akee & Yazzie-Mintz, 2011; Guillory & Wolverton, 2008; Sharik et al., 2015). Most attempts to understand and address this problem have been done by western education professionals using a "deficit model" approach. In this context, the model is used where "underrepresented students are considered to be lacking in particular identities, skills, competencies, experiences, or backgrounds" (McCoy & Winkle-Wagner, 2015, p. 424). Specifically, when applied to the education achievement of Native Americans, the "deficit" approach has ignored recognition and inclusion of Native cultural legacies and community practices.

The deficit approach has built formidable walls for Native American students to climb in order to achieve success within the educational paradigm in the United States. Hurdles exist throughout the educational system for Native youth from kindergarten through matriculation at postsecondary education and graduate school (Guillory & Wolverton, 2008; Hunt, 2008; Makomenaw, 2014; Smith, 1999; Yosso & Yosso, 2017). Key barriers have been identified within the parameters of postsecondary education that include "lack of access to resources, lack of comparable educational funding between Caucasian and minority youths" and "lack of administrative support, faculty misconceptions and stereotypes and defective student relations" (Hunt, 2008, p.5). Hunt continued to suggest that a number of obstacles to retention and timely graduation include “inadequate academic preparation, unclear and/or ill-defined academic or vocational goals, financial aid, incongruence between high school and college environments, prejudice, and social isolation."(p.6). These concerns have been echoed by Caldwell, (2014) Guillory & Wolverton, (2008); Horowitz, Robinson, & Seifer, (2009); Mosholder, Waite, Larsen, & Goslin, (2016); Ragoonaden & Mueller, (2017). Prior to reaching postsecondary levels, Native youth face similar challenges in secondary education as highlighted by NEAP results above, which further compound their challenges.

The above barriers can be grouped into three critical elements that Native youth face: a lack of inclusion, an educational framework developed by predominately white institutions (PWI), and the influence of the dominant ideology (Makomenaw, 2014; Mayhew, Grunwald, & Dey, 2005; B. Smith, 2014).

Lack of Inclusion.

Inclusion in this context refers to the inclusion of culturally relevant information, in particular, the inclusion of CS. Ball (2011) recognized that "unique student learning styles including Native ways of knowing" have shown to increase Native American students’ success

in postsecondary schools. Kimmerer (2002) concluded, "[i]ncorporation of traditional ecological knowledge into the curriculum can increase the participation of Native American students and practitioners in the scientific community" (p. 435). Inclusion of culturally relevant information has not been a part of mainstream educational curriculum in the past but current research has shown its value relating to Native American students success and retention in postsecondary education (Bartlett, Marshall, & Marshall, 2012; Feinstein, 2005; Hatcher, Bartlet, Marshall, & Marshall, 2009; Kimmerer, 2012).

As most postsecondary curricula are traditionally developed from a western science perspective, academia, for the most part, does not embrace the cultural significance, nor address the community connections, that are important components in the Native American population for achieving academic success in science (Akee & Yazzie-Mintz, 2011; Hunt, 2008; Reyhner, 2001; Sutherland & Swayze, 2012) discussed earlier. The first four years of questionnaires from the WaYS students at earth camps have shown the number one priority for Wabanaki students is culturally relevant pedagogy and mentoring (carr, 2014, personal research Fall 2017).

WaYS is a model educational program for high school students that incorporates a multi-pronged approach to bring CS and WS together for Native youth in Maine. Culturally-relevant forms of pedagogy and mentorship have been shown as critical components for success in Native American postsecondary education (Akee, and Yazzie-Mintz, Tarajean, 2011; Hunt, 2008; Sutherland, Dawn, and Swayze, Natalie, 2012; Reyhner, 2001).

Educational Framework in Predominantly White Institutions.

Many ethnic minorities struggle with challenges similar to those described early in this paper, but for Native American students these barriers are greater and rooted in central

differences in perception of the world and cognitive styles of learning (Hunt, 2008). One significant contributing factor leading to the lack of educational success for this population can be attributed to learning style. There are other contributing factors such as lack of financial stability, family needs, first generation to garner access to college, but learning style is a large factor for Native success. An example of learning style in this context refers to hands-on, place-based educational style, which is not typically present in secondary and postsecondary institutions (McKenzie, 2008; Roehrig, Campbell, Dalbotten, & Varma, 2012; Thomas, Teel, & Bruyere, 2014). It is important for the teacher/professor to recognize this different learning style and make the changes needed to increase retention of Native American students.

Lack of Awareness of the Negative Effects of Dominant Ideology.

Another factor affecting Native American success within postsecondary education includes academic barriers that "obstruct the successes of American Indian students at predominantly White institutions (PWIs)" (Makomenaw, 2014, p. 380). This deficit thinking ideology does not just occur in education. There is a parallel correlation in scientific research and the use of the deficit model in that domain which perpetuates this cycle for and within the educational construct.

Nadasdy (1999) indicates that western science resource professionals go so far as to acknowledge participation of cultural values yet do not fully include the information provided. Nadasdy equated this to compartmentalization. Yosso (2006) has a similar construct as it related to minorities failure within the PWI due to a lack of assimilation into the dominant lens. All of which can be traced back to how and what students learn in the education framework described prior.

Adding to this complexity, there continues to be a disconnect between the theorist (i.e. researcher trying to change the paradigm) and the practitioners (i.e. educators and western

resource professionals). When theorists suggest alternatives such as adding culturally relevant curriculum or changing the manner in which research is done to be more inclusive (Belone,et al., 2016; Horowitz, et al., 2009; Jagosh, et al., 2015; Simonds et al., 2013) they are ignored at PWIs.

Osborne (1996) suggested that cultural differences may increase Native students' likelihood of being at odds with the dominant ethnic culture. Nadasdy has suggested that western science has not truly embraced Indigenous Science. In his 1999 research, Nadasdy stated that during his study that western science was paying lip-service because it is politically expedient. It also felt to the Indigenous contingency that there was a calculated strategy for retaining control over management of the land and resources and a never-ending power struggle. This will be discussed in detail later (Nadasdy, 1999). Fast forward 15 years or so, Kimmerer (2013) acknowledges that "western science-communities ...lack a framework of respect and reciprocity to guide the science" (p.52). This lack of recognition on the part of the dominant culture remains a challenge.

Challenges to Integrate Indigenous Science into Western Science Education

Information gleaned from research at the Institution of Research Learning at Stanford University during the 1990s (but it is ,sadly, still relevant today) provides a number of applicable examples as it relates to the pedagogy for public schools. Eckert, Goldman, & Wenger, (1997) looked at school as a community environment for learning. This dovetails with the community learning style for many Native students (C. Bartlett et al., 2012a; Makomenaw, 2014; McKenzie, 2008; L. Williams et al., 2014). The researchers at Stanford University suggested that often students remembered the social aspect of their young lives. It would only make sense that if school were viewed more as a community learning environment, students would benefit. Eckert et al. (2019) pointed out that most students in a classroom setting learn along a "linear scale of

better or worse, based on the standardized performance of a standardized task" (p.4). The standardized performances on standardized tasks were developed by the predominant white pedagogy of which the prerequisite is to assimilate to a similar end goal. It is driven by competition versus collaboration (Antone & Dawson, 2014; Cherry & Shefner, 2004; Hrabowski, 2014; L. Williams et al., 2014).

Part of the challenge is the recurring need to compartmentalize learning within the current educational framework for K-16 education. Eckert et al, offered the following:

"(s)tandardized testing is currently used to assess the success of our educational institutions

and their students. But because this method can only test the student's retention of abstractable

> facts and formalisms, the schools have felt constrained to prepare their students by organizing their curriculum around a strictly sequential delivery of these same abstracted bits. Every piece of curriculum has been justified uniquely by its necessity within a closed system—i.e. as preparation for the next piece of curriculum in the sequence, and for the assessment. What makes reform difficult is that generations of education following this mold have instilled in almost all of us a belief in the necessity of retaining some bits of this abstraction." (p.9).

The authors further discussed the challenge as it relates to the division of the subject matter which reinforces compartmentalization of assessments mentioned above. Eckert et al. states "(t)he division of subject matter into cleanly separated areas—math, science (and within science biology, chemistry, physics), language arts, art, music etc. abstracts subject matter away from the real-life phenomena of which it is part. This makes the material harder to learn because

it lacks cohesion for the student" (p. 14).

Education as a Holistic Adventure.

Barnhardt and Kawagley (2005) pointed out that "Western science and education tend to emphasize compartmentalized knowledge that is often decontextualized and taught in the detached setting of a classroom or laboratory…" (p.11). Conversely "Indigenous people have traditionally acquired their knowledge through direct experience in the natural world" (p.11).

This perspective could be an underlying challenge for many Native youth as it relates to academic success. The authors suggested that for "a Native student imbued with an Indigenous, experientially grounded, holistic worldview, typical approaches to schooling can present an impediment to learning to the extent that they focus on compartmentalized knowledge with little regard for how academic subjects relate to one another or to the surrounding universe" (p.11).

This form of learning has shown repeatedly to not be an effective means of learning for Native youth but a standard operating procedure that supports and reinforces western academic ideology (Antone et al., 2014; Gruenewald, 2013). Barnhardt and Kawagley noted that "(t)hrough long observation they [Indigenous people] have become specialists in understanding the interconnectedness and holism of our place in the universe" (p.12).

Williams (2013) research further highlighted the challenges as it relates to non-Native teachers in embracing the inclusion concept. Williams research looked at cultural competency within non-Native teachers at a Mohawk Tribal school. Her research focused on the disconnect that occurs with inclusion of language and culture within the academic structure in the Mohawk School. The study revealed that "Four percent of teachers believed the inclusion of cultural competency training was interesting but viewed it as an "add-on" to their overburdened workloads. Fifteen percent of teachers objected to the inclusion of culture knowledge because they believed it prioritized Native students over mainstream students. Four percent of

Farmingdale teachers believed the inclusion of cultural competency was irrelevant to the learning process" (p. 6). These facts are not an anomaly but have been reinforced through a number of Native and non-Native researchers including Hrabowski (2014), Mayhew, Grunwald, & Dey (2005), ; Reyhner (2001) and Simpson (2017) who have asserted similar challenges within western science education.

Much of the struggle lies within the academic structure of the western-based school system. After all, it was developed by and for western ideology. Barnhardt and Kawagley acknowledge that "(t)he specialization, standardization, compartmentalization, and systematization that are inherent features of most Western bureaucratic forms of organization often are in direct conflict with social structures and practices in Indigenous societies, which tend toward collective decision-making, extended kinship structures, ascribed authority vested in elders, flexible notions of time, and traditions of informality in everyday affairs" (Barnhardt 2002). It is little wonder, then, that formal education structures, which often epitomize Western bureaucratic forms have been found wanting in addressing the educational needs of traditional societies.

Different Forms of Knowledge.

In recent years, support for other "ways of knowing" (Barnhardt & Kawagley, 2005; C. . Bartlett et al., 2012; Gone, 2019; L. Simpson, 2000) has gained validity. Other ways of knowing from an Indigenous perspective can also be thought of as "two-eyed seeing" (C. Bartlett et al., 2012). Two-Eyed seeing is explained as "the gift of multiple perspective treasured by many aboriginal peoples that refers to learning to see from one eye the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing, and to using both these eyes together, for the benefit of all (Bartlett 2006, 2011, 2012; Iwama et al. 2009; Hatcher and Bartlett 2010; Marshall et al. 2010).

Two-Eyed Seeing further "enables recognition of IS as a distinct and whole knowledge system side by side with the same for mainstream (Western) science" (Bartlett et al. 2012, p. 335).

Benefits for Inclusion of Cultural science for Native and Non-Native Students

Inclusion of CS for Native and non-Native educational curricula will better equip all students for future decision making and to work with a collaborative perspective and manner with other viewpoints (C. Bartlett,et al. 2012; L. Simpson, 2002), though there is limited research in what or how this might look like as it relates to post-secondary education. This research looks specifically at ways to enhance learning for Native and non-Native students to help fill this gap.

Literature review and my own personal observations and discussions with others led me to ask, "Is it the framing of the discussion at the faculty level that is causing barriers to remain for the inclusion of CS for the benefit of the Native and non-Native students?" This led me to read work by William Issacs (1993) that focused on how to change the discussion by changing the dialogue. He uses corporate America as the example, but there is a parallel within post-secondary education culture to the business culture.

Issacs' focus was on organizational learning and bringing diverse entities with diverse perspectives to "collective thinking" (p.28). Issacs defines dialogue as "a sustained collective inquiry into the processes, assumptions, and certainties that compose everyday experience" (p.25). He clarified further that dialogue is about "the experience of the meaning embodied in a community of people" (p.25). According to Issacs, the challenge that many people find themselves facing within an organizational discussion, particularly when it involves difficult topics, is that it ends up being a debate where no one wins. One of the most interesting points of Issacs' comments was the essence for the dialogue. His point was that "(i)n dialogue, as we use the term, people gradually learn to suspend their defensive exchanges and further, to probe into the underlying reasons for *why* those exchanges exist. However, this probing into defenses is not

the central purpose of a dialogue session: the central purpose is simply to establish a field of genuine meeting and inquiry" (p.25).

Issacs suggests that "If people can be brought into a setting where they, at their choice, can become conscious of the very process by which they form tacit assumptions and solidify beliefs, and be rewarded by each other for doing so, then they can develop a common strength and capability for working and creating things together" (p.25). Issacs's work is creating a setting to learn to listen. This model can help build to develop active listening. Active listening creates a means to engage different viewpoints which can be shared. This shared knowledge enhances learning for all who are interested in listening. It forms an amazing circle of knowledge.

Issacs' work can provide some fundamental solutions for framing the paradigm shift within academic institution and create a venue for listening to and incorporating other viewpoints. This lack of incorporating other views has been reinforced by Nadasdy. Reinforcing the art of listening and dialogue as discussed by Issacs would be to embrace Native culture which has excelled in the art of listening for thousands of years (Antone & Dawson, 2014; Marshall et al., 2014; G. J. Snively & Williams, 2008; Tatum, 1992).

CHAPTER 3

METHODOLOGY

Introduction

The purpose of this chapter is to describe the research methodologies, both quantitative and qualitative, used in this study, and why they were chosen with particular emphasis on the importance of qualitative methodology. A more thorough review of the theoretical framework for the study, presented in Chapter 1, is also given.

Data for the study were collected during the spring semester of 2018, the fall semester of 2018 and the spring semester of 2019 at the University of Maine at Orono campus. Because this study was funded by part of a larger grant from the National Science Foundation (NSF), known as INCLUDES, not all of the data collected was relevant to and included in the present analysis. The completion of the INCLUDES research, of which the current research is a part of, will provide baseline information and guidance to develop best practices within post-secondary education.

Like most journeys, regardless of how thorough, thoughtful and meticulous one can be to details of the plan, not all can go as designed. Forks in the stream can appear, choices may need to be made. Weather may not always be sunny and warm. More layers may need to be added. My methodology had a similar experience requiring additional layers and the weather was not always sunny and warm. Nevertheless, along the way, the need for fluidity and flexibility was discovered. No matter the modifications needed, the Internal Review Board (IRB) protocol was followed.

An example of this change in fluidity is below. The initial plan was to have a faculty member and a Cultural Knowledge Keeper (CKK) co-teach the classes and to use triangulation (pre/post-questionnaires, reflections and focus group/interviews) to validate the data (Merriam,

2002). Co-teaching within the study context was defined as having both the faculty member and the CKK for each class share the design and implementation of the course pedagogy with both having equal voice and equal participation.

The groundwork for the course pedagogy was established with the first class in spring of 2018. That prototype design process was then to be used by each pair of co-teachers when planning classes to be held in fall 2018 and spring 2019 to employ the same rich rigor, validity and equal participation. The data gathered through quantitative (questionnaires) and qualitative (reflections, interview/focus group, observations) methodologies would then be comparable.

Co-teaching did not happen as planned as each pair of faculty member and CKK practiced different ideas and processes in teaching the fall 2018 and spring 2019 classes. The varied approaches ultimately added another dimension and additional information to the study. In particular it raised the question of whether the varying degrees of involvement of a CKK in co-teaching would result in different responses by the students.

This divergence led to individualized descriptions of the method used for each class to understand and guide interpretation of the data results later. Thus, the route originally planned became more complicated with additional forks in the stream, a different path travelled, and more layers needed to combat climatic changes.

To assist in methodology design and implementation, I utilized suggestions by Bogdan and Biklen (2007) related to how best to handle the various data management challenges. These guidelines provided parameters when the data, particularly the reflections, became overwhelming. Their suggestions are presented in Table 3.1 below.

Table 3.1 Methodology Design and Implantation Parameters (Bogdan and Biklen, 2007)

1. Force yourself to make decisions that narrow the study
2. Force yourself to make decisions concerning the type of study you want to accomplish
3. Develop analytic questions
4. Plan data collection sessions according to what you find in previous observations.
5. Write many "observer comments" as you go.
6. Write memos to yourself about what you are learning.
7. Try out ideas and themes on participants.
8. Begin exploring the literature while you are in the field.
9. Play with metaphors, analogies, and concepts.
10. Use visual devices.

Research Questions

This study focuses on two research questions:

1. Does inclusion of Native cultural science (CS) in academic curriculum enhance Native youths' learning within post-secondary science education?

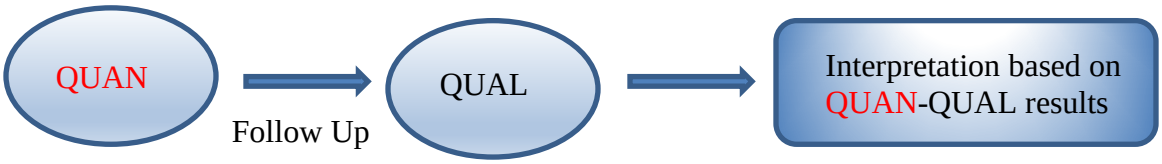
2. Does inclusion of Native CS (CS) in academic curriculum enhance non-Native youths' learning within post-secondary science education?

Methodology

For this study mixed methods, quantitative and qualitative, were utilized. One benefit of utilizing a mixed method approach, referred to as explanatory designs by Creswell & Clark, (2007) is that the "quantitative data informs the qualitative data selection process (Almalki, Centre, Arabia, & Centre, 2016). Another benefit is that mixed methods "enables researchers to specifically pinpoint data that is relevant to specific research projects" (p. 293).

Figure 3.1. shows the mixed methodology that I used:

Figure 3.1 Mixed Methodology Design (Almalki et al., 2016)



Quantitative data were collected from students enrolled in five undergraduate courses conducted during the spring 2018 through spring 2019 semesters within the University of Maine College of Engineering, the Department of Anthropology, and School of Forest Resources. Students taking the five courses were asked to complete written pre and post-questionnaires. The students were both Native American and non-Native American. The questionnaires were completed during class time, but it was made clear to the students that they could skip questions if they wished or not participate at all. Students were asked to complete questionnaires both before and after (pre and post) CS information was integrated into the course curriculum. The questionnaires included Likert-type scales and open-ended questions. The pre and post questionnaires are in Appendix A.

Reflections written by students enrolled in four of the five courses supported the qualitative aspect. Reflection questions varied by class based on input by the faculty member and CKK. They are included in Appendix B. In all instances of classroom data collection, approval was given by the student through letters of consent distributed prior to any data being collected.

Additional data was collected through interviews with four former WaYS students currently attending college. These semi-structured interviews were approximately 15 minutes in length. The interview questions are in Appendix C.

Another data collection tool was a focus group that was conducted in the Anthropology class Spring 2019. The class was 50% Native and 50% non-Native.

Table 3.2 (following page) lists all the sources of quantitative and qualitative data collected by course number, semester, number of participants and methodology. Later in this chapter, there is a more detailed description of the data collection and analytic processes used for each class. The justification for both methodologies, quantitative and qualitative, are described below in a general overview.

There continues to be the question of "validity" with qualitative research within academia (Pratt, 2008). Miles et al (2014) counters this with stating "qualitative data can help the quantitative side of a study during design by adding in conceptual development and instrumentation" (p.43). The authors further state that qualitative data can "... help by validating, interpreting, clarifying and illustrating quantitative findings, as well as through strengthening and revising theory" (p.43). By utilizing a mixed-method approach, I desired to incorporate a richer contextual discussion and provide an opportunity for CKK and faculty to have an equal input on reflection questions.

Table 3.2 Summary Table for Methodology by Class

Course	Semester & Year	Participating Students (Native)	Quantitative Methodology	Qualitative Methodology
Environmental Attitudes and Behavior SFR 479	Spring 2018	34 (1)	Pre/Post Questionnaire	Weekly Reflections
Forest Vegetation, SFR 107	Fall 2018	64 (2)	Pre/Post Questionnaire	Reflections from specific Lecture/Lab that included CKK
Forest Landscape and Management Planning, SFR 477/577	Fall 2018	37(2)	Pre/Post Questionnaire	Reflections from specific Lecture/Lab that included CKK
Hydrology, CIE 455	Fall 2018	43(2)	Pre/Post Questionnaire	
Indigenous Science Across the Curriculum, Anthropology 290/Native American Studies 201/Forestry 345	Spring 2019	10(5)	Pre/Post Questionnaire	Focus Group
WaYS student interviews	Spring 2018 – Fall 2018	4	Post Questionnaire	Interviews

Review of Theoretical Framework

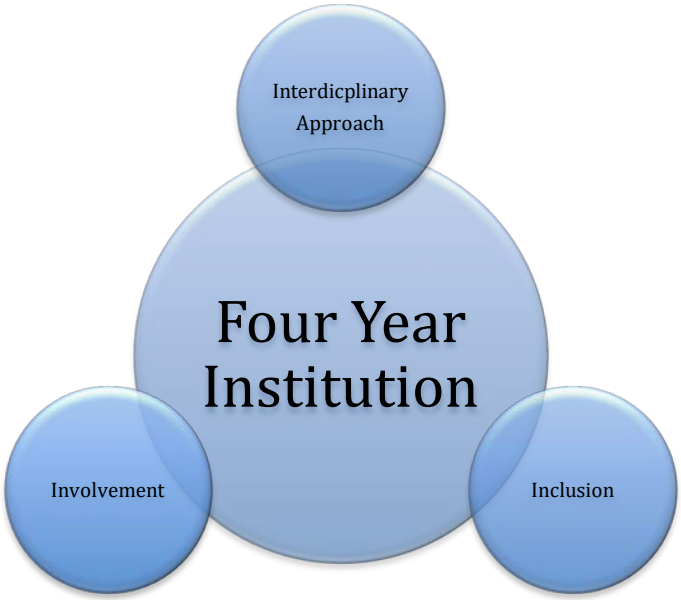
As described in Chapter 1, the Wabanaki Youth in Science (WaYS) program provides the platform for this post-secondary study. By expansion of the WaYS model to the college level an alternative means that aims to further the success of Native American students at the next level, college science education. This framework is important because numerous researchers have acknowledged the challenges faced by Native youth to graduate with a post-secondary degree (Braxton, et al. 2004; Engstrom et al. 2007; Kuh et al. 2005; Pascarella, et al. 1991, 2005; Seidman 2005; Tinto 1993,1997; Tinto et al. 1994; Tinto, et al. 1993; Tinto et al. 1994). All mention some lack of inclusion, lack of involvement by mentors and lack of an interdisciplinary approach (or a combination of all three) that contribute to the lack of success for Native Americans students.

In addition, by educating all college students in an inclusive, interdisciplinary manner, this may ultimately help change the perspective of the dominant, non-Native ideology. It is believed that mainstream students will also benefit from this approach in post-secondary education. Holoien (2013, p.7) points out that "greater diversity-related experiences are associated with positive learning outcomes for whites and people of color alike".

A theoretical vision of this is presented in Figure 3.3. in which the ideas of inclusion, an interdisciplinary approach and involvement are depicted for a four-year, college-level institution, all aimed at improving student success.

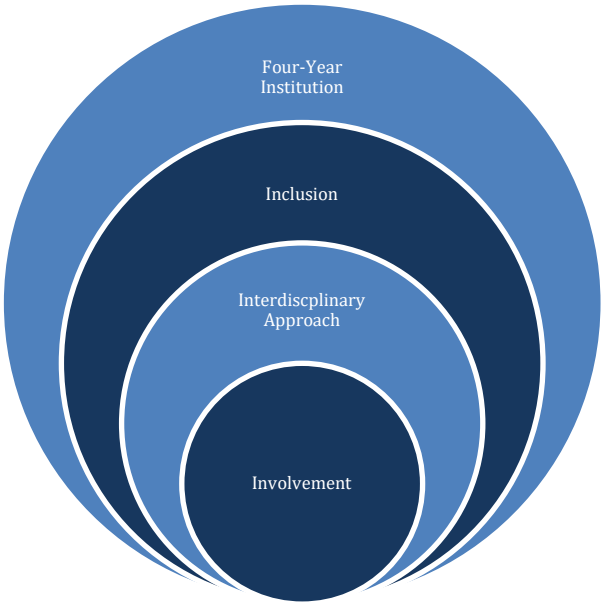
By comparison, the current educational framework for most four-year institutions, Figure 3.2, resembles a disconnected framework or parts and pieces that are an add-on or outside of the PWI's internal sphere as shown below. It represents an educational system that "Indigenous peoples did not develop…nor was it developed for Indigenous people"(Makomenaw, 2014, p.382).

Figure 3.2 Current educational framework at most PWI.



The new image reflects a consistent and inclusive vision embraced by all four years of college education and is the foundation with which WaYS is based.

Figure 3.3 Inclusive Theoretical Framework



Within a four-year institution, the idea of embracing inclusion of alternative knowledge, an interdicplinary approach that might embrace other ways of thinking or doing with the involvement and input of CKK is not the current standard procedure for PWI but could be through the WaYS model, highlighed early that reflects this nesting approach.

Through WaYS and this research, we are looking to change the theoretical model to be embracing of other forms of knowledge, to involve other voices than the dominant voice to enhance learning and to bring the vision of Figure 3.3 into standard model of teaching.

My Role as a Researcher

I have worked closely with Wabanaki partners through the WaYS program over the last six years to ensure that there was collaboration from the onset. Before this research

started in 2017, insight and guidance were sought through individual members of the Tribes, through the WaYS Board (also all Tribal) and through faculty at the Wabanaki Center. WaYS also reached out to other Tribal organizations such as Wabanaki Health and Wellness, with whom we collaborated on a number of mini camps, earth camp and grants. WaYS also worked with Tribal Boys and Girls Clubs and the Penobscot Teen Center. Collaboration has been at the heart of this program.

Through all of these connections, a foundation of trust and respect has been built. During the research, there were check ins with community members as the project moved forward primarily through the WaYS Board at their bi-quarterly meetings. This was done in order to listen to what they shared and ensure that it is incorporated into the study. There were check ins with key CKK's, in particular, Suzanne Greenlaw, a member of the Houlton Band of Maliseet Indians and a PhD candidate at University of Maine Orono. She and I had weekly check in when she was co-teaching or participating in the classes. There were three meetings with Butch Jacobs, a member of the Passamaquoddy Tribe and WaYS CKK during his work with the Environmental Attitudes and Behaviors class.

Quantitative Methodology

Maxwell has pointed out the valid use of numbers to strengthen research. He wrote "…numbers are important for identifying and communicating the diversity of *action...*" (Maxwell, 2013, p. 128).

The current research collected quantitative data by way of pre and post-questionnaires given students while enrolled in courses as described in Table 3.2 noted earlier in this chapter. The classes selected were purposefully selected to cover a wide audience to determine who (Native and non-Native) and how CS is valued, based on what was learned over the term (See Participant Selection Strategy for detail). A university faculty member partnered with

Cultural Knowledge Keepers (CKK) to present the CS information to students. How each faculty member interreacted and presented the material varied with the class taught.

As examples, with the class SFR 479, the faculty member met with each CKK multiple times to develop an outline. The CKK presented twice to students in partnership with the faculty member. In ANT 290, eight different case studies were presented to students. Each CKK (or a pair of CKK) attended only one class to present the case study. For the CIE course work, the information shared was by the faculty via lecture on a case study. There was no one way that the material was presented to allow for flexibility for the faculty and CKK to work in a collaborative manner. This also meant that it was challenging to keep all of the data organized for each of the classes. Because a different format was used to present the CS in each class, it led to the question of whether these variations made a difference for enhanced learning by the student.

There was more consistency with regards to the quantitative data collection methodology. Prior to the start of each class on the first day, the students were asked to sign a voluntary consent form (Appendix D) and to complete a questionnaire (Appendix A). There was no identifying information being asked on the questionnaire, other than background information that was used to determine if the student was Native or non-Native, gender and year in college. After the pre- questionnaires were returned, a brief overview of the purpose of the questionnaire was explained by me. This was done to provide students with an understanding of how the upcoming course was being structured with the inclusion of CS and why. A post questionnaire was given to each student at the last class (Appendix A).

Quantitative Data Analysis.

The Statistical Package for Social Science (SPSS) was used for quantitative data analysis. The quantitative data utilized Likert scale, yes/no and check boxes.

As a result of not pairing the before and after by student, a flaw in the data design initially, the results were pooled (aggregated) based on pre and post questionnaire and by course attended and not by individual student. This did not allow for significance or change by student perceptions of enhanced learning to be calculated directly but as an aggregate by class and Native versus non-Native. To calculate significance, the means for each continuum based on the Likert scale were obtained.

I utilized SPSS *One-Way Analysis of Variance (ANOVA)* to calculate significance within individual classes and as an aggregate. The choice to use one-way ANOVA versus an alternative such as a t-test was the function of the number of questions on the Likert scale and whether it constituted continuous or categorically. Categorical refers to three or more unordered categories. Continuous has at least five ordered levels. This questionnaire had between five and eight ordered levels: Not at all important (1) Low importance (2) Slightly important (3) Neutral (4) Moderately important (5) Very important (6) Extremely important (7) Unsure of terminology (8). This met the definition of continuous and is the appropriate analysis strategy (Vaske, 2008, P. 85).

The null hypotheses subject to the significance test were:

H_1: Inclusion of Native cultural science (CS) in academic curriculum does not enhance learning for Native students within post-secondary science education?

H_2: Inclusion of Native CS (CS) in academic curriculum does not enhance learning for non-Native students within post-secondary science education?

The significance threshold was set at p=.05.

Qualitative Methodology

Community Based Participatory Research

To truly understand the contributions and dynamics within CS pedagogy, this study needed to move beyond solely numbers or a quantitative lens. A quantitative study alone does not fully capture the lessons learned particularly when people's perceptions and their change in perception is the outcome. Quantitative data lacks the ability to transcribe the human element of this particular research. With the inclusion of CS, this research has a strong human dimension component to it to ensure all voices are heard equally and they needed to be included (Bartlett et al., 2012; Cherry et al., 2004; Hatcher et al., 2010; Smith, 1999).

Underlying the decision to utilize qualitative as well as quantitative methodologies for this study, the methodologies need to: (1) ensure input from Cultural Knowledge Keepers as well as western scientists and (2) be an inclusive method of research to meet the short and long-term study goals(Bartlett et al., 2012; Smith, 1999).

This research needed a strong trustworthy strategy, a means of building rapport and a transparency regarding ethical considerations given the collaboration with the Wabanaki community. Research utilizing Cresswell (2013); Jason et al., (2004); Maxwell (2013) and Merriam (2002) indicated that Community Based Participatory Research (CBPR) would be the most inclusive method of research to meet short- and long-term study goals and is considered a decolonizing methodology. As a subset of this methodology, I included Indigenous values and beliefs (Gone, 2019) within the study's framework. Smith (1999, p.28) points out that a framework that "involves *re*writing and *re*righting the Indigenous position in history and society" helps create change within the dominant ideology. This research looks to continue that change by utilizing human dimension perspectives.

Utilizing Community Based Participatory Research Methodologies.

Historically, CBPR is considered "action research" which has its roots dating from the 1940s by Kurt Lewin. Dr. Lewin is credited in developing this method to "use research for making planned social change" (Neil, 1998). Even so, utilizing CBPR as the framework to data collection is important.

This approach, is alluded to in Merriam (2002, p.10) with a reference to Participatory Action Research (PAR) as a sub context to *Critical Qualitative Research* that Merriam separates from Ethnography (Merriam, 2002, p. 8) which Creswell seems to link together (Creswell, 2013, p. 93). I highlight this to emphasize the many ways to describe the varied methods of research that create change as an outcome for the research. By whatever terms CBPR is referred to, this approach is key and enhanced within a framework of Indigenous methodology. This framework provides a platform for equal voice, equal partnership for participants. When "knowledge and power is shared equitably between the researchers and the community" (Le et al., 2015, p.20.) learning is enriched for all parties involved. By utilizing an Indigenous Research methodology within the context of this research provides a small step is forward to shift the argument that the "language of imperialism may have changed, the specific targets of colonization may have shifted and indigenous groups may be better informed, but imperialism still exists" (Smith, 1999, p. 100).

Table 3.3 (Horowitz et al., 2009) highlights the guidance I am using regarding CBPR methodology and highpoints its nuances. One of the important considerations within CBPR is the degree to which the community is involved in the process. It should include the

Table 3.3 Characteristics of CBPR (Horowitz, et al., 2009)

- Community members and researchers contribute equally and in all phases of research
- Trust, collaboration, shared decision making, and shared ownership of the research; findings and knowledge benefit all partners
- Researchers and community members recognize each other's expertise in bi-directional, co-learning process
- Balance rigorous research and tangible community action
- Embrace skills, strengths, resources, and assets of local individuals and organizations
- Community recognized as a unit of identity
- Partners commit to long-term research relationships

commitment of both researcher and the community to be equal partners in the entire process, including the presentation of the materials to the audience. And most important, the research questions should be derived from the community. Unlike many western-driven qualitative studies where a researcher arrives asking their own questions or utilizing data collected prior such as qualitative content analysis which focuses on latent meaning or qualitative network analysis which looks at interpersonal relationships, CBPR/IRM questions initiate, or should initiate from the community. Everyone is learning from one another; creating new knowledge. The collective community outcomes should lead to change. CBPR/IRM is not a linear process.

It is important to make a clear distinction between the idea of collaboration and participation. Nadasdy (1999) and Runk (2014) have attempted to do so. Runk notes that

"Although there is a broad spectrum of participatory research, within the literature on indigenous knowledge, participation has been roundly critiqued for, at best, providing

a veneer of local input to research and, at worst, integrating simplified notions of indigenous knowledge that serve to reinforce the power of the technical, nonindigenous elite" (p.36).

> Nadasdy (1999) wrote "Returning decision-making power over the land to local communities, however, would provide a counter-weight to the power-centralizing tendencies of scientific resource management. This would not preclude scientists from engaging in their own set of socially useful practices, but they would be doing so at the request and direction of local communities. Thus, scientists would no longer define and drive the process of resource management, but would act as a resource, providing communities - upon request - with a perspective on the environment that, by virtue of its greater scope for large-scale comparison, would help local people to deal with larger regional or global issues that cannot be well under- stood from a purely local perspective." (p.15)

For all these reasons, I have been working closely with Wabanaki partners over the last six years to ensure that there has been collaboration and equality from the onset. In this vein, the questions for this research were generated by the Wabanaki community in concert with the Wabanaki Center, University of Maine. I continue to check in with community members and the WaYS Board member with each step in the process, listening to what they share and incorporate their suggestions into the study.

Ethical considerations.

Because this research involves Native American partners, ethical considerations are paramount. Consent is an important consideration as well as ensuring that the partners need for "privacy and protection from harm" is met (Merriam, 2002; p. 29). Both Merriam (2002) and Maxwell (2013) suggest that ensuring the research is valid, increases the likelihood that

it is ethical. This responsibility falls to the researcher to ensure the course and direction of the journey stay true to the safest and best route along the river. To ensure that this project had validity and was ethical meant continued communication between the CKK, myself and faculty to avoid or redirect any potential rapids that may appear to subvert the intended route along the river. Following CBPR/IRM methodology leads to the relationship which allows a transparency that strengthens both the validity and ethical way the research is conducted. CBPR/IRM helped us, in particular me, to stay on-course with frequent contact and communication with everyone. Consent forms were provided to all participants (see Appendix D) to ensure participants understood that this was voluntary and not a required aspect of their course.

Gaining entry and building rapport.

In this aspect the idea of decolonizing this research project through CBPR is imperative and empowering. It reinforces the validity to the people who are participating. I utilized several of Maxwell's (2013) strategies (pp 125-129) among them intensive, long-term involvement. With over four years of work with the original WaYS high school program and another two years (or so) engaged in this study, I met the parameters for long-term involvement suggested by Maxwell.

Another aspect is member checking (Lincoln and Guba, 2000; Maxwell, 2013)as it related to the four interviews. This was accomplished by revisiting the interviewees, where possible, and sharing their respective transcripts. This provided a mechanism to solicit feedback that not only helped avoid "misinterpreting the meaning" (Maxwell, 2013, p. 126) of the participants but also encouraged equal participation amongst all parties, a key component of CBPR methodology. This was also done as it related to written observations within the classrooms when CKK's were present. I made a point to engage CKK's in follow

up discussions to seek their input and thoughts about what they saw within the classroom and lab settings where applicable.

Participant selection strategies.

Research participants were college students recruited from the five classes incorporating CS from co-principal investigators with the NSF grant Dr.'s Crandall, Daigle, Ranco and Jain. These classes were selected because the faculty above, taught the respective courses and desired to include CS within their coursework. Additionally, Dr. Livingston (SFR 107) asked to participate because of his prior work with WaYS at earth camps and a genuine interest in having students and himself learn more about CS. We also sought input from current WaYS college students who had participated in internships and WaYS camps as high school students.

The research participants were undergraduate students above the age of 18 attending the University of Maine. All were enrolled in the five classes identified in Table 3.2. The four students who were interviewed participated previously in WaYS programs and WaYS activities as high school students and currently enrolled at the University of Maine. The WaYS students selected for the interviews, utilized purposeful selection (Cresswell, 2013; Maxwell, 2013) because of their longitudinal connection with WaYS. We felt that they would have unique insight from the WaYS framework and perspective having transitioned from high school to college.

Trustworthiness strategies.

Trust is a key component to a successful research project (Runk, 2014; Walsserstein & Duran, 2008). To earn trust, one must participate. Smith (1999) shared that in the Hawaiian culture it is important to talk to "many aunties, uncles and elders whose views must be sought prior to conducting any interviews in a community" (p.15) to help garner trust. She shared

"showing your face, turning up at important cultural events - cements your membership within a community in an ongoing way and is part of how one's credibility is continually developed and maintained" (p.15).

Prior to initiating this study in 2017, I met with Roger Paul, a Community Elder and CKK for WaYS. Mr. Paul was and is a member of the Wolastoqin (Maliseet), and Peskotmuhkat (Passamaquoddy) communities. He was kind enough to speak with me for over an hour to share his thoughts on the present research structure and methods and wanted to find ways for the research to be successful from his perspective. This partnership interview process is reinforced in literature (Runk, 2014).

When I asked Mr. Paul about his thoughts on our research to bring CS into the WS paradigm, Mr. Paul commented that "our Traditional Ecological Knowledge of thousands of years on this continent can actually be shared into modern scientific lessons, for lack of a better word, findings. More and more of the scientific findings today have proven our stories to be true." (personal conversation 10/24/2017). This confirmed we were on the right path.

A final strategy worth mentioning utilized reflexivity. Berger (2015) stated that "One goal of reflexivity in qualitative research is to monitor …[and]…enhance the accuracy of the research and 'the credibility of the findings by accounting for researcher values, beliefs, knowledge, and biases' that is, to gain plausibility by securing research's trustworthiness" (p.137). Additionally, Berger (2015) wrote that "[r]eflexivity helps maintain the ethics of the relationship between researcher and research by 'decolonizing' the discourse of the 'other (p.221). Because of my lens and perspective towards this research, this is a critical priority. Table 3.2 provides an overview of the courses, numbers of students in each course and the methodology used to collect data for the study. All classes had quantitative methodology. Four

classes had the addition of qualitative research integrated into the curriculum. The classes are listed in the order in which the data was collected. In the coming sections, each class is discussed in terms of the specific data collection methodologies used. Each class reflected inclusion of CS as an overarching paradigm with individual class variance due to topic and faculty who instructed the class.

Qualitative Data Analysis in Detail

Computer Assisted Qualitative Data Analysis Software (CAQDAS), NVivo. NVivo 12 was selected as it is supported by the University of Maine. I utilized this database to manage the transcriptions and reflection portion of this research. The amount of data anticipated to collect, the ability to manage data, manage ideas, query large data sets, visualize data and ultimately develop reports is an attractive feature provided by NVivo (Bazeley & Jackson, 2013). There are well over 1,100 reflections, most of which were salient to this work. The ability to synthesize this data and provide an audit trail for decisions and changes that occurred through the research was a critical component.

Methods for displaying data (e.g. matrices, networks, tables, graphs, models).

One helpful feature of NVivo is the ability to create cases and attributes. As an example is the student data. I treated each student as a case with a set of attributes. These attributes allow for comparison between students (for examples, WaYS students versus non-WaYS students, pre and post questionnaire). These comparisons allowed for a matrix to be created to help data analysis. A matrix can "collect and arrange data for easy viewing .. [and] permits detailed analysis.."(Miles, Huberman, and Sadana 2014, p.111) to help draw and verify conclusions.

Methods for drawing and verifying conclusions.

Miles, Huberman, and Sadana (2014) suggest 13 tactics to assist the researcher in "generating meaning" (p. 277). Three of these have played an integral role in data analysis for this research: Noting Patterns and Themes, Counting, and Making Contrasts/Comparisons.

Using a systematic approach to note patterns and themes utilizing a database will corral this challenge.

Noting Patterns and Themes.

This method of data analysis was important when reviewing the reflections. Miles et al (2014) note “Pattern finding can be productive when the number of cases and/or the data overload is severe” (p.278). This methodology is also intuitive. Miles et al (2014) shares “[t]he human mind finds patterns almost intuitively; it needs no how-to advice” (p.278). Noting patterns and themes is also an inclusive process, meaning that others can join in the process, which enriches the data results. By including others, it can minimize the subjectivity that Miles et al refers to and ultimately present “useful knowledge” (p.278).

There were five themes that were relevant to this research. These are listed in Table 3.4 below.

Table 3.4 Themes based on student reflections and focus groups

Change in ideology	This node includes terms, phrases as "why wouldn't I embrace a new way of thinking?", Or "I believe" Things that talk about a change in ideals or beliefs
Change in perception	This looks at how a student sees or views things .. terms that were keyed into this include "have a superior understanding". This knowledge will help you to do what is best for this species both in the short and long term" or I see as beneficial. The ability to see, hear, or become aware of something through the senses
Relevance of TEK	Connections made to TEK - phrases or words that were included There are many benefits to using traditional ecological knowledge to manage your forest: This knowledge will help: Traditional Ecological Knowledge is an invaluable tool for forest manager

Table 3.4 continued

Enhanced learning	This node includes comments that reflected a change in learning such as "Traditional ecological knowledge is important in .." "it became clear …" "In terms of learning you are better off having multiple ideologies contributing to your decisions."
Did not enhance learning	This node captured reflections that did not feel that the addition of CS was of value or the person had misconceptions or misunderstood what was being shared. Phrases such as "I highly disagree with this. .."

Counting.

This research provided a juxtaposition with regards to the numbers aspect. On one hand, the questionnaires provided a means to count the frequency of responses in order to gauge patterns of change between pre and post questionnaires. As indicated earlier, these numbers do not portray the entire story, thus the need for a qualitative perspective to add contextual richness to the human dimension perspective.

The challenge lies that often qualitative research is also often viewed as a "round peg in a square hole" (Pratt, 2008) when seeking validity from western paradigm peer-reviewed journals or even within the small scale confines of a college campus department such as the School of Forest Resources (Ellis, 2016). Challenges exist within the peer-reviewed framework as to what constitutes validity and reliability. As Pratt indicated from his research, "In general, the positivist perspective is applied by most reviewers in evaluating qualitative" research—for example, complaints that research is not 'scientific' and interpretations are 'subjective.'' (Pratt, 2008, p.491). To try and meld these differing views and perspectives, counting reoccurring themes was utilized. I focused on four re-occurring themes highlighted prior within the classes that utilized reflections and the one class which had a focus group.

This is reinforced by Miles et al (2014) whom suggests that numbers within the context of qualitative research "goes beyond how much there is of something to tell us about its essential qualities" (p.282). Counting can strengthen outcomes "when judgments of qualities are being made" and it keeps one "analytically honest" (Miles, Huberman, and Sadana 2014, p. 282).

It strengthens and enhances the use of patterns as well. Miles et al (2014) notes that there are three reasons to count: "(1) to see rapidly what you have in a large batch of data, (2) to verify a hunch or hypothesis, and (3) to keep yourself analytically honest, protecting against bias" (p. 282). These two methods, patterns and themes and counting complement and augment the research.

Making Contrast/Comparisons.

Following the rhetoric of Miles et al (2014), "[c]omparisions between two sets of things ... is a time honored, classic way to test a conclusion." (p.284). What is important with this method is understanding that one does not need a test of statistical significance (as in quantitative analysis) but a test of "practical significance" (Miles, Huberman, and Sadana 2014, p.284). Utilizing this method particularly with interviews and reflections, helped with the validity and rigor as it relates to themes that developed. With the utilization of attributes such as Native vs. non-Native, pre and post questionnaires and WaYS participation, we can see if there are differences in responses to specific questions. As an example, were there differences amongst the students when asked if it was important to understand the relationship between TEK/Cultural Knowledge and Western Science (Interview question 4). Understanding the responses to such questions will help develop one of the final outcomes of this study and help with the next phase to develop Best Practices for including CS.

Individual Class Methodology

Environmental Attitudes and Behaviors (SFR 479).

The Environmental Attitudes and Behaviors class (SFR 479), taught by Dr. John Daigle, Spring 2018, was an upper level course required for Parks Recreation and Tourism majors and optional for Forestry students and other disciplines. There were 35 students in the class, one was from the Wabanaki community. This class formed the pilot study for the subsequent Fall 2018 and Spring 2019 classes.

Initially, we were planning on using only a pre and post questionnaire for data collection. Prior to the start of class, Dr. Daigle suggested the inclusion of reflections as a part of the data collected from his class to not only enhance student learning but to provide additional feedback as it related to the class and the inclusion of CS. The class was structured in a manner such that CS was an integrated part of the course, initially through readings to provide context, followed by the inclusion of CKK presentations on specific topics later in the semester. Dr. Daigle's goal for the students was to 1) understand and appreciate the significance of core concepts from the fields of environmental and social psychology; natural resources management; and conflict resolution, 2) to gain an understanding of the complexity involved in human-environment interactions in a variety of social, political, environmental, and cultural contexts and most importantly 3) to enhance learning through appreciation of different knowledge systems of western science and traditional ecological knowledge.

To attain these goals, there were meetings between CKKs, Dr. Daigle and myself. My participation in these meetings was to observe the discussion process. The first two of these meetings were with Butch Jacob, CKK, (Passamaquoddy Tribe member and Maine Basket maker). It should be clarified that Dr. Daigle is a member of the Penobscot Nation and a long

time acquittance of Mr. Jacobs. They have presented work related to the emerald ash borer (*Agrilus planipennis* Fairmaire) (EAB) on a national level for a number of years. This long-term relationship provides a familiarity that is not replicated with other presenters during the semester course. The familiarity is evident with the first two meetings held at Mr. Jacobs home rather than at Dr. Daigle's office or another location on campus, where subsequent meetings with other CKK were held. Meeting where Mr. Jacobs preferred (at home) was important to provide a stronger sense of partnership to the project and to see Mr. Jacobs role through his eyes in a place where he was most comfortable to share his thoughts and ideas.

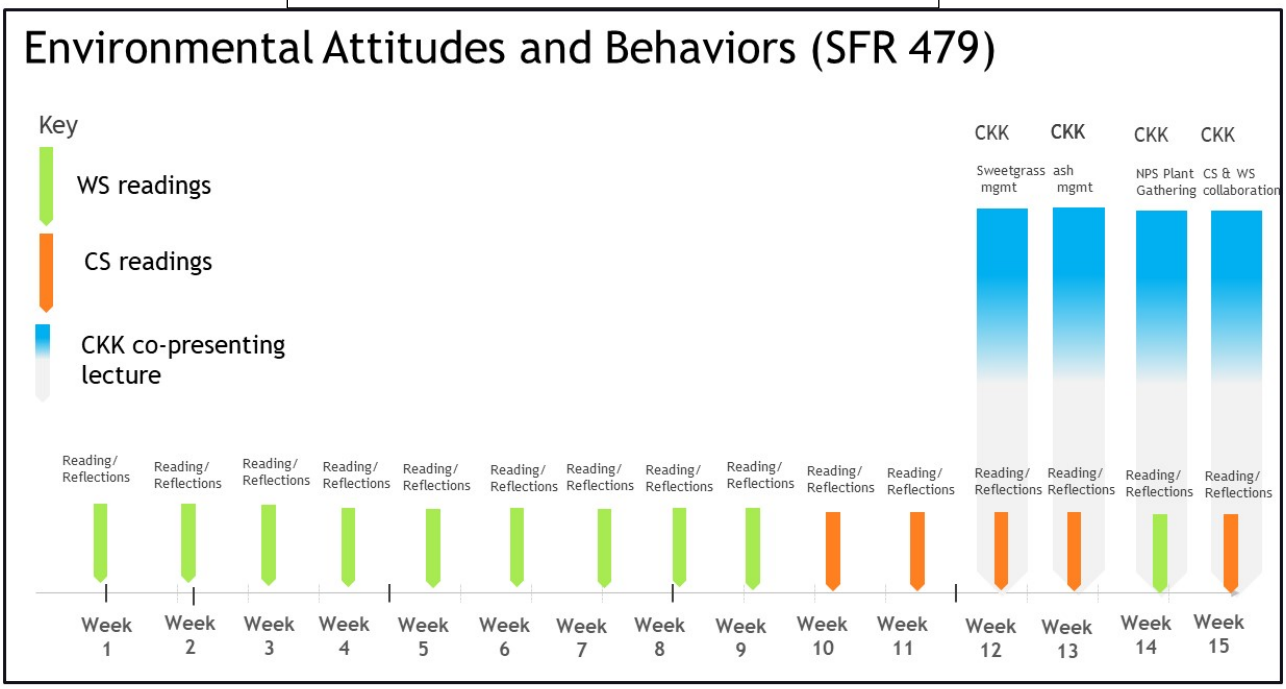
I also attended the classes which Mr. Jacobs was the guest lecturer as an observer. I did not attend the subsequent meetings between Dr. Daigle and Ms. Suzanne Greenlaw, another CKK, or the meetings between Ms. Greenlaw and her co-presenter Ms. Rebecca Cole-Will (Cultural Resource Specialist, National Park Service/Acadia National Park). I did attend the presentations given by Ms. Greenlaw and Ms. Cole-Will as an observer.

These meetings and discussions helped to develop the questions for the weekly class reflections. This process was inclusive with the CKK's taking the lead on the development of the reflection questions. With regards to Dr. Daigle's SFR 479 class, the meeting notes between Dr. Daigle and Ms. Greenlaw were shared with me as a means of reference. I obtained the weekly student reflections that were posted on Blackboard for the qualitative portion of the research.

The time line of the class is below to help understand the integration of the lecture, readings, CKK involvement and schedule of reflections. The class syllabus (along with the additional classes) is in Appendix F.

Data determination methods.

Figure 3.4 SFR 479 Class Time line



With over 800 reflections from just this class, to determine relevant reflections was key. This class was prior to understanding NVivo, albeit I did learn it to some degree on my own over the Summer 2018. I was grateful for the class during the Fall, 2018 to help refine my skill sets. I did not use NVivo for this class methodology initially. The reflection questions are in Appendix B.

To start with, I used three search words to help refine the reflections, “indigenous”, “culture” and “native”. These three words, I felt, were core words and would be included in reflections that were relevant to this study. To do this I did a search of the words through all the reflections. With this information, I saved it and then copied it into an excel file. From the over 800 reflections, there were 354 that had one, two or all three of the core words associated with the reflections once the duplicates were removed.

I read each relevant reflection and then organized the reflections into other files, “keepers”

that highlighted change in student's perceptions, both positive and negative. Not all of the reflections related to the research. There were a total of 54 of these reflections. I further refined those 54 into ones that were "noteworthy" "interesting" and "negative".

After completing the NVivo class, I did take the 54 "keepers" and integrated those into the reflections from SFR 107, SFR 477 and ANT 290 to enrich the contextual data and potential themes. These 54 reflections represented 26 of the 35 students in the class roughly ¾ of the class.

SFR 107 Forest Vegetation (Lab and Lecture).

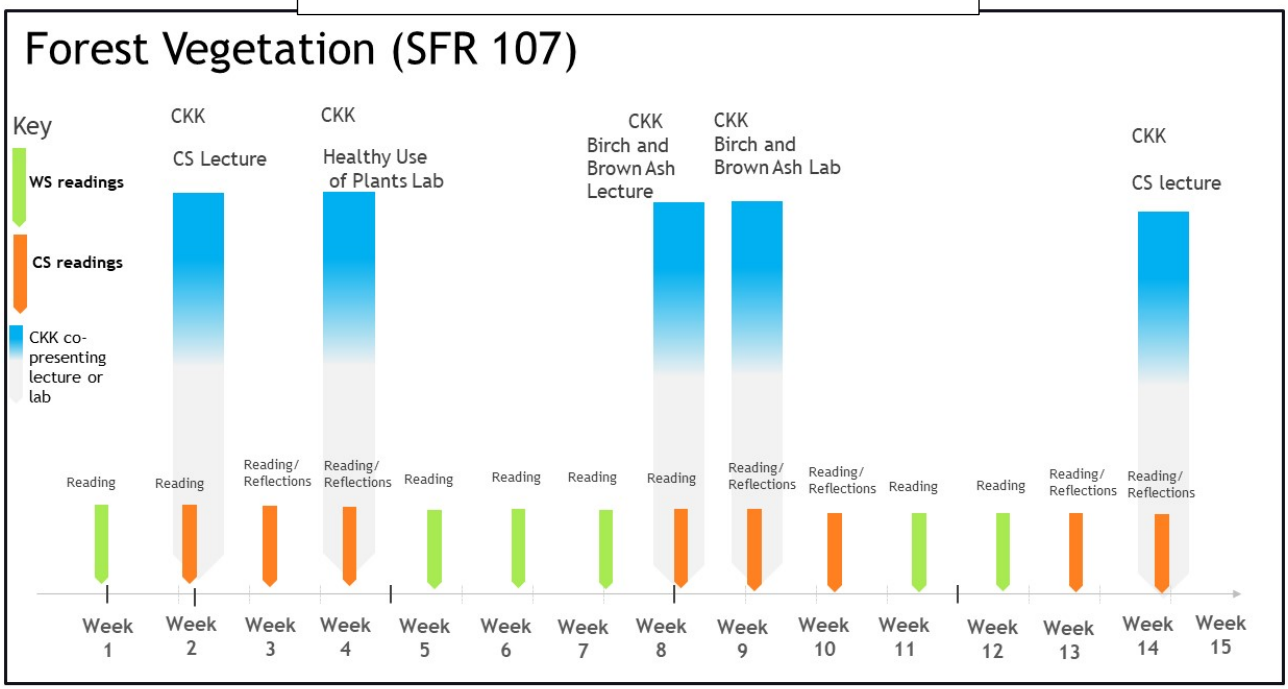
This freshmen level lecture/lab class was instructed by Dr. William Livingston with CKK Ms. Greenlaw participating in select lectures that tied into specific labs incorporating additional CKK. This class utilized the same format of pre and post questionnaires and included reflections. There were 63 students in the class with two students that self-identified as Native.

Through a number of meetings in Dr. Livingston's office with Ms. Greenlaw and myself, the course was ultimately structured differently than the Spring 2018 pilot class. There was more compartmentalization between the lectures because each week focused on a different tree species. There were three lectures presented prior to the respective CKK labs to provide students with foundational information as it related to CS. Two of the three lectures correlated to trees, brown ash and birch, that had strong Indigenous ties. The third topic that covered what Dr. Livingston referred to as "Healthy Use of Plants". That lab covered plants that had medicinal benefits to them and was instructed by a CKK, Jennifer Neptune, from the Penobscot Nation. The birch and ash labs were taught by invited CKK from the Penobscot Nation (John Neptune and Pam Cunningham) and Passamaquoddy Tribe (Gabe Frey). Ms. Greenlaw presented a final lecture (last class) to tie back in the cultural connections that were learned throughout the semester. I attended all the classes and labs as an observer when a CKK taught or when Ms. Greenlaw lectured. Ms. Greenlaw was the primary contact for and between Jennifer Neptune

and Gabe Frey. I was the primary contact for John Neptune and Pam Cunningham.

A time line is provided for this cla ss to provide the broader landscape to when CKK where involved in the classes. Unlike the rest of the classes, there was no indication on the syllabus (Appendix F) when CKK where going to be a part of the classes.

Figure 3.5 SFR 107 Class Time line



Data determination methods.

Student reflection questions were developed between Dr. Livingston and Ms. Greenlaw with some input by me. Most often Dr. Livingston would ask Ms. Greenlaw or myself for our thoughts to generate the questions. Student reflections were graded and reviewed by Ms. Greenlaw, Kyle Lolar and me. Mr. Lolar, from the Penobscot Nation, was an undergraduate student at the time but was also

involved with the WaYS program as a CKK for WaYS high school students. These 219 reflections from four labs were entered into NVivo and coded accordingly.

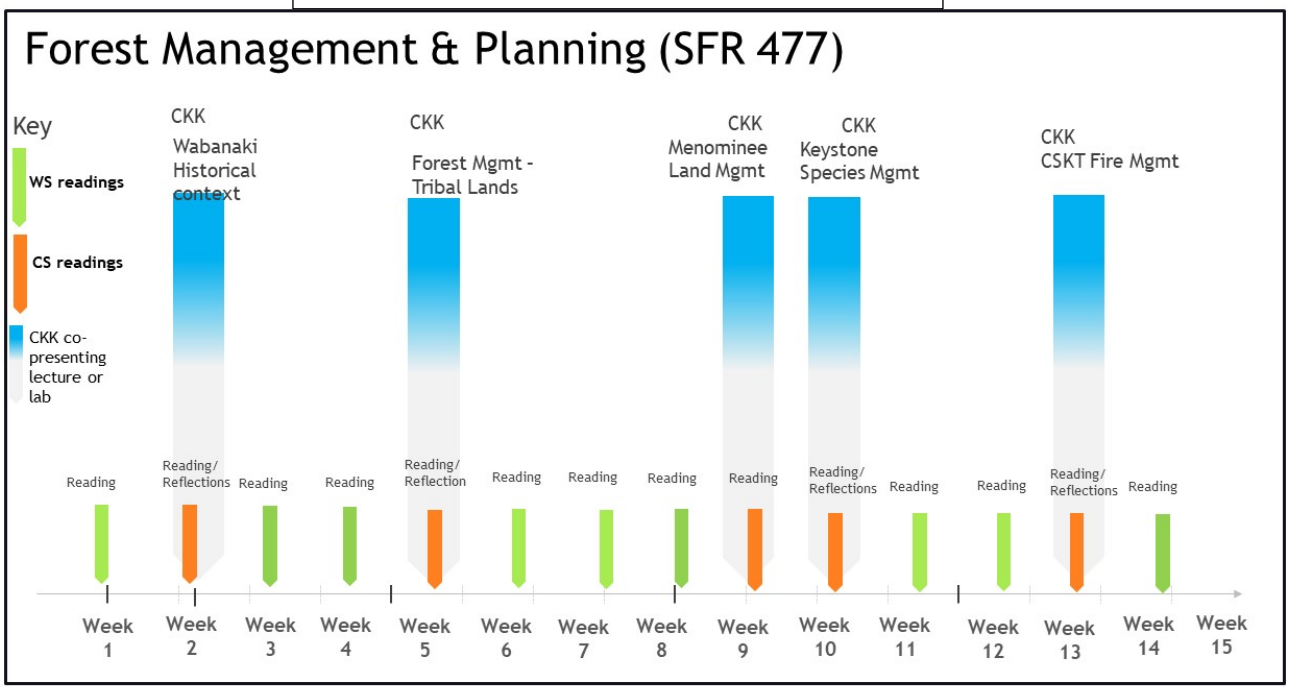
Forest Landscape and Management Planning, SFR 477/577.

This upper level forest management class was taught by Dr. Mindy Crandall. Dr. Crandall attended a tribal college out west for her undergraduate degree and has maintained a number of connections within that tribal community. There were 36 students in this class with two that self-identified as Native.

This class utilized a similar format to Dr. Daigle's course in that CS was integrated by way of initial readings to provide context and followed by the inclusion of CKK presentations on specific topics as the semester continued. There were no in person pre-meetings involved with this class between Dr. Crandall, the CKKs or me mostly do to distance constraints. Three of the five CKK that presented were long distance, two out of state and one multiple hours away. Dr. Crandall connected directly with two of the CKK directly. I connected with the two of the CKK directly and the last one was a joint call between the CKK, Dr. Crandall and me. Topics covered by the five invited CKKs aligned with the topic of discussion for that week. I attended the specific classes that included CKK as a presenter.

A time line of these presentations is below with the full syllabus for the class in Appendix F.

Figure 3.6 SFR 477 Class Time line



The 36 students produced 146 reflections in response to four reflections. Two students self-identified as Native.

Data Determination Methods.

The reflections asked specific questions that related to the CKK that participated in the classes. The presenters included James Francis, Penobscot Nation, who spoke on Indigenous historical knowledge and context related to Wabanaki Lands; Ernst Carle, forester for Passamaquoddy Tribe, who spoke on the Passamaquoddy's forest practices; Suzanne Greenlaw, who spoke on Cultural Keystone species management; Chris Caldwell from the Menominee Nation who spoke on their fire regime and forest practices as it related to the Menominee Nation; and Tony Incashola who gave a presentation on the Traditional Ecological Knowledge (TEK) of prescribed fire on the Salish-Kootenai forest land. The latter

two participated virtually by remote connection via Zoom from their respective locales.

The reflections responses were input into NVivo for transcribing. The pre and post questionnaire responses were entered into SPSS.

CIE 455 – Hydrology.

This course was taught by Dr. Shaleen Jain. Dr. Jain had included a cultural component in his engineering class the last few years and was excited to have more CS included with this class. This class participated in this study because of the relevance it has to the larger pedagogy goals of the NSF INCLUDES grant. Data were collected from 42 students with two self-identifying as Native and a third one, unsure.

The intent with this class inclusion was to compare student perceptions relevant to their college interest. For example, is there a difference in perception for an engineering student versus an environmental student as it relates to CS? It was envisioned that this class would include CS guest lectures or a field trip related to the seasonality of water/hydrological fluctuations. As the semester wore on, this prospect dimmed due to limited availability by CKK water resource staff . Scheduling was a challenge due to field schedules of the CKK and the course scheduling. We were able to solidify one date and time that worked for all parties but at the last minute, that had to be cancelled and we were unable to coordinate an alternative time. There was one lecture, at the last class, that was given by Dr. Jain that reflected some of the cultural significance around water for the Indigenous peoples of Australia.

This course did utilize the pre and post questionnaire, but there were no reflections.

ANT 290/NAS 201/SFR 345 – Indigenous Science Across the Curriculum.

This course was taught by Dr. Darren Ranco, Associate Professor in the Anthropology Department. This course was first offered and taught in the Spring 2019 as part of the curriculum outlined in the National Science Foundation (NSF) INCLUDES grant to integrate CS within

post-secondary education. The NSF grant is the overarching document that is supporting this PhD research. Ultimately, the result of this research will help to develop best management practices to integrate CS into post-secondary science curriculum and the outcome of the NSF grant.

The intent of this course was to provide an integrated and holistic approach to teaching environmental science that included CS throughout the course. It was the trial course designed to integrate what was learned in prior semester four classes. There were 10 students in the class. Five students self-identified as Native.

The course was designed to introduce students to American Indian/Native American/indigenous cultures of North America with emphasis on issues related to the use of CS within indigenous and non-indigenous contexts. Earlier classes had woven in CS as part of the class but was not positioned as the primary focus. This was in part because they were existing classes and being modified with the inclusion of CS.

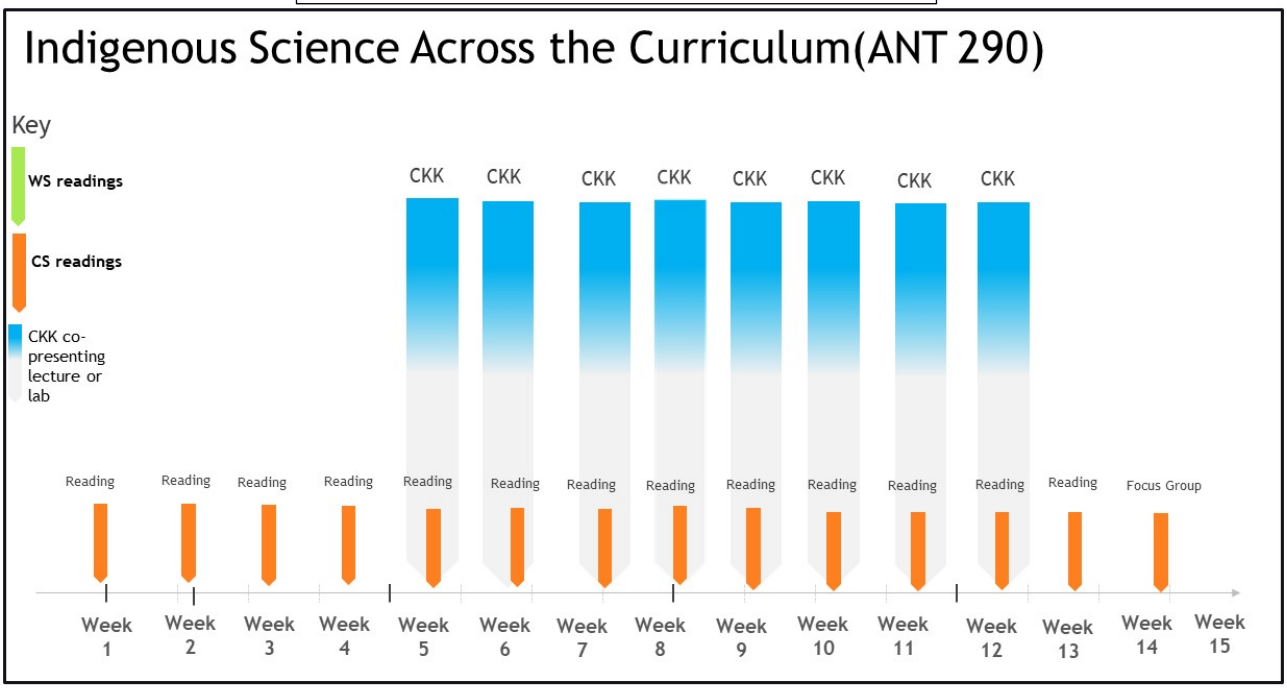
This class, referred to as ANT290, integrated CS from the beginning with a primary focus being CS. Using eight case studies, students explored the pathways and barriers related to integrating and emphasizing the use of CS in educational, environmental management, and scientific contexts. Students were asked to do follow up with summaries from the readings. The last class I was able to hold a focus group which was included in this portion of the data analysis.

Dr. Ranco's goals were for students to gain a deep understanding of the different experiences of Native peoples regarding CS as well as the different forms of knowledge and political engagement advocated by indigenous peoples in North America. It was important for the students to understand how ecological changes have, and will, impact indigenous peoples, their health, cultures and well-being.

In addition to Dr. Ranco, there were a number of guest lecturers that presented case studies. The list of lecturers included Pam Cunningham (Penobscot Nation member and Basket Maker) and Suzanne Greenlaw who discussed Invasive Species and Brown Ash; John Banks, Director of the Penobscot Nation Department of Natural Resource and a Penobscot Tribal member, who spoke about dam issues as they relate to the Penobscot Nation and the Penobscot River; Jennifer Neptune spoke on Native Plants; and Tony Sutton, Passamaquoddy Tribal member, discussed Food Sovereignty. In addition, Jason Mitchell and Sean O'Brien, also members of the Penobscot Nation, shared with students water issues/Brownfield concerns on a local level. This was followed up with a virtual meeting via Zoom, with Dr. Karletta Chief, Assistant Professor and Assistant Specialist in the Department of Soil, Water, and Environmental Sciences at the University of Arizona in Tucson. One other case study looked at water from a local level and was presented by Jan Paul (Penobscot Nation member) and Jan Reed.

A time line highlighting readings, CKK presentations and the focus group gathering is below. The full syllabus is in Appendix F.

Figure 3.7 ANT 290 Class Time line



The pre and post questionnaire and reflections were a part of the course and entered into their respective data analysis programs.

Individual Interviews.

The remainder of this Data Collection section for the study focused on the transcription creation and synthesis as it relates to the individual interviews. The four semi- structured interviews were transcribed by me. I chose to do this process to gain familiarity with the participants and the information shared. The interviews were transcribed verbatim, with non-verbal behaviors (e.g. “laugh” or “pause”) to help establish reliability, dependability and trustworthiness and rigor (Kowal & O’Connell, 2014; Roulston, 2014; Tracy, 2010). I did not include words that detract from the interpretation of the data (e.g. “um”).

The four interviewees were current WaYS college students that had involved with WaYS during high school and were attending the University of Maine in one of the science programs. The students selected where they wanted to be interviewed and when. This was done to

encourage the students to have ownership and equality in the process (Runk, 2014; L. T. Smith, 1999). The interviewees were asked to share their experiences in college and if the inclusion of CS through WaYS had helped them in their college-level classes. Interview questions included questions related to their career paths. A summary of the interview questions asked of all four students is in Appendix C.

Transcriptions were listened to initially and then transcribed at ½ speed. Once transcribed, there was a final review at normal speed to make sure that nothing was missing. This information was then imported into NVivo, with the student's names removed and an alias given to ensure anonymity.

Process and strategies for coding.

The next step was to do open coding on the transcriptions. Initially, I utilized "purely descriptive terms" (Bazeley and Jackson 2013, p.70). These initial steps where a "rough sorting of the data into major categories" (Bazeley and Jackson 2013, p.71). This was a conscious decision on my part because I had just started working with a CKK in the transcription process. Doing this kept the CBPR process, discussed earlier, at the forefront of the research process and to work in partnership with the community in the research process, one of the fundamental aspects of CPBR being inclusive and ensuring that all members of the project were equal partners. I had intended, with the assistance of the CKK, to implement the next phase of the coding process with the CKK, to collectively look at the coding detail in order to "capture the finer nuances of meaning" (Bazeley & Jackson, 2013). Unfortunately, due to extenuating circumstances with the CKK, this collaborative step did not occur. I ended up doing the final analysis of the Individual Interviews on my own.

With the four students interviewed, I feel that they were upfront and honest with me as it relates to their responses. I believe that the students were speaking from their heart and sharing

their thoughts honestly and openly. All but one of the students interviewed had been a part of WaYS for multiple years and all students had long-term internships.

Students that were interviewed were also asked to fill out the post- questionnaire as a means to quantify their thoughts and ideas.

Summary

The goal of this chapter was to define the research methodology, mixed methods, and the strategy used for the data collection and analysis. This chapter also highlighted the broadening of the research methods to include the diversity that each faculty member and CKK brought to the methodological process, which was quite fluid at times. The students, CKK and faculty that participated provided an enriched learning experience that exceeded the initial scope of this project. The next chapter will present the findings from the data collected that is specific to the research questions.

CHAPTER 4

FINDINGS

Introduction

In this chapter, the data collected (responses to pre and post questionnaires, reflections and interviews) are analyzed and presented in terms of the two primary study questions. All of the data collected through questionnaires were analyzed quantitatively; all of the data collected through reflections, focus groups and interviews were analyzed qualitatively.

There are two ways to present this information. One way would be to pose each question and then follow it with responses from all five classes related to that question. Another way is present all responses to each question from five classes with each class viewed as its own community. The latter approach, I believe, serves to enrich and support study conclusions with its inclusion of all voices with a common experience. It maintains the feeling of community. The first method mentioned above – presenting all response questions by question returns to a western paradigm of putting each question into a box and leaves out the collective voices of reflection that lend support, or not support, a specific question.

The lens through which I chose to present this work, is from a position of community voices. The strength comes from the collective whole and the interaction of all of the collective pieces, particularly the questionnaire responses and the reflections, to provide a whole picture rather than pieces and parts. This holds to Smith's (1999) desire to rewrite and reright the Indigenous position. I return to the building of a river canoe. There are a multitude of different pieces and parts, outer shell, thwarts, ribs, strapping to name just a few that are needed in the finished canoe. Those pieces and parts come from an array of different trees like birch, spruce, ash to name a few. It is these collective pieces that when woven together make a strong canoe.

Findings from the individual interviews are presented after the questionnaire findings. After the results by class or the collective community as stated above, I look at the broader global findings and share thoughts on those results.

I equate this manner of presentation to what happens when one is paddling on a stream and notices something of interest in the water or along the shore and decides to take a closer look at what that might be. Often that "aha moment" is the time to learn or share a story that you can ponder and can reflect on more as you paddle downstream. Why would one want to wait and talk about it later? The time is there, when you see it, when you can feel it, hear it and be a part of it.

The Pre and Post Questionnaire.

Three questions from the questionnaire (Appendix A) were chosen to help answer the Study Questions:

Pre-Questionnaire Questions:

Q.1. Do you think learning about Traditional Ecological Knowledge is Important?
□ Not at all important □ Low importance □ Slightly important □ Neutral
□ Moderately important □ Very important □ Extremely important □ Unsure of terminology

Q.2. How important do you think it is to understand the interplay between western science & Indigenous Knowledge for a future career?
□ Not at all important □ Low importance □ Slightly important □ Neutral
□ Moderately important □ Very important □ Extremely important □ Unsure of terminology

Q.3. How important do you think it is to know diverse cultural traditions as a part of your future career?
□ Not at all important □Low importance □Slightly important □ Neutral
□ Moderately important □Very important □Extremely important

Post-Questionnaire Questions:

Q.1. After this course, do you think learning about Traditional Ecological Knowledge (aka Indigenous Knowledge) is Important?
☐ Not at all important ☐ Low importance ☐ Slightly ☐ Neutral
☐ Moderately important ☐ Very important ☐ Extremely important ☐ Unsure of Terminology

Q.2. How important do you think it is to understand the interplay between science and Traditional Ecological Knowledge for a future career?
☐ Not at all important ☐ Low importance ☐ Slightly ☐ Neutral
☐ Moderately important ☐ Very important ☐ Extremely important ☐ Unsure of Terminology

Q.3. How important do you think it is to know different traditions for a future career?
☐ Not at all important ☐ Low importance ☐ Slightly important ☐ Neutral
☐ Moderately important ☐ Very important ☐ Extremely important

In both questionnaires, there is a slight difference in verbiage between Q1 and Q2 as it relates to the CS terminology. In Q1 Tradition Ecological Knowledge was utilized. In Q2 Indigenous Knowledge was used. This was done to gauge students recognition (or not) of one term over another. According to Pew Research Center (2019) questionnaire verbiage is "critical as it relates to expressing the meaning and intent of the questions" (p.5). It would be curious to see if the terminology influenced students response, particularly as it relates to moving forward and developing best management practices.

Table 4.1 shows the number of students enrolled, the number of students who responded to the pre and post questionnaires, and the number of students who self-identified as Native. Gender was not found to be a significant related to the results. I chose not to present a factor that was not relevant to the presented outcome and to focus on what factors could influence enhanced learning.

Table 4.1 Summary of Participants related to the questionnaire

Course Name	Number Students Enrolled	Pre-Questionnaire Participants	Post Questionnaire Participants	Native youth
SFR 479	35	34	30	1
SFR107	64	64	60	2
SFR477	37	37	32	2
CIE455	43	43	39	2
ANT290	10	10	10	5
TOTAL	189	188	171	12

Below responses to the pre-questionnaire are compared to responses after the respective course was completed.

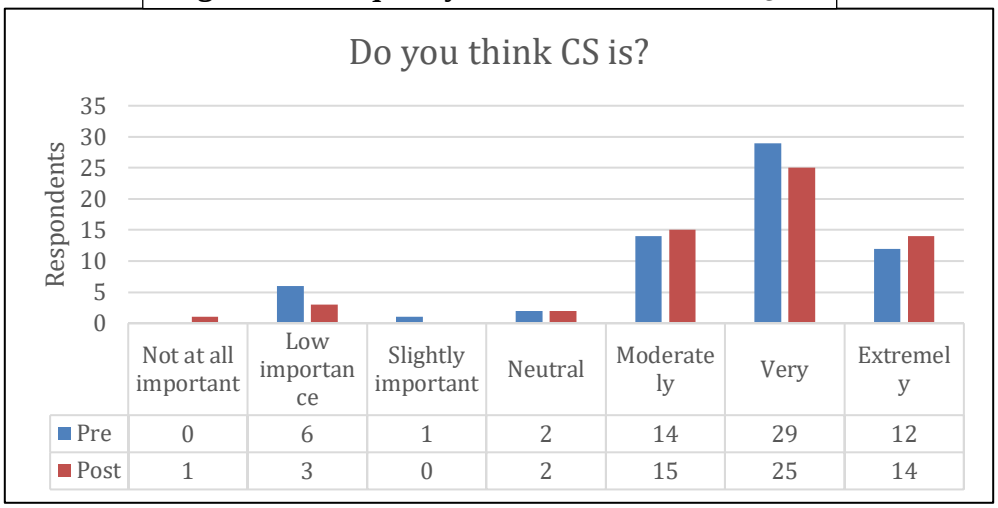
Findings By Course

Environmental Attitudes and Behaviors (SFR 479.)

Questionnaire Responses

From this class of 35, responses to the pre and post question Q.1. (Do you think Traditional Ecological Science is important?) indicate, overall, a change toward increased importance of CS.

Figure 4.1 Frequency results for SFR 479; Q1.



Prior to taking the course, the distribution of 34 responses to Q.1 were: Zero students felt CS was Not important; three (nearly 9%) students felt that CS was either low or of slight importance; most students took either a Neutral position (11 or 32%) or felt CS was moderately important (13 or nearly 39%); six (nearly 18%) felt that CS was Very important, and one (2%) felt that it was Extremely important. By the end of the semester, 30 responses from this group indicate that their perception of the importance of CS had been positively changed. There were fewer students who were n Neutral, five rather than 11, a percentage decrease of 54.5%.

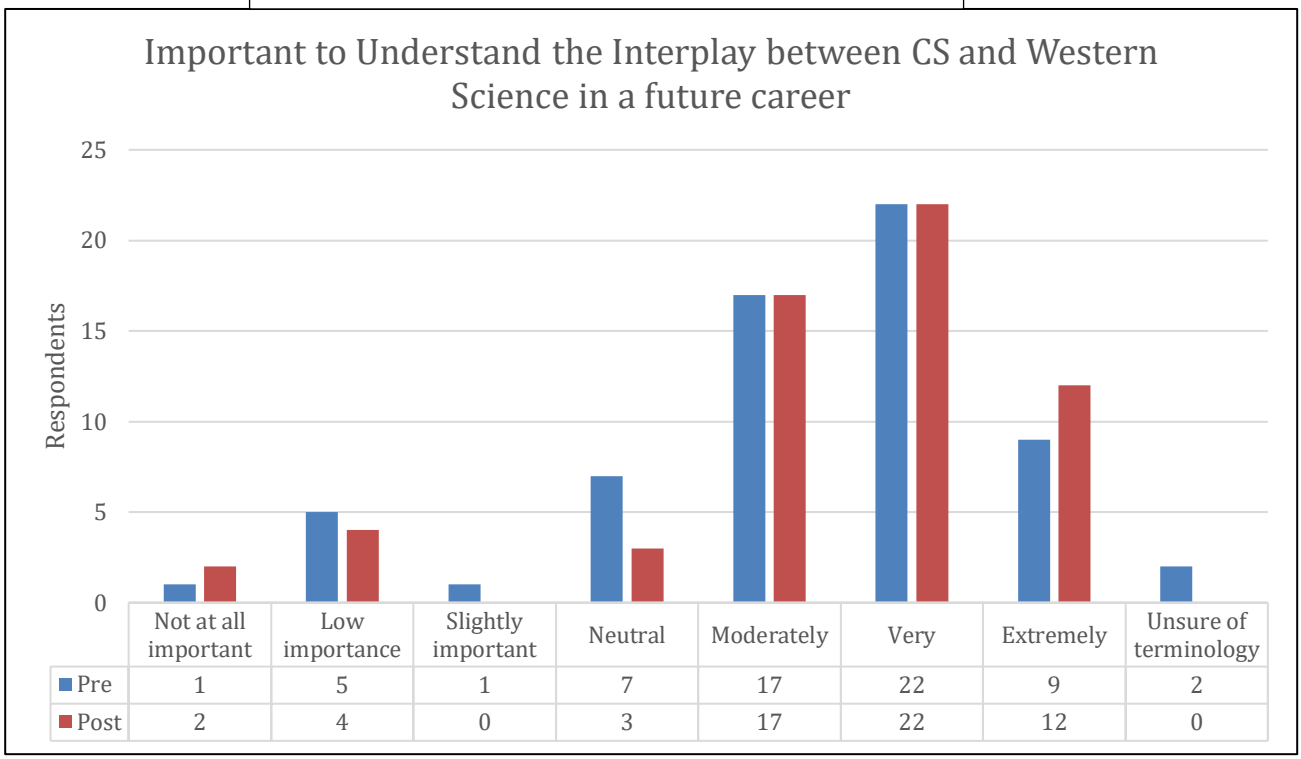
More students either agreed that CS was Moderately important 15 rather than 13, or Very important nine compared to six. Both of these latter response categories showed a percentage increase of 15.4% and 50%, respectively. One student felt that CS was Extremely important in the post-questionnaire, same as before. Zero students chose low or Slightly important. These results are shown in the graph above.

Q.2, the second question, asked the importance students felt it was to understand the interplay between CS and western science as it related to their future career. In response to this question on the initial questionnaire no student indicated that it was not important. Six students felt that it was of low or slight importance to their future career. The majority of students, 15 (44%), felt Neutral about the relevance CS would play in their future career path. Seven (21 %) felt that it was moderately important and five (14.7%) felt that it was very important. One (2%) felt that it was extremely important.

A comparison with post-questionnaire responses showed a shift to greater understanding of the relevance of CS has with regards to western science and future careers. For example, only three (3) students felt Neutral on this question post-course, compared to 15 before the course. This was a shift of 80%. Moderately important shifted by over 71% with an increase of five

students to 12, and Very important increased over 160 % (from five to 13). Extremely Important doubled from one to two people, though this accounted for less than 7% of the overall results.

Figure 4.2 Frequency results for SFR 479, Q2.



	Not at all important	Low importance	Slightly important	Neutral	Moderately	Very	Extremely	Unsure of terminology
Pre	1	5	1	7	17	22	9	2
Post	2	4	0	3	17	22	12	0

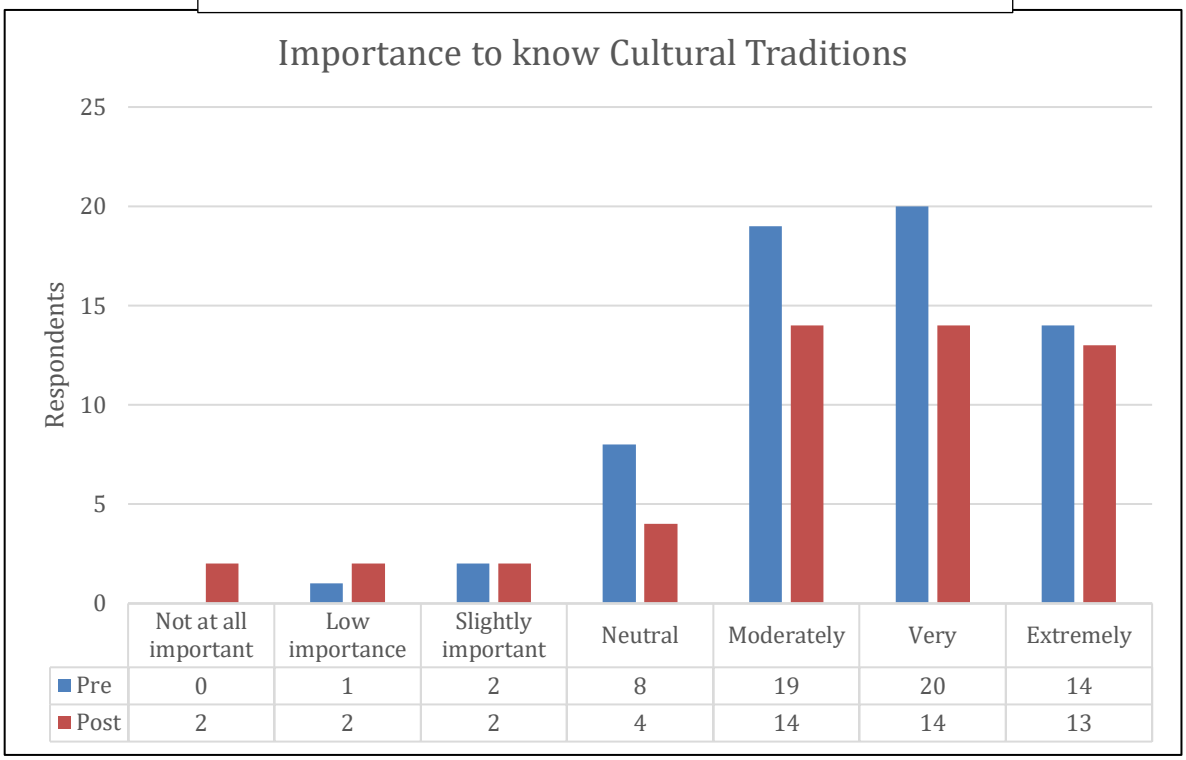
Q.3, the third question, asked students if understanding Cultural Tradition(s) was important. (Of note: The term “cultural traditions” was not explained at the time of the pre-questionnaire but by the end of the semester the idea and term had been emphasized in multiple ways including but not limited to Ms. Greenlaw and Ms. Cole-Will’s discussion about sweetgrass and Mr. Jacobs ash baskets.)

In response to this pre-course question, a small number of students, three, thought that knowing the importance of Cultural Traditions was of low or slight importance; they represented less than 10% of the class. Five (15%) students were Neutral about the idea; nearly 10 (30%)

and 14 (45%) who thought this concept was moderately or very important to them. At the time of the pre-questionnaire, no one felt that it was extremely important.

Relevance shifted upward with this question as well when compared to post-questionnaire responses. One person still felt that it had Low Importance, but fewer were Neutral. Moderately important increased by almost 20 % (from 10 to 12). Very important decreased by four respondents (28%), but there was an increase of three respondents (or 30 %) that felt it was extremely important to know Cultural Traditions compared to zero responses before the course.

Figure 4.3 Frequency results for SFR 479, Q3.



	Not at all important	Low importance	Slightly important	Neutral	Moderately	Very	Extremely
Pre	0	1	2	8	19	20	14
Post	2	2	2	4	14	14	13

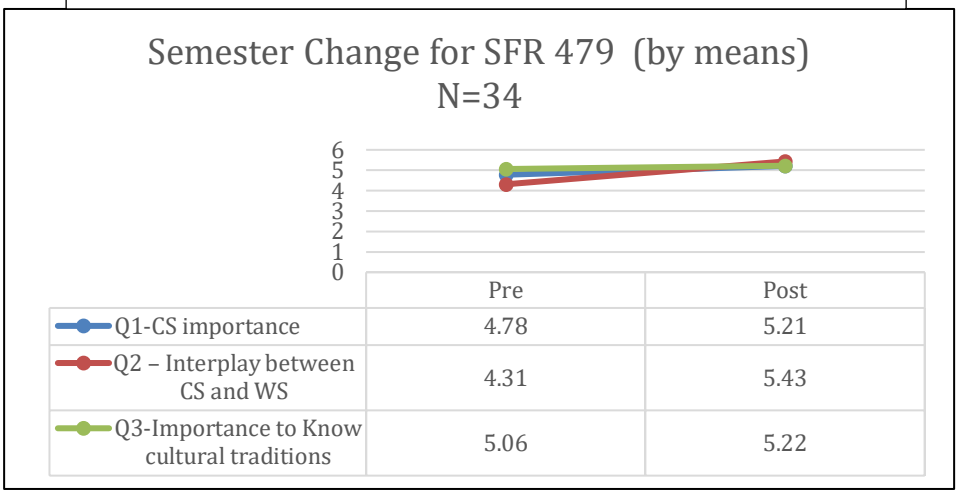
In summary, the mean responses from course SFR 479 for the three questions, pre and post, are provided below:

Table 4.2 Mean for SFR 479 Q1-Q3

Mean for SFR 479		N	Mean	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Q1- CS Importance	Pre	34	4.71	4.35	5.07	2	7
	Post	30	5.20	4.92	5.48	4	7
Interplay b/t CS & WS	Pre	34	4.29	3.86	4.73	2	7
	Post	30	5.47	5.18	5.76	4	7
Importance to know cultural traditions	Pre	32	5.06	4.67	5.45	2	6
	Post	28	5.39	4.99	5.79	2	7

It is interesting to note that the students in SFR 479 initially responded to the importance of CS, the interplay between CS and western science as well as the importance to know cultural traditions at a “Moderately important” level. Over the semester this increased to very important (or slightly greater) for all questions. No student indicated that they were unsure of the terminology, a possible response option.

Figure 4.4 SFR 479 Semester change based on means.



The null hypothesis explained in detail in Chapter 3 and abbreviated here as enhanced learning will not occur for Native and non-native students by inclusion of CS in SFR 479 was tested utilizing ANOVA. This was a test to determine if there was significant differences between the pre and post questionnaire.

Table 4.3 ANOVA for SFR 479

SFR 479		Sum of Squares	df	Mean Square	F	Sig.
Q1- CS Importance	Between Groups	3.891	1	3.891	4.652	0.035
	Within Groups	51.859	62	0.836		
	Total	55.750	63			
Interplay b/t CS & WS	Between Groups	21.912	1	21.912	19.825	0.000
	Within Groups	68.525	62	1.105		
	Total	90.438	63			
Importance to know cultural traditions	Between Groups	1.630	1	1.630	1.464	0.231
	Within Groups	64.554	58	1.113		
	Total	66.183	59			

The ANOVA analysis disproved the null hypothesis because the *p* value was .05 or less for the first two questions. Only the last question was not disproven. In other words, the students in SFR 479 did feel like the inclusion of CS was important and it was important to learn about the interplay between western science and CS.

This change is supported by their reflections.

Reflections.

Review of the reflections for this class supported what was revealed with the pre and post-questionnaires, i.e. students' learning appears to have been enhanced by the inclusion of CS in the course curricula. What follows are selected quotes from the 26 students from this course that reinforces what was produced in their pre and post-questionnaires both undergraduate,

graduate, positive and negative. These reflections offer insight to enhanced learning through the readings as well as the presence of the CKK.

All reflections were analyzed to discover how many times students mentioned specific themes. Themes included:

- Change in ideology
- Change in perception
- Enhanced learning
- Relevance of CS (aka TEK)
- Did not enhance learning either because of a disconnect to the concept or misperceptions of the topic

These themes were determined earlier to be relevant to the study questions based on the methodology outcomes. After reviewing the over 800 reflections, there were 54 that were coded in NVIVO.

The summary below shows the frequency with which the themes repeated themselves within the students' reflections from SRF479.

Table 4.4 NVivo Codes for SFR 479

Codes	Number of coding references within files	Number of items (files) coded
Change in ideology	5	5
Change in perception	10	8
Enhanced learning	30	26
Relevance of TEK	5	5
Not enhanced learning	Not analyzed	Not analyzed

Of the 54 student reflections, there were over 30 instances where "enhanced learning opportunities" were mentioned by 26 of the students or over 50% of the class. Enhanced learning opportunities appear when students acknowledge that they have gained something beyond the class that they were not expecting. Examples are reflected in the below reflections.

. There was an increase in understanding and value from the pre to the post class. Over 40 references were made by students in their reflections acknowledging the benefit of CKK presentations. Multiple presentations by the same team of CKK over the semester could be a contributing factor to the increase. The class reflections supported this and showed consistent value in learning CS and the role that it has within the science field. The reflections below showcase this change in learning within SFR 479.

> "Overall, the guest speaker was able to provide an abundance of knowledge as to how Native Americans perceive the world." Reflection 4/10/18.

This is noteworthy from the perspective of the student still thinking that this is about how Native Americans perceive the world and not how this can help the student be a better manager by understanding the broader context that was provided here. I wanted to include this to show that this is one of the barriers that exists within student perceptions.

> "When one of our classmates asked how the western world can better adapt and integrate indigenous knowledges into our current world, the speakers response had a lasting impression on me. She said that too often we go into situations thinking we know everything about the environment after studying it for a small amount of years, whereas the natives might know much more about the environment through their of lifetime experiences. She said that breaking down assumptions about ourselves and the people we work with is really important. I think breaking down assumptions about people applies both to indigenous knowledges but also in our everyday lives. We often are so caught up in what we know, or what we think we know, that it can limit our actual learning."
> (Undergraduate Student, April 10, 2018)

> "I was really interested in the connection of cultures to the environment. Though it makes so much sense now, and seems almost common sense, I never had the idea that culture was so tied to the natural environment in which people live and interact." "...discussions on sweet grass have helped me formulate this idea into my knowledge and I think it is an idea and concept that I strongly agree with and will communicate to others in conversation and in writings."
> "I cannot help but think if the Native Americans had sailed across the Atlantic first and colonized Europe somehow, the world would be a very different place than it is today. And I think this would be the only way for Indigenous Knowledge to have the strong involvement that Wildcat desires and asks of man."
> (Undergraduate Student, March 29, 2018)

I found this personally interesting noting how the student is thinking about the reversal of the relationship.

> "This is a much different mindset, and ramifications from issue like climate change will be perceived extremely differently amongst these two groups. For example, if lobster becomes extinct, the primary concern for westerners will be economic revenue, which in many cases can be made up with other shellfish species. However, if species like sweet grass or brown ash become extinct, then native tribes would lose an enormous aspect of their culture and spirituality." (Undergraduate Student April 10, 2018)

This is noteworthy from the perspective that student is understanding the different views that people have and the impact those views have with regards to their respective culture.

> "I think this is a great way to frame how and why TEK would be an important and critical asset to Western science. The competitive nature (probably established by capitalism) in academia can sometimes create somewhat good, Cold War type rivalries that can motivate scientists to produce meaningful research. Other times these competitions can be detrimental to scientific integrity and progress. The field of TEK does not seem to hold the same motivators. " (Graduate Student, April 10, 2018)

> "Seeing that [referring to a video seen in class] really showed me that indigenous cultures are the first ones to see and feel the impacts of climate change because of the way they live their lives. Although we aren't completely disconnected from nature here in Maine, we do not value our environment to the extent that native tribes do."
> (Undergraduate Student March 27, 2018)

> "I see lots of students eager to understand a new way of knowing, and a new perspective of indigenous cultures. I also see it in our society, becoming more accepting of different ideologies and cultures. That being said the only way for tolerance to survive is by being intolerant of intolerance. (Undergraduate Student April 12, 2018)

Because I did not use NVivo initially with this class, my focus in looking at those reflections were from the perspective of enhanced learning. In taking the NVivo class, I learned the value of looking at not only the need to track the positive but also the counter discussion. Within those reflection, one can learn how to improve. I did include a counter view in the subsequent classes. That being said, one student reflection from Dr. Daigle's class did stand out as a counter discussion. It is below:

> "Another thing that was mentioned was the western culture is to blame for the global

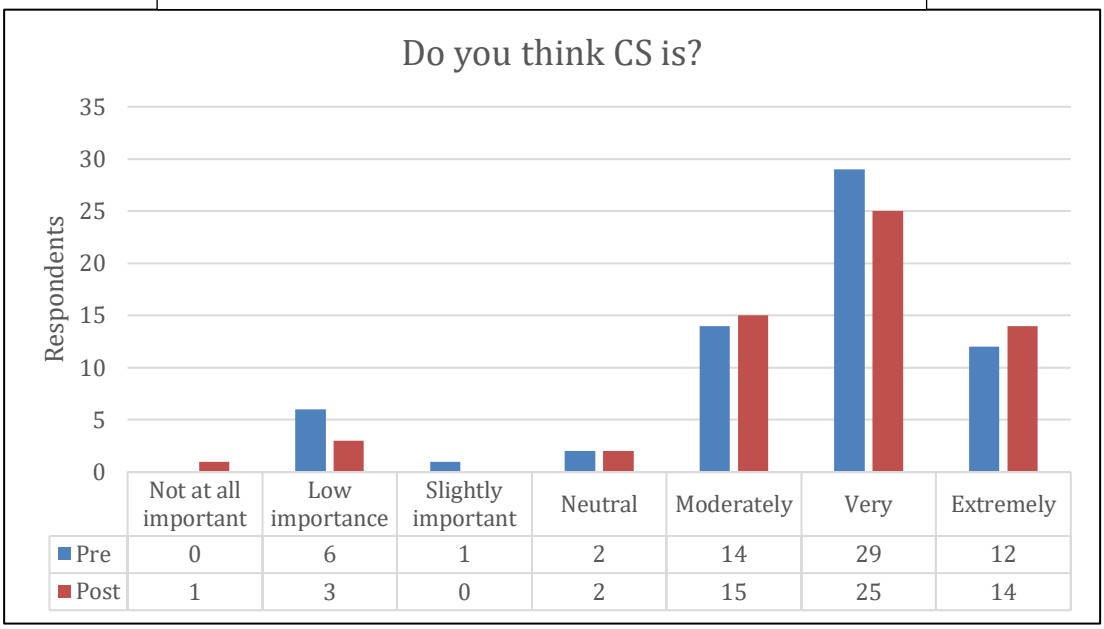
> warming and in particular Christian based ones. I highly disagree with this as most none of these nations have any laws forcing you to be Christian. In fact many people now do really have any religious belief. I also this it is unfair blame the west for everything witch (sic) is something that comes up a lot and is really kind of bothering.
>
> (Undergraduate Student April 3, 2018)

Forest Vegetation (SFR 107).

Questionnaires

For this course, Q.1 responses are shown in the chart below. Six considered it of Low importance and one said that it was Slightly important. Two people reported feeling Neutral about it with another 14 (nearly 22%) saying that it was Moderately important. The majority of the pre-course responses, 45% or 29 students felt that CS was Very important. Another 12 (nearly 19%) felt that it was Extremely important.

Figure 4.5 Frequency results for SFR 107; Q1.



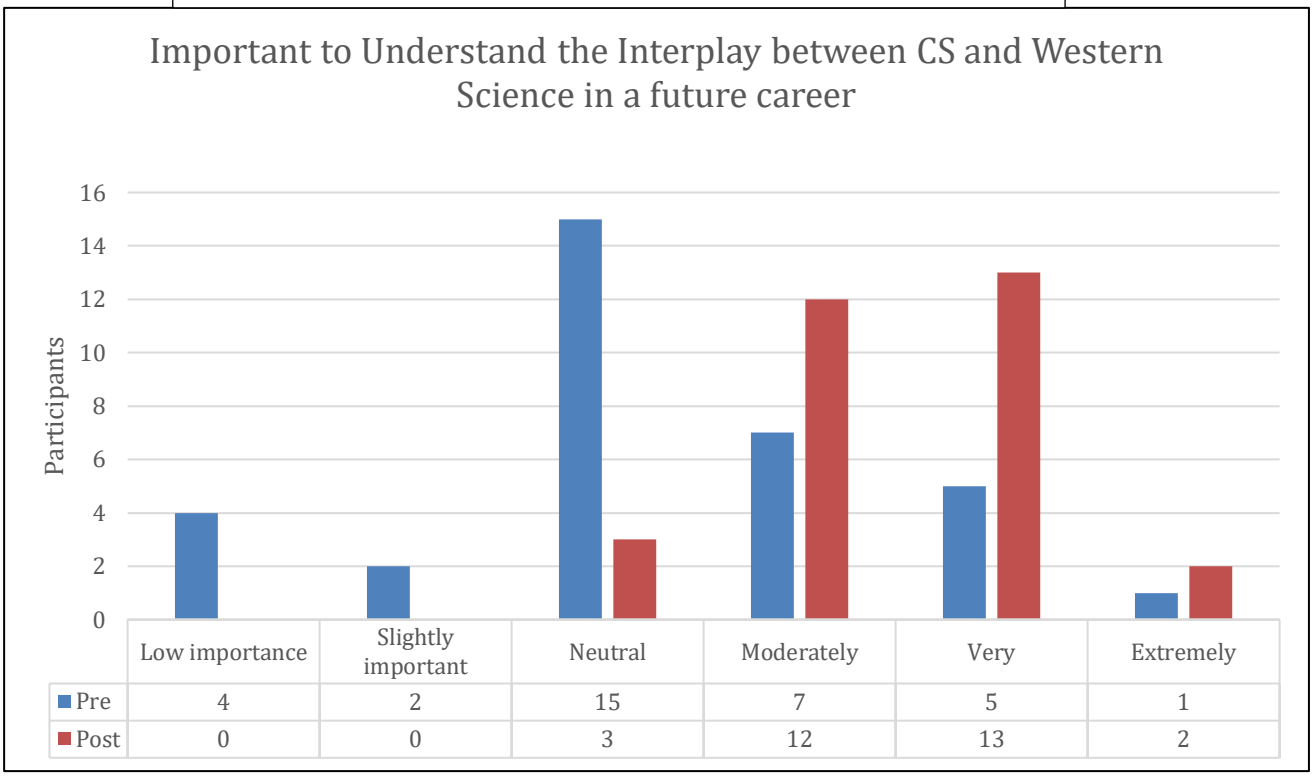
	Not at all important	Low importance	Slightly important	Neutral	Moderately	Very	Extremely
Pre	0	6	1	2	14	29	12
Post	1	3	0	2	15	25	14

It is interesting to note that at the end of the semester one person felt that CS was Not at all important (up from zero in the pre-questionnaire), the number of respondents thinking it was of Low importance decreased from six to three and no one felt that it was Slightly important down from one in the pre-questionnaire. There was a slight increase, one person, with

Moderately important and a decrease in Very important to just under 14 % of the students. Extremely important, however, did increase by two people for an overall increase of 26 %.

Q.2. As it relates to the importance to understand the interplay between CS and western science in one's future career, there was very little difference between the pre-and post-questionnaire responses. Initially, two people were unsure of the terminology in the pre-questionnaire, but this

Figure 4.6 Frequency results for SFR 107; Q2.

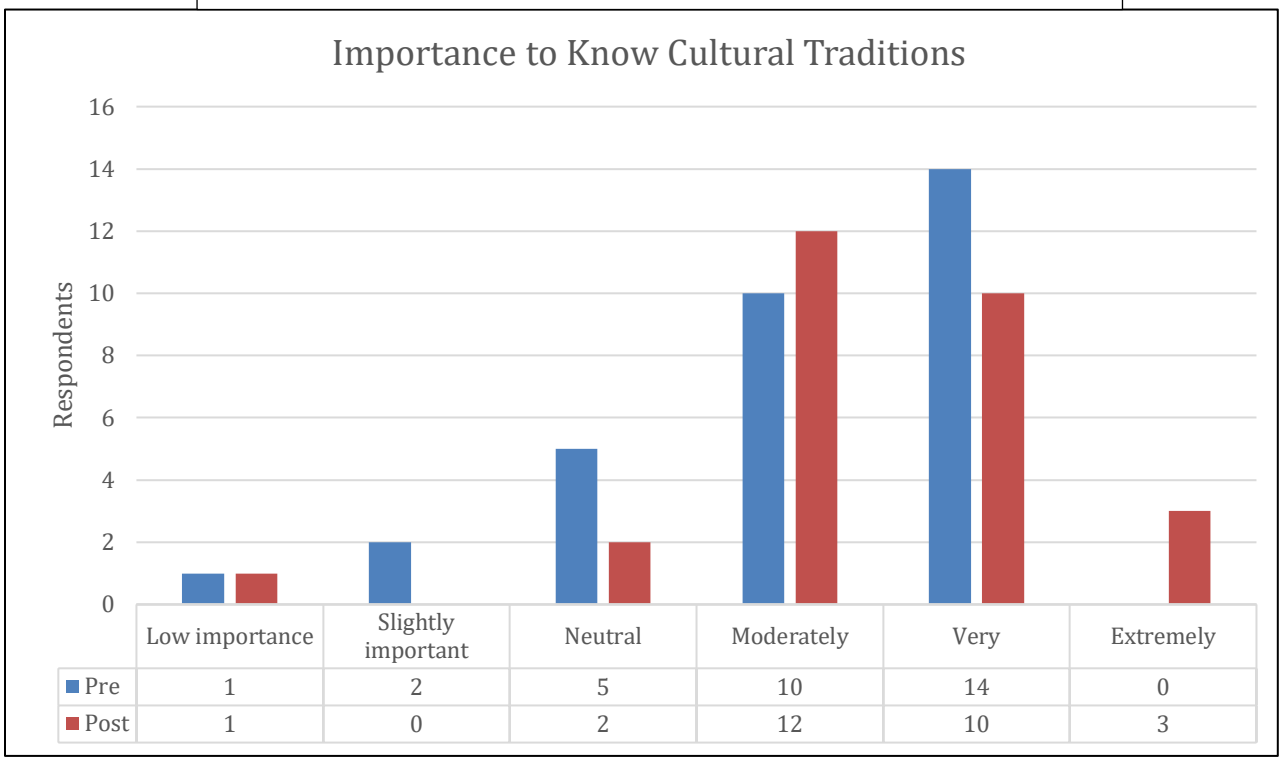


was not the situation by the end of the semester. No one found it to be Not at all important. There were slight decreases in Low importance from five (5) to four (4) and Slightly important (one to zero).

It is interesting that, in both questionnaires, the count stayed the same for the moderately and very important (17 and 22 students, respectively). There was a slight increase with Extremely important, from nine to 12.

Q.3. Responses to the final question for SFR 107 students --- the importance to know Cultural Traditions --- showed an overall downward trend. While no one that felt CS was Not at all important before the course, by the end of the course two students chose this response. Initially, one person felt that it was of Low importance and by the end two people felt the same.

Figure 4.7 Frequency results for SFR 107; Q3.



	Low importance	Slightly important	Neutral	Moderately	Very	Extremely
Pre	1	2	5	10	14	0
Post	1	0	2	12	10	3

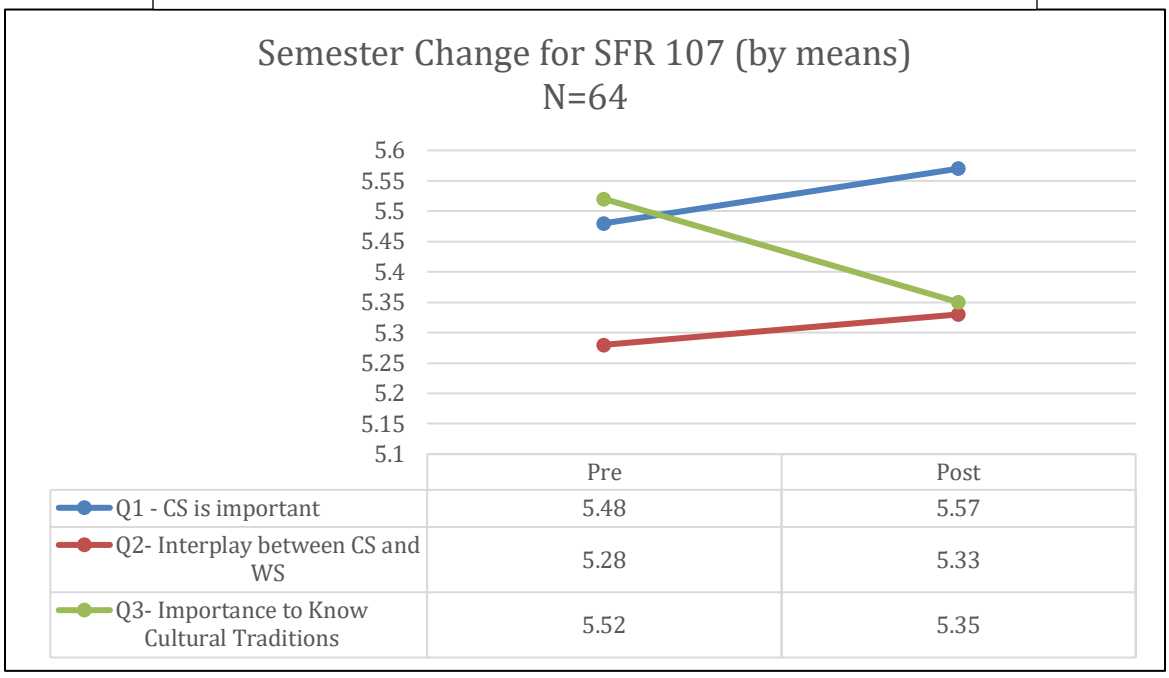
Slightly important stayed the same but in all subsequent answer categories there was a downward progression (Moderately,19 to 14 (26%); Very Important, 20 to 14 (30%); and Extremely, 14 to 13 (7%). These responses are shown in the means table below

The mean for these three questions in SFR 107 are below:

Table 4.5 Means For SFR 107 Q1-Q3

Mean for SFR 107		N	Mean	95% Confidence Interval for Mean	Minimum	Maximum	Mean for SFR 107
Q1- CS Importance	Pre	64	5.48	5.14	5.83	2	7
	Post	51	5.57	5.18	5.96	1	7
Interplay b/t CS & WS	Pre	64	5.28	4.9	5.66	1	8
	Post	51	5.33	4.89	5.78	1	7
Importance to know cultural traditions	Pre	64	5.52	5.23	5.8	2	7
	Post	51	5.35	4.91	5.79	1	7

Figure 4.8 SFR 107 Semester Change by means



Two of the three questions, Q1 and Q2, did show positive changes based on the mean. This indicates to me that students felt the addition of CS and understanding the interplay between CS and WS was important to them., but the relevance to cultural traditions may not be. The

reflections provide a clearer answer to these data results. The ANOVA for this class showed the following:

Table 4.6 ANOVA for SFR 107 Q1-Q3

SFR 107		Sum of Squares	df	Mean Square	F	Sig.
Q1- CS Importance	Between Groups	0.201	1	0.201	0.104	0.747
	Within Groups	218.494	113	1.934		
	Total	218.696	114			
Interplay b/t CS & WS	Between Groups	0.077	1	0.077	0.032	0.857
	Within Groups	268.271	113	2.374		
	Total	268.348	114			
Importance to know cultural traditions	Between Groups	0.751	1	0.751	0.413	0.522
	Within Groups	205.631	113	1.820		
	Total	206.383	114			

This analysis revealed a null in the hypothesis, meaning that there was not significant change within the pre and the post questionnaire. If this was the only context with which this research was being based, it would not provide the complete picture. When the human dimension is evaluated through reflections and observations, a richer context and shared voice by the students is included which supports the findings from SFR 479.

Reflections.

To help reinforce the overall positive changes students felt with the inclusion of CS, below are specific quotes from student reflections from the four labs and lectures. There were a total of 219 reflections between the four labs. In particular, 46 students referenced the value the guest lecturer brought to the lab or the lectures.

"In the face of habitat loss, global warming, pollution, and water scarcity, the west should check its hubris and learn from the lessons the Wabanaki and others have known for millennia."
(Undergraduate Student, September 17, 2018)

"I've learned that the identification of cultural keystone species helps in knowing the starting point for its preservation and conservation".

(Undergraduate Student, September 17, 2018)

"Sustain the ones who sustain you and the earth will last forever" said Greenlaw, a point that stuck with me. If everyone had this deep understanding perhaps the way humans utilize the world would be different and less destructive".

(Undergraduate Student, September 16, 2018)

"One of the most interesting topics throughout her lecture was the ideological differences between western science and traditional knowledge. I was particularly interested in the list of guide lines about harvesting that she taught us. An inherently issue for Western society is consumption to the point of depletion whereas the Wabanki [sic] follow these set guidelines to ensure that this does not happen (i.e. never take the first thing you see, harvest in a way to minimize harm, take only what you need and leave some for others. It is my belief that these guidelines allow for the Wabanki [sic] to have success in protecting their culture keystone species—unlike Western ideology which almost caused the demise of the American bald eagle due to our use of DDT and illegal takings"

(Undergraduate Student, September 16, 2018)

"When our guest lecturer talked about how to observe the vegetation that surrounds us, it was actually very eye opening." [This lab was presented by Jennifer Neptune on medicinal plants].

(Undergraduate Student, September 21, 2018)

"Dr. Greenlaw also talked about cultural keystone species - species that play a key role in the structure and functionality of an ecosystem, and they are cultural icons as they are species that play a fundamental role in the lives of native people. Naturally, this concept helps me better understand traditional knowledge by being able to recognize what they considered important in the species whether that be for food, materials, medicine, or spiritual practices. By understanding cultural keystone species, I can better understand a community's cultural identity which in turn helps me better understand traditional knowledge by being able to see where this knowledge is coming from and its value" (Undergraduate Student, September 18, 2018)

There were a few students that participated in the lectures and labs that did not see the value within the class period. Within SFR 107, of the 219 student reflections, seven reflections were coded as not enhanced learning. An example is:

"I understand this was a walk through and not a full botany herb and plant medical guide, but I left lab that day with a potentially misplaced trust in the direct consumption some of our selected plants without truly understanding concepts such as dosage and preparation."

(Undergraduate, Lab 4)

Utilizing NVivo to quantify the reflections and learning based on student reflection, the code hierarchy summary organizes the results based on the same themes as SFR 479.

Below is a summary.

Table 4.7 NVivo coding SFR 107

Codes	Number of coding references within files	Number of items (files) coded
Change in ideology	16	13
Change in perception	42	37
Enhanced learning	174	114
Relevance of TEK	97	70
Not Enhanced Learning	8	6

It was interesting to observe and read the students enthusiasm particularly within the labs. As this was a freshmen class, with more structure within the framework of the material that was presented, there still was a positive shift as it related to the inclusion of CS. It was interesting to note the frequency that "enhanced learning" opportunities appeared. Overall, most students valued the additional knowledge.

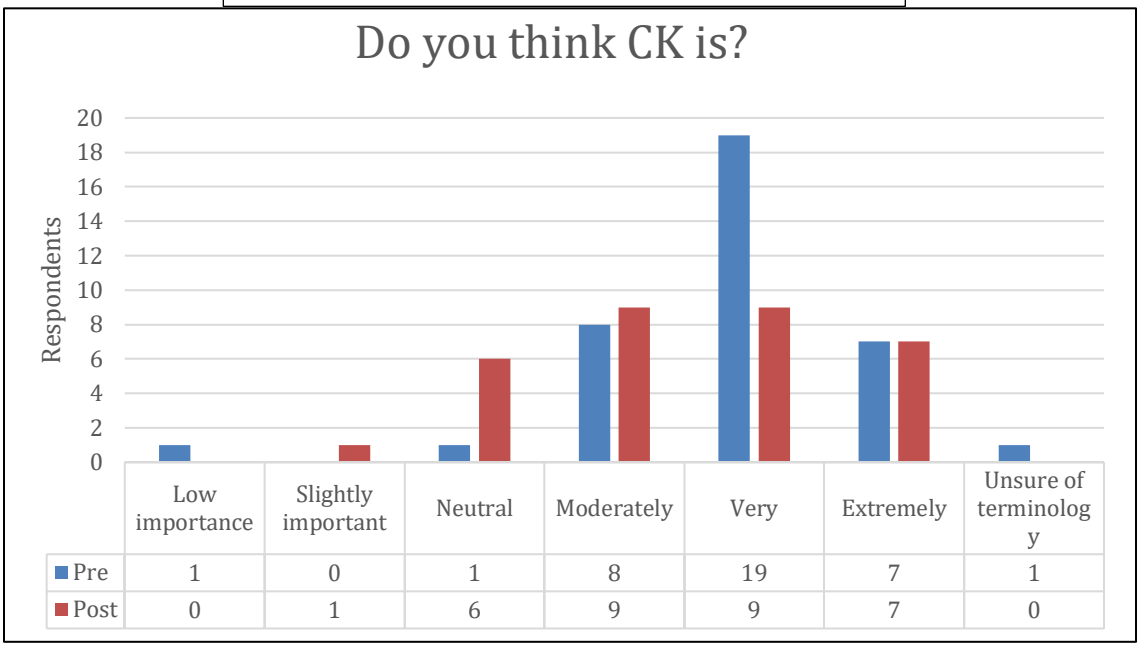
Forest Landscape and Management Planning (SFR 477/577).

This class of 37 students was an upper level forest management course, required for forestry majors. Graduate students were also enrolled. Early on it was realized there were students in this class, offered in Fall 2018, that had participated in a prior course, SFR 479, in Spring 2018, also part of this study. This meant that some students, 12 in all, would twice experience the inclusion of CS within the curriculum and would also be asked a second time to complete the pre-and post-questionnaires. For purposes of data collection and analysis, these students were asked to mark their questionnaires with an "x" at the top and a column was added to account for their prior knowledge.

This class of students showed interesting trends as related to all the questions. Prior to the introduction of CS within the curriculum, the class started at a relatively high relevance of understanding. With Q.1, over 50% of the class (19 students) felt that it was “Very important” to know about CS. Of the 19, six had been in SFR 479 given in the prior spring. Eight felt that it was Moderately important, five of whom had also completed SFR 479. Seven found CS Extremely important, one of whom had attended the prior class. One person felt that CS was of Low importance and another was Neutral on the matter. It may be of interest that all 12 of those students who had been exposed to a prior course in which CS had been integrated found its importance either Moderately, Very or Extremely Important on the pre-course questionnaire.

The Q.1 post-questionnaire indicated that no one felt that CS was of Low importance but

Figure 4.9 Frequency results for SFR 477; Q1.

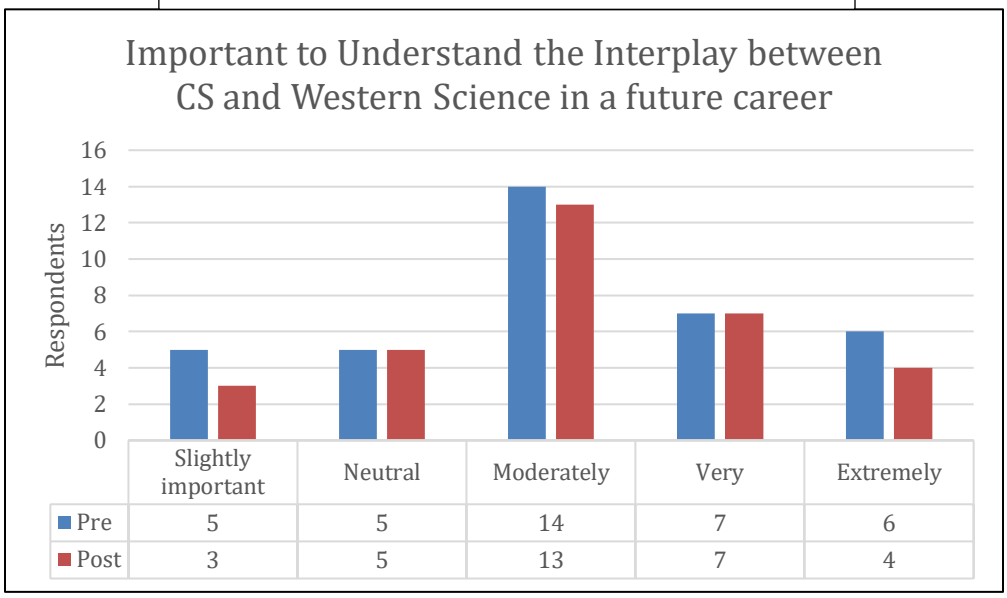


	Low importance	Slightly important	Neutral	Moderately	Very	Extremely	Unsure of terminology
Pre	1	0	1	8	19	7	1
Post	0	1	6	9	9	7	0

one person shifted to Slightly important and five more people (totaling six) were Neutral about the question of how important CS is. There was also a decline by 53% of students who felt at the start of the class that CS was very important. Extremely important stayed the same. One person indicated that they were Unsure of the terminology at the onset.

Q.2 The second question related to understanding the relationship between CS and western science as it relates to one's future career. Overall, responses were consistent between the pre-and post-questionnaire. No one thought that CS was Not at all important. Responses were the same on Neutral (five) and Very important (seven) between questionnaires. There was a slight downward trend with Slightly important (from five people to three), but also with Moderately important (from 14 to 13) and Extremely (from six to four).

Figure 4.10 Frequency results for SFR 477; Q2.

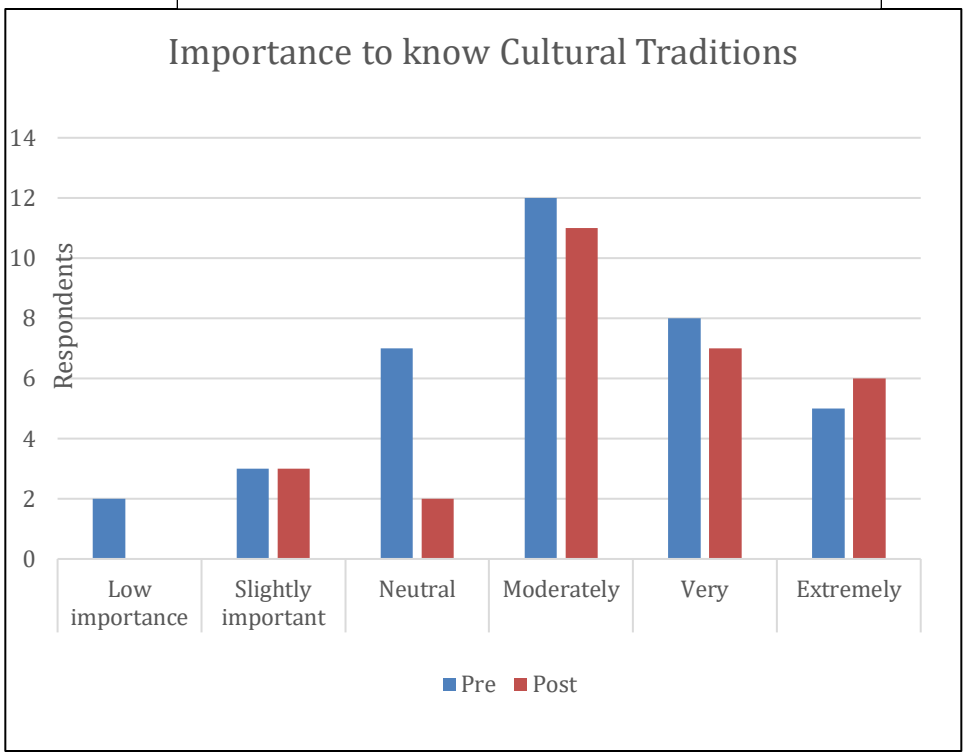


	Slightly important	Neutral	Moderately	Very	Extremely
Pre	5	5	14	7	6
Post	3	5	13	7	4

Again, it may be of interest that 11 of the 12 students who had been exposed to the course (SFR 479) in which CS had been integrated responded to the question as either Moderately (three), Very (three) or Extremely (five) Important on the pre-course questionnaire. One of the 12 was Neutral.

Q.3 The final question, the overall importance of knowing Cultural Traditions, showed a slight overall downward trend. Again, there was no one who felt that it was not important, but students stayed the same in both questionnaires with respect to feeling it Slightly important. There was a decrease with regards to Low importance (from two to zero) and from seven to two in the Neutral category. The other decreases were for Moderately important (from 12 to 11) and

Figure 4.11 Frequency results for SFR 477; Q3.



Very important (from eight to seven). Extremely important was the only category that saw an upward trend (from five to six). The majority of the students felt that knowledge of cultural traditions was Moderately important, by their pre-and post-questionnaires responses.

These results showed that the prior participating students in Dr. Daigle's class made up 12 of the responses. Of these 12, five responded Extremely important, two responded Very important, two responded Moderately important, one was Neutral and two responded Slightly important on the pre-questionnaire. Overall, these students came in at a higher level of

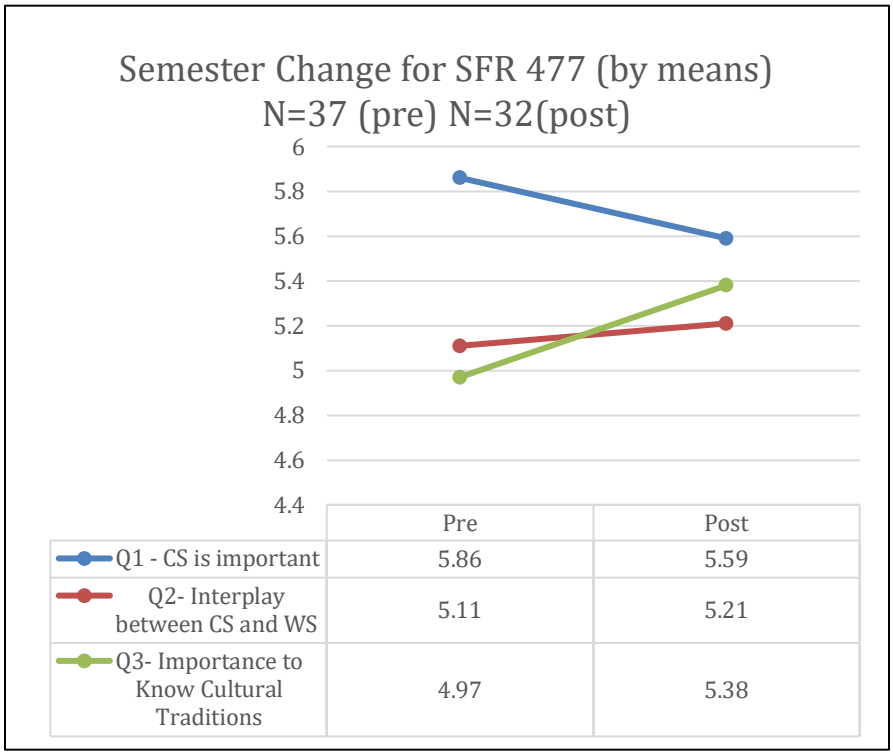
understanding to the importance of CS. It is interesting to note that there was a drop in student participations between pre and post questionnaires, but it amounted to an increase in percentages, by 2%, because it was a smaller number of students that participated in the second questionnaire (n = 37 vs. n=32).

The means for the three questions are given below.

Table 4.8 Mean for SFR 477 Q1-Q3

Mean for SFR 477		N	Mean	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Q1- CS Importance	Pre	37	5.86	5.52	6.21	2	8
	Post	29	5.59	5.17	6	4	7
Interplay b/t CS & WS	Pre	37	5.11	4.69	5.52	3	7
	Post	29	5.21	4.78	5.63	3	7
Importance to know cultural traditions	Pre	37	4.97	4.53	5.42	2	7
	Post	29	5.38	4.92	5.84	3	7

Figure 4.12 SFR 477 Semester Change by means



	Pre	Post
Q1 - CS is important	5.86	5.59
Q2- Interplay between CS and WS	5.11	5.21
Q3- Importance to Know Cultural Traditions	4.97	5.38

In terms of means there was an overall positive change with two of the three questions. This is similar to SFR 107 results, but unlike that class, SFR 477 saw a drop in the perception in relation to CS (Q1). The interplay between CS and WS (Q2) and the importance to know cultural traditions (Q3) saw a positive change from the pre and post questionnaire. One interesting point, regardless of the final means is the level where students started. The pre-questionnaire Q1 was a high very important at 5.86. Even a drop to 5.59 has it above very important to know CS. This is a positive step in understanding and have students acknowledge the importance CS has to their learning. Even the relevant importance to know cultural traditions is almost a 5 (very important). After the course this does shift to very important.

The Anova analysis provides additional information

Table 4.9 ANOVA for SFR 477: Q1-Q3

SFR 477		Sum of Squares	df	Mean Square	F	Sig.
Q1- CS Importance	Between Groups	1.262	1	1.262	1.132	0.291
	Within Groups	71.359	64	1.115		
	Total	72.621	65			
Interplay b/t CS & WS	Between Groups	0.159	1	0.159	0.112	0.739
	Within Groups	90.326	64	1.411		
	Total	90.485	65			
Importance to know cultural traditions	Between Groups	2.684	1	2.684	1.624	0.207
	Within Groups	105.801	64	1.653		
	Total	108.485	65			

There was no significance as it related to the three questions to disprove the null hypothesis from a quantitative perspective. The reflections support more of a positive change than is reflected through the questionnaire.

Reflections.

The reflections for this class spoke more towards the interplay between CS and western science compared with the SFR 107 class, which had a more formal structure with reflections focused on the differences rather than the integration of CS. Students embraced the opportunity to hear from CKK. The reflections had over 92 student references from the semester reflections. Averaging 36 students per reflections and four reflections for the semester, this indicates an appreciation of the value CKK brought to their learning. This is reinforced with over 217 specific references to the CKK contribution to the class. A few examples of this from the students include:

"The Menominee nation using their TEK have successfully incorporated this reality into their model of sustainability, which is found to apply successfully to cultures around the world. They focus not only on their understanding of ecosystems, but also with how their institutions, technology, economics, perceptions, and sovereignty all interacted with the land they call their

home. TEK also gives society other benefits such as the ability to examine science and ecology from different "value laden" cultural perspectives and allow greater access for first nation people into our educational and social insinuations. This will allow us understand the world in a more holistic way." (Undergraduate Student, Reflection 3)

"Suzanne Greenlaw gave a passionate presentation about the traditional importance of this species and how collaborative efforts are being made to incorporate both TEK as well as scientific knowledge to better manage the species for sustainability and basket making."
(Undergraduate Student, Reflection 3)

"For example, Ernest talked about the about how Mt. Katahdin was defined as scared[sic] to the Penobscot tribes or how the how Orono was named after the Great chief Orono. This is the based on the spiritual aspect of TEK, also in the case of the Passamaquoddy tribe in jackman [sic], Maine where they try to the manage the land to help maintain the tradition game species habitat of traditional hunting the tribal land as well as supply the finical[sic] benefit from the logging / maple syrup making. what a Learned[sic] from this theme as that you can use still be make a profitable return, as well as maintain traditional values by using different management tactics to help achieve the same goal"
(Undergraduate Student April 18, 2018)

"I believe traditional ecological knowledge (TEK has a lot more to bring to the table then most western scientist would care to admit." (Native Graduate Student, Reflection 3)

"As forest managers we have the ability and responsibility to incorporate TEK into our practices; as a way to build bridges between our two differing cultures and to gain knowledge we otherwise would not have. In some ways TEK and western knowledge is like a tree; Western knowledge digs down to the root of the mechanisms, and TEK grows up to see where the tree itself is growing a the forest. TEK brings hundreds of years of experience to the table. Intricate and life sustaining knowledge that has been generated into a method of living. One value of TEK is in its ability to teach things that western ways of thinking cannot teach us. If it can help me grow better trees, why wouldn't I embrace a new way of thinking?"
(Undergraduate Student, Reflection 3)

"Incorporating local, traditional knowledge into management of a particular forest will capture subtleties not found or "proven" through measurements and statistics. To think that a few periodic measurements will give comparable to results to decades or centuries of close observation is to ignore a scientific resource that can provide insight into how an ecosystem functions." (Graduate Student, Reflection 3)

"By learning from communities that have been working in an area for generations, not just referencing peer-reviewed scientific studies, forest managers will improve their understanding of the land, its connection to those who have managed it, and how it has and can continue to provide resources." (Graduate Student, Reflection 3)

"By using local ecological knowledge by people whose very lives are closely connected to their natural environment, forest managers can plan more efficiently and also involve the surrounding community." (Undergraduate Student, Reflection 3)

"I believe that TEK can be a resource that we can look up to for a means of a system that functions to live with the natural ecosystem rather a "worldview of human beings being part from and above the natural world" (Kimmerer). The typical studies of the natural world which we term as "science" and in this context Scientific Ecological Knowledge (SEK) have not portrayed our connections with nature appropriately and fall short when dealing with our complex ecological systems. TEK can make up that difference as it "is woven into and is inseparable from the social and spiritual context of the culture" (Kimmerer). Traditional Ecological Knowledge is something that many people can take something away from, it is an alternative way of thinking that should be considered when dealing with our land practices and how they effect ecosystems." (Undergraduate Reflection 3)

"Ernest Carle's speech on forestry in relation to Passamaquoddy lands was very interesting and insightful on managing forests to meet traditional needs."
(Undergraduate Student Reflection 2)

There were also a few alternative perspectives that added some breadth to this class that others did not have. Off the 145 reflections, four were coded as unenhanced learning. This may have been due in part to its being an upper level class (versus SFR 107) where students have a more global perspective with regards to forest issues. It may have been due to each guest lecturer was present for one visit, even though there were multiple lectures on CS. The value in repeated opportunities to interact with CKK, as in SFR 479, indicated a significant change. This was also shared by a couple of students in SFR 477. Examples are below:

"To simply summarize a complex debate, more is better. In terms of learning you are better off having multiple ideologies contributing to your decisions".
(Undergraduate Student Reflection 3)

"Traditional ecologic knowledge is the counterpoint to Western science in the way that it deliberately incorporates human bias into decision making."
(Undergraduate Student Reflection 3)

"Being in the SFR department you are largely exposed to western science and little else is at the forefront of your education." (Undergraduate Student Reflection 3)

More research, in particular focus groups or student interviews, will help shed light on these particular finding.

Utilizing NVivo to synthesize the four themes, the following provided guidance on the relevance and frequency of the themes as they appeared within the context of the reflections.

Table 4.10 NVivo coding SFR 477

Codes	Number of coding references within files	Number of items (files) coded
Change in ideology	10	9
Change in perception	78	56
Enhanced learning	132	85
Relevance of TEK	61	45
Not Enhanced Learning	5	4

There were 145 reflections that were coded with NVIVO. There were a number of "enhanced learning" opportunities that availed themselves within the context of the four reflections. There continues to be a high level of consistency with regards to students' comments through the reflections that indicate enhanced learning and their changes in perception regarding the role CS has with their learning. Though a comparison cannot be made on an individual basis, looking at the class as a community and shared voices, the consensus indicates enhanced learning with the inclusion of CS. These students did not have the group learning dynamics that SFR 479 had but the course did provide consistent readings throughout the semester which were reinforced with the involvement of the CKK. In reviewing the reflections, the students were thoughtful in their responses.

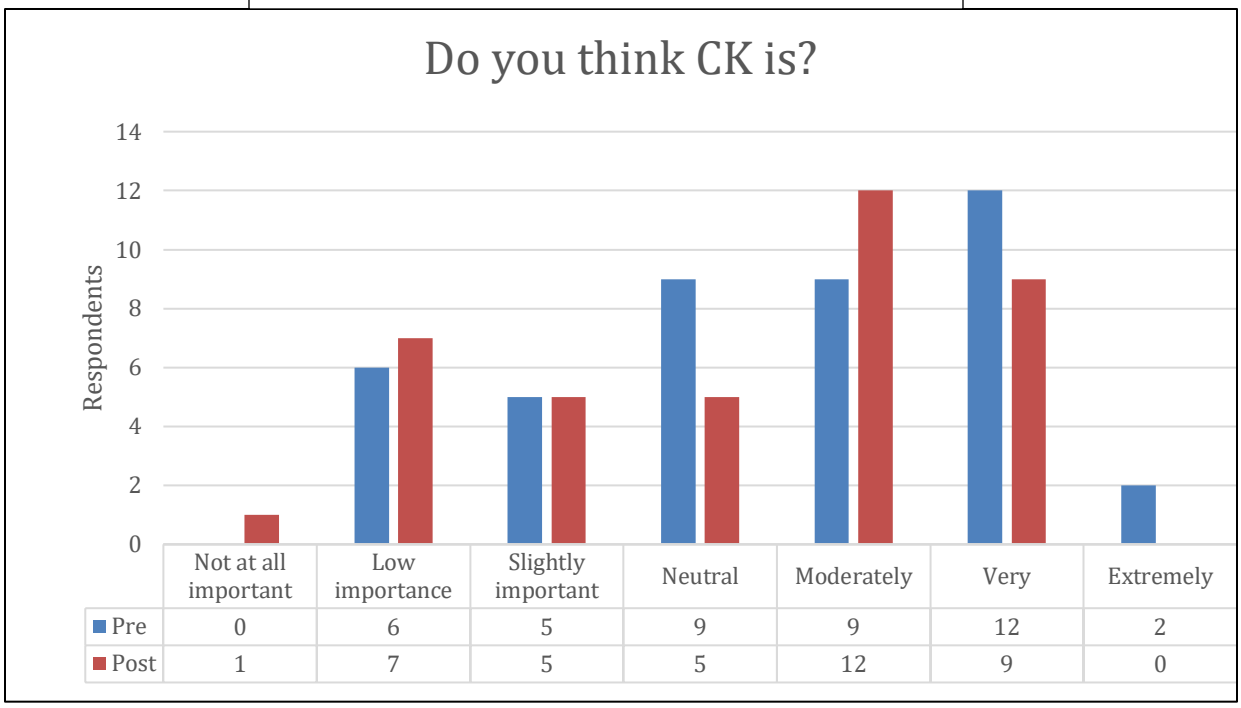
Hydrology (CIE 455).

This course of 43 students was a senior level engineering course and was the only class that did not have a CKK participate in the curriculum presentation.

Questionnaires

I found these trends interesting. In the pre-questionnaire no one indicated that CS was Not at all important. By the end of the class, however, one person chose this response. At the other end of the scale, initially two students felt that CS was "Extremely important" but by the end of the semester this had changed to zero students. "Moderately important" and "Very

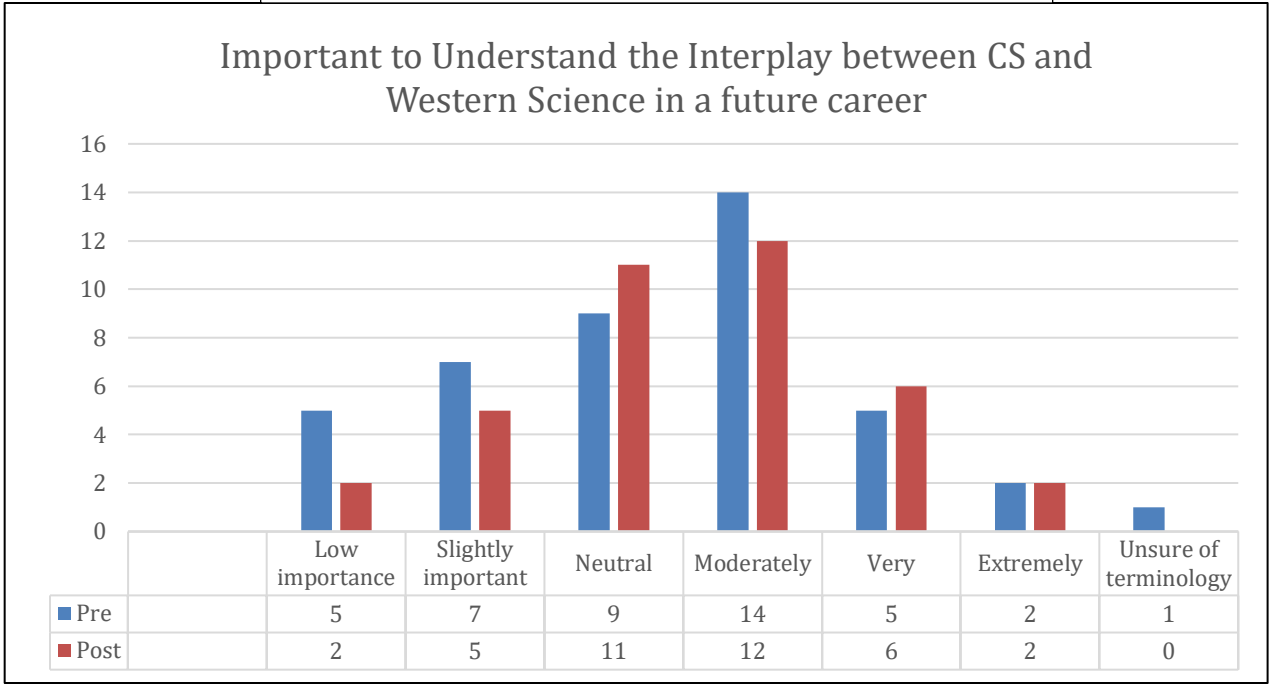
Figure 4.13 Frequency results for CIE 455; Q1.



important" became mirror images of themselves as can be seen in the accompanying chart. These two categories, for both pre and post made up 76% of the class. Slightly important stayed the same and Neutral dropped from nine to five responses between the two questionnaires. There was also a slight downward trend as one more person felt that CS was of Low importance at the end of the semester.

This trend continued with Q.2, the question that related to the importance of understanding the interplay between CS and western science as it related to a student's future career. Pre-questionnaire responses indicated that 12 students felt that understanding the interplay was of Low importance or Slightly important. Compared with post-questionnaire responses to the same question, fewer people, seven, felt it had Low or Slightly important status.

Figure 4.14 Frequency results for CIE 455; Q2.

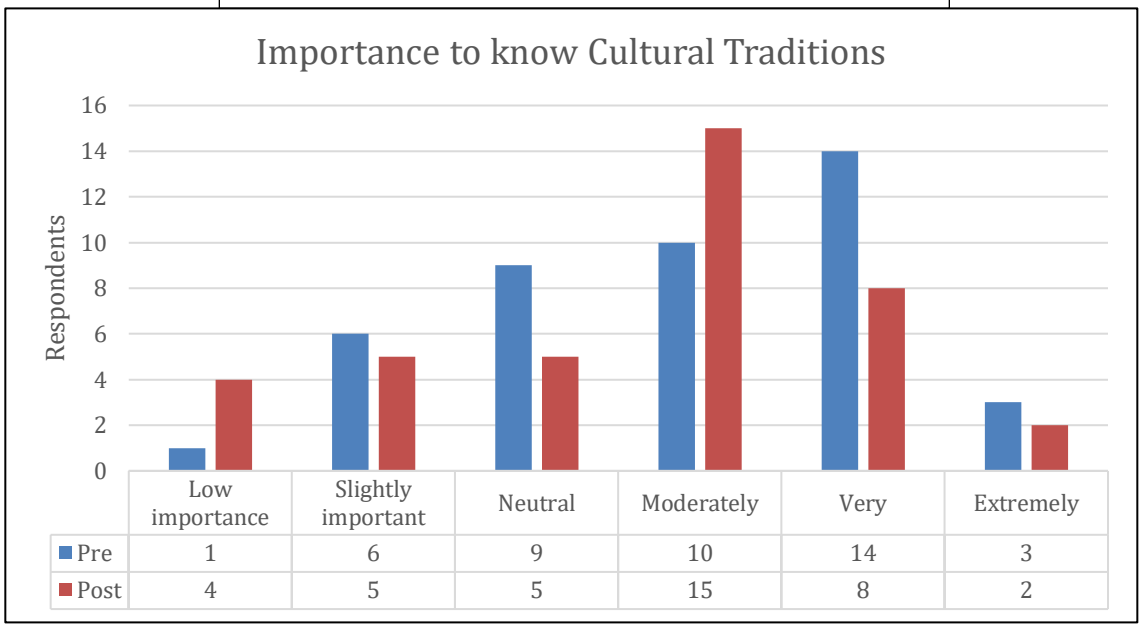


		Low importance	Slightly important	Neutral	Moderately	Very	Extremely	Unsure of terminology
Pre		5	7	9	14	5	2	1
Post		2	5	11	12	6	2	0

To continue the comparison: the Neutral category gained two responses; Moderately important dropped from 14 to 12 responses; and, Very important gained one response. It was interesting to note that two students felt that it was Extremely important both before and after the course. One student was Unsure of terminology at the time of the pre-questionnaire but apparently gained an understanding by the end of the semester as indicated by zero responses in that response category.

Pre-and post-questionnaire responses to Q.3, the question relating to the importance of knowing cultural traditions, had variability within them. As shown in the chart, both Very important and Extremely important dropped as a response choice from the start of the class to the end of the class; there was a gain of five in Moderately important responses; and Neutral and Slightly important dropped in the post-questionnaire. Low importance saw an increase from one student to four students by the end of the course.

Figure 4.15 Frequency results for CIE 455; Q3.

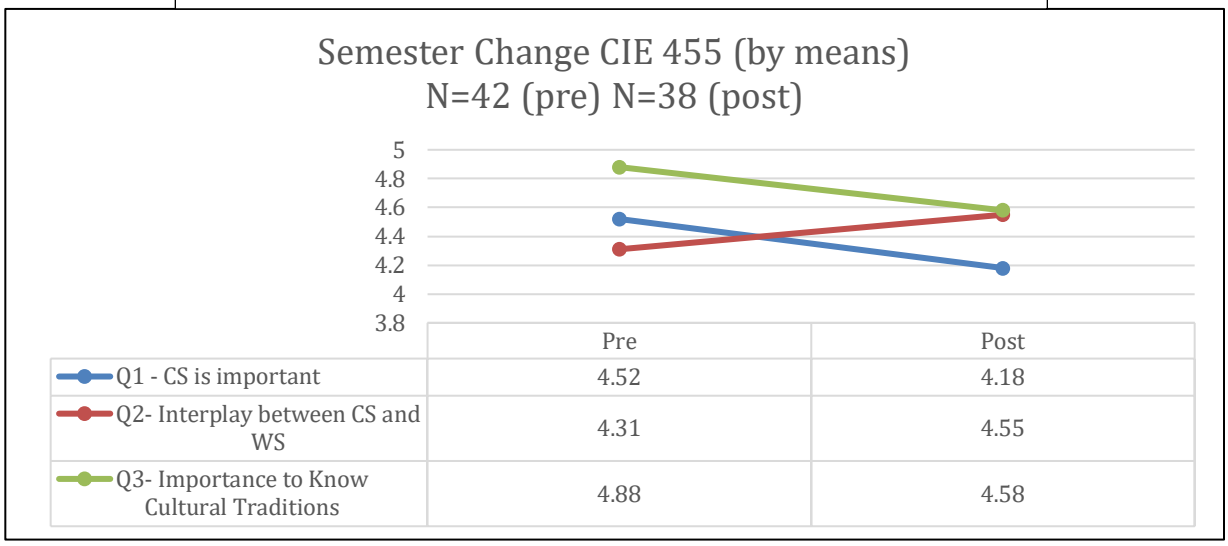


The mean for the three questions above shows that two of the three reflected a downward trend between the pre and the post. The table below shows the means.

Table 4.11 Mean for CIE455 Q1-Q3

Mean for CIE455		N	Mean	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Q1- CS Importance	Pre	42	4.52	4.06	4.99	2	7
	Post	38	4.18	3.68	4.69	1	6
Interplay b/t CS & WS	Pre	42	4.31	3.89	4.73	2	7
	Post	38	4.55	4.15	4.95	2	7
Importance to know cultural traditions	Pre	42	4.88	4.48	5.28	2	7
	Post	38	4.58	4.13	5.03	2	7

Figure 4.16 CIE 455 Semester Change by means



The means indicated that two of the three questions, Q1 and Q3, showed a drop from the pre to the post. It was interesting to note that Q2 showed a slight increase. Follow up with interviews or focus groups would have been helpful as it related to the results. This is a challenge when the curriculum is presented the last hour of the last class.

The ANOVA results for this class were:

Table 4.12 ANOVA for CIE455 Q1-Q3

		Sum of Squares	df	Mean Square	F	Sig.
Q1- CS Importance	Between Groups	2.301	1	2.301	0.996	0.321
	Within Groups	180.187	78	2.31		
	Total	182.487	79			
Interplay b/t CS & WS	Between Groups	1.179	1	1.179	0.705	0.404
	Within Groups	130.371	78	1.671		
	Total	131.55	79			
Importance to know cultural traditions	Between Groups	1.82	1	1.82	1.046	0.31
	Within Groups	135.668	78	1.739		
	Total	137.488	79			

Again, this indicated that there was no significant difference between the pre and post questionnaire responses.

What was surprising was that the engineering students initially thought CS was very important. I am not sure if this was because they actually knew what it meant or that it sounded interesting. Even the pre questionnaire mean indicated that students thought CS relationship with western science was moderately important. This was a class of students with whom that I would have wanted further engagement to try and understand their perceptions and attitudes before and after their exposure to the course material.

Reflections.

This class did not have reflections associated with the curriculum.

Comment.

One of the interesting aspects to this class of students is that engineering students take a very specific curriculum with a focus on acquiring a professional engineer's license upon graduation. There is little room for deviance from the curriculum. Even with a very willing and eager faculty member looking to fit a CKK into the schedule, it became a challenge. Time became a challenge as well. These were similar concern with SFR courses even though there

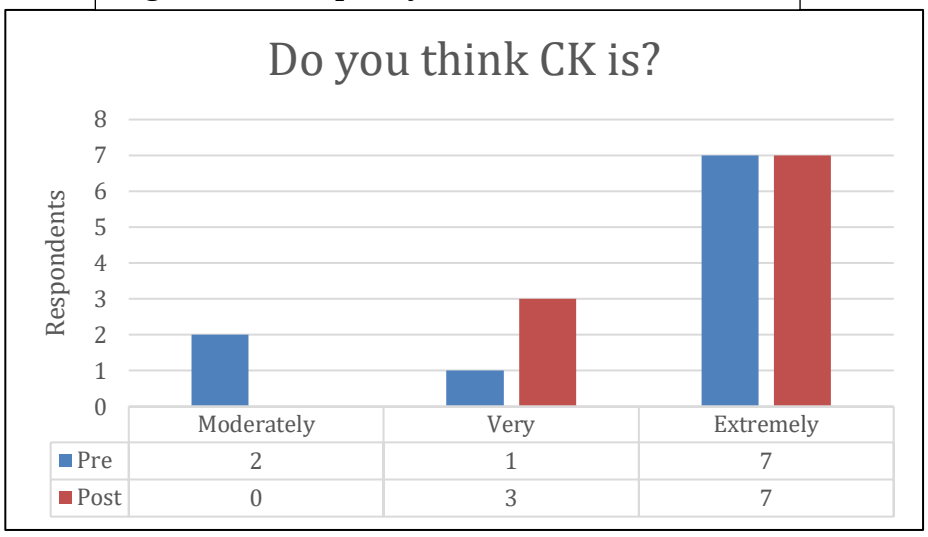
was flexibility with regard to the readings and presentations. These issues have the potential to impact the next phase of the grant, implementations of the Best Practices.

Indigenous Science Across the Curriculum (ANT 290/NAS 201/SFR 345).
This course content spread across three programs, Anthropology, Native American Studies and School of Forest Resources. It was a diverse class of 10 students with half self-identifying as Native and half as non-Native. In addition, there were three former WaYS students in the class.

Questionnaire Responses.

Q.1 As it related to the first question, it was not surprising that the class started out at a higher level of understanding. The majority of the students indicated initially that CS was extremely important, seven of the 10 students. Of the remaining three, two felt it was

Figure 4.17 Frequency results for ANT 290; Q1.



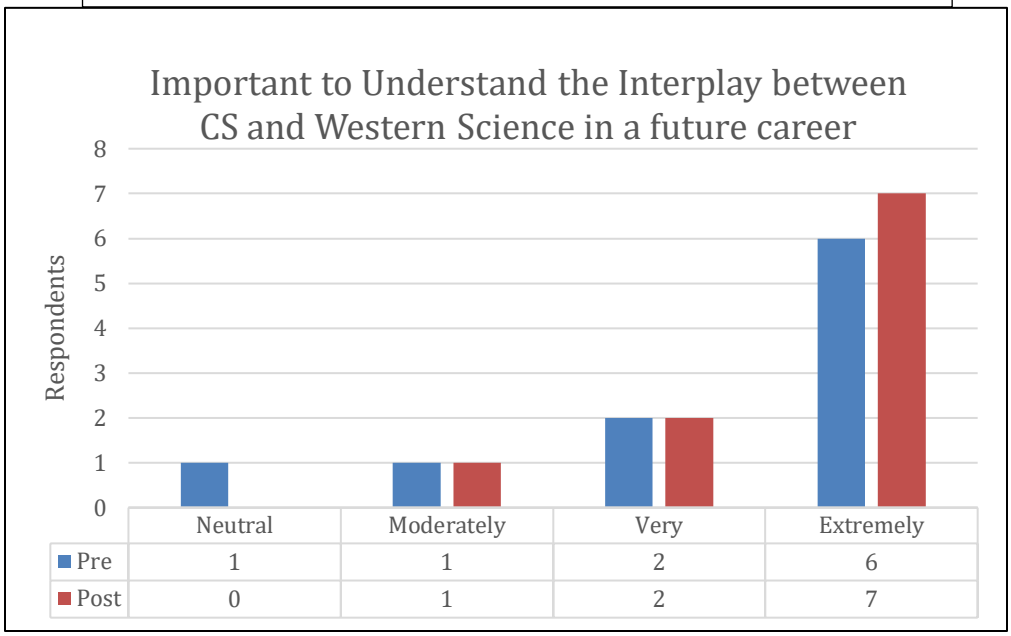
"Moderately important"

and one felt it was Very important. Little changed in questionnaire responses after the semester with seven students still feeling that CS was Extremely important. The only change was that now all three remaining students felt that it was Very important.

Q.2 With the second question, six students initially felt that the interplay between CS and western science as it related to their future career was Extremely important. One person felt

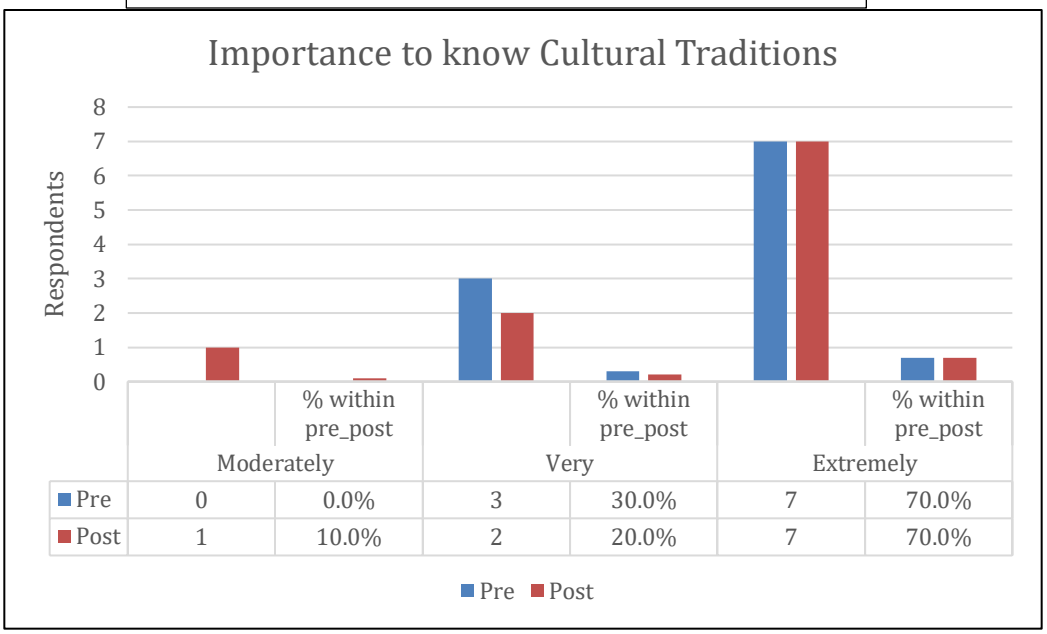
Neutral about it initially and another student felt that it was Moderately important. With the post questionnaire, one student still felt that it was moderately important, but seven students felt that it was Extremely important. Two students remained consistent with thinking that this was Very important. These responses are shown in the accompanying chart.

Figure 4.18 Frequency results for ANT 290;Q2.



Q.3, the final question, asked students about the relevance of knowledge about Cultural Traditions as part of their future. The pre-and post-questionnaire responses are shown in the chart below:

Figure 4.19 Frequency results for ANT 290; Q3.

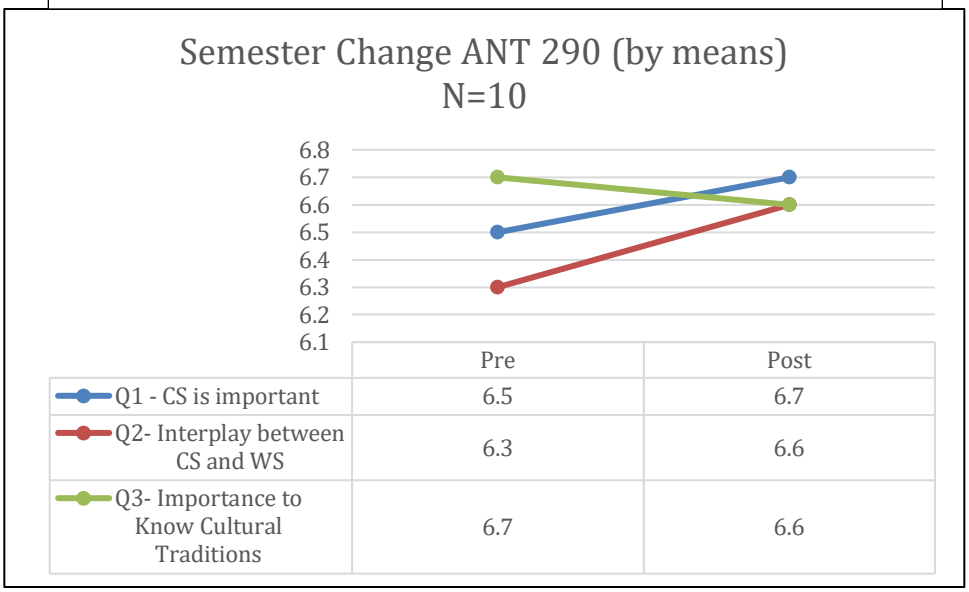


As shown in the table below, the means for the three questions above shows a positive change.

Table 4.13 Means for ANT 290 Q1-Q3

Mean for ANT 290		N	Mean	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Q1- CS Importance	Pre	10	6.50	5.89	7.11	5	7
	Post	10	6.70	6.35	7.05	6	7
Interplay b/t CS & WS	Pre	10	6.30	5.54	7.06	4	7
	Post	10	6.60	6.10	7.10	5	7
Importance to know cultural traditions	Pre	10	6.70	6.35	7.05	6	7
	Post	10	6.60	6.10	7.10	5	7

Figure 4.20 Semester Change for ANT 290 by means



The ANOVA for this class calculated the following:

Table 4.14 ANOVA for ANT 290: Q1-Q3

		Sum of Squares	df	Mean Square	F	Sig.
Q1- CS Importance	Between Groups	0.200	1	0.200	0.419	0.526
	Within Groups	8.600	18	0.478		
	Total	8.800	19			
Interplay b/t CS & WS	Between Groups	0.450	1	0.450	0.559	0.464
	Within Groups	14.500	18	0.806		
	Total	14.950	19			
Importance to know cultural traditions	Between Groups	0.050	1	0.050	0.138	0.714
	Within Groups	6.500	18	0.361		
	Total	6.550	19			

This result is above the threshold for being significant between pre and post questionnaires, although in this case, the class was starting at a high place initially so it would be difficult for there to be enough change to be significant between the pre and the post.

In addition, there may be some concern about the small number of respondents (n=10) with this group of students. ANOVA will technically work when you have one value more than groups, which I have. I felt that it was important to utilize similar analysis to insure validity. Working with Dr. Carly Sporanski, Assistant Professor at University of Maine, Dr. Sporanski focus is on the social impacts of resource management – the community interactions, the human dimensions of natural resources. She also taught the SPSS course that I took. Over multiple conversations during the Spring 2019 semester, various analyses were proposed and implemented based on her guidance and tutelage. It appeared that utilizing an initial alternative based on group numbers, means and standard deviations specifically designed for small numbers accessed via the web (Loper, 2019) provided nearly similar results to the ANOVA. I elected to utilize ANOVA for consistency throughout the research.

Whichever quantitative data tool utilized with this small number is not the critical piece to this research. At the core this research looks at the value that is added by the students input through reflections, interviews and/or focus groups. The questionnaires provide a one-dimensional view of the data which does not tell the whole story.

Which is the ultimate reason for this journey – ensuring the whole story is shared by all the voices involved on an equal basis. Students developed reflections/Annotated Bibliography based on their readings. There were no specific questions given them for responses that had been developed by the faculty member or CKK. This information will be invaluable for the next phase of the work as it relates to the contextual framework of incorporating CS into academia, as

opposed to the current focus on the relevance of incorporating CS into the classroom to enhance learning. What was important from this class was the focus group discussion.

Focus Group.

This group of students met with me on April 30, 2019. This was an opportunity for me to learn from the students if they felt the inclusion of CS into the curriculum enhanced their learning and was included in this study. The discussion was recorded with student permission.

One question in particular that mimicked Question 2 (regarding the interplay between CS and western science and the relevance it has to learning) solidified the need for incorporation of CS to enhance student learning, both Native and non-Native. Students responses included:

> It allows for a different perspective .. it could be considered a better perspective. It allows you to see away that ,oh I am just not going into the woods to cut down trees. There are a lot of other things involved. This class could replace one of the classes that exist in the forestry curriculum[referring to a specific SFR course] ." "Basically what happened in that class we just looked at case studies looking at parks. Somehow that is basically all that it was." The student felt that it was missing something and that it "could have included a lot more stuff like this [CS].
>
> (Undergraduate student, Native)

> It adds like an ethics to western science that isn't necessarily really there. I think for people who are non-Native this is good background information for them to have when going out no matter what field they go in to." "Wherever I go .. I want to be able to bring my native background to view to hopefully sway some people's education.
>
> (Undergraduate student, Native)

> Before this class, not that there is only one way to do anything, I wasn't aware of the other way things could be done. This information is more than just important for people going into science, the more people know in general, it will reach .. it will have a wider reach and more people will care about it.
>
> (Undergraduate student, non-Native)

Aggregate Trends.

The final analysis compared all the class responses by question, pre and post, to see if there was any significant difference. I used ANOVA to accomplish this as I had with the individual classes. By looking at the aggregate, the view is similar to an entire city's perception

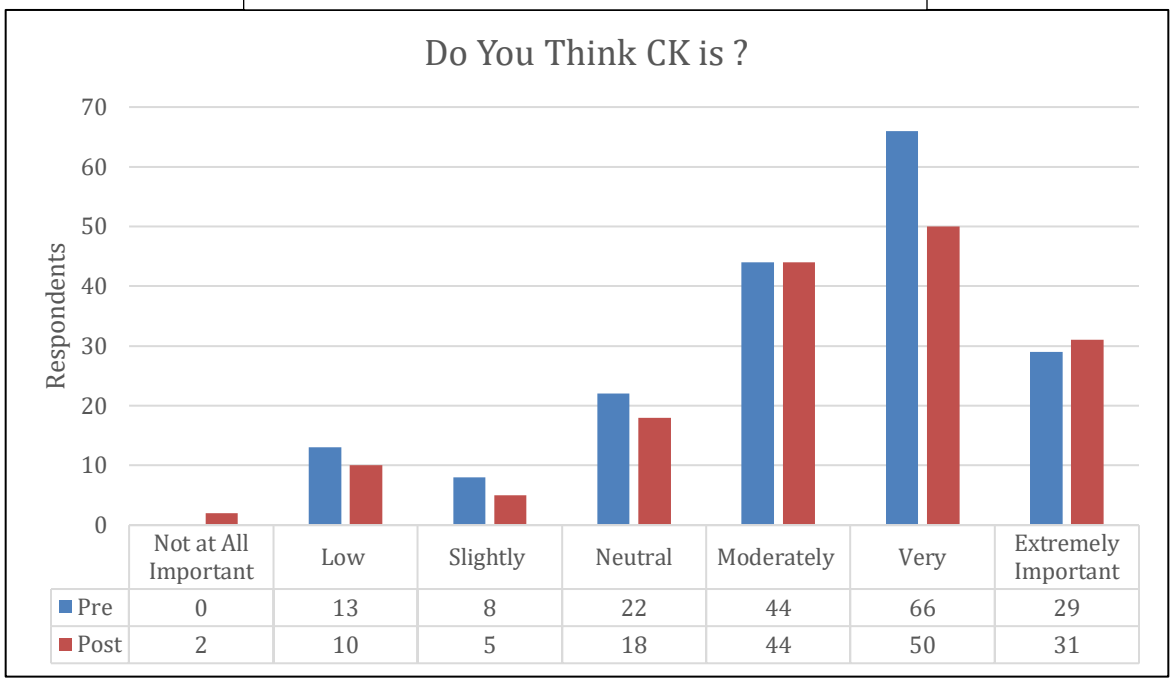
versus the communities within the city. A global view provides a larger perspective and the potential for change to occur as a collective group versus individual communities. This could prove to be important when looking to garner collective action to implement curriculum change. More collective voices can help bring about change because "[i]f we don't speak up, then no one will know we are here" (Rose Mapendo – Pushing the Elephant).

The results of the aggregated question are below:

Question 1 – CS is?

Overall, the five classes showed consistency between the pre and the post questionnaire. Students believed that CS was moderately important to extremely important with the majority of students saying it is very important (74% pre questionnaire, 80% post questionnaire). When comparing the means and looking at statistical significance, as an aggregate between classes, pre and post, there was no statistical significance.

Figure 4.21 Frequency results for Aggregate Q1.



It is interesting to see that as a group, the majority of students (139 of the 183) felt that knowing CS was moderately important to extremely important to start with. This shifted little during the semester with 125 of 157 students. It remained at 76% of students participating felt that CS was moderately important more so by the end of the semester.

ANOVA analysis showed that there was no significant difference though, indicating that there was not enough shift between pre and post questionnaire to be significant.

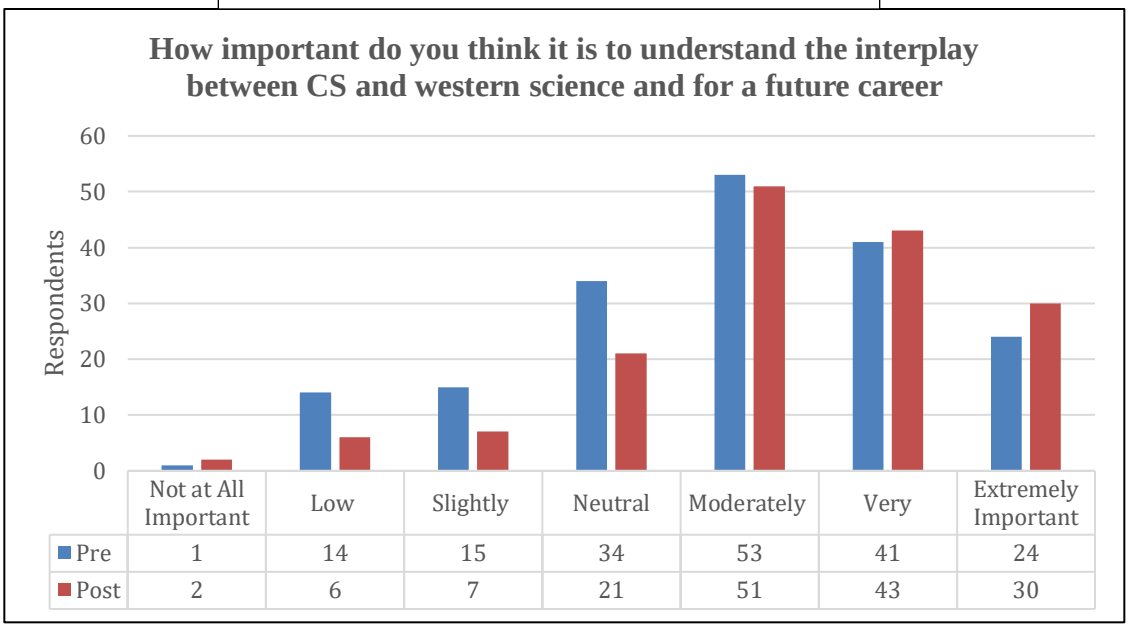
Table 4. 15 ANOVA for Aggregate Q1

		Sum of Squares	df	Mean Square	F	Sig.
Q1- CS Importance	Between Groups	0.200	1	0.200	0.419	0.526
	Within Groups	8.600	18	0.478		
	Total	8.800	19			

Question 2 – Important to Understand the Interplay between CS and Western Science

The majority of the student, both pre and post questionnaire, was similar to Q1 as to feeling that it was moderately to extremely important, 65% and 77% respectively.

Figure 4.22 Frequency results for Aggregate Q2.



The Anova noted a similar analysis for Q2, noting there was not a significant difference or change between the pre and post questionnaire.

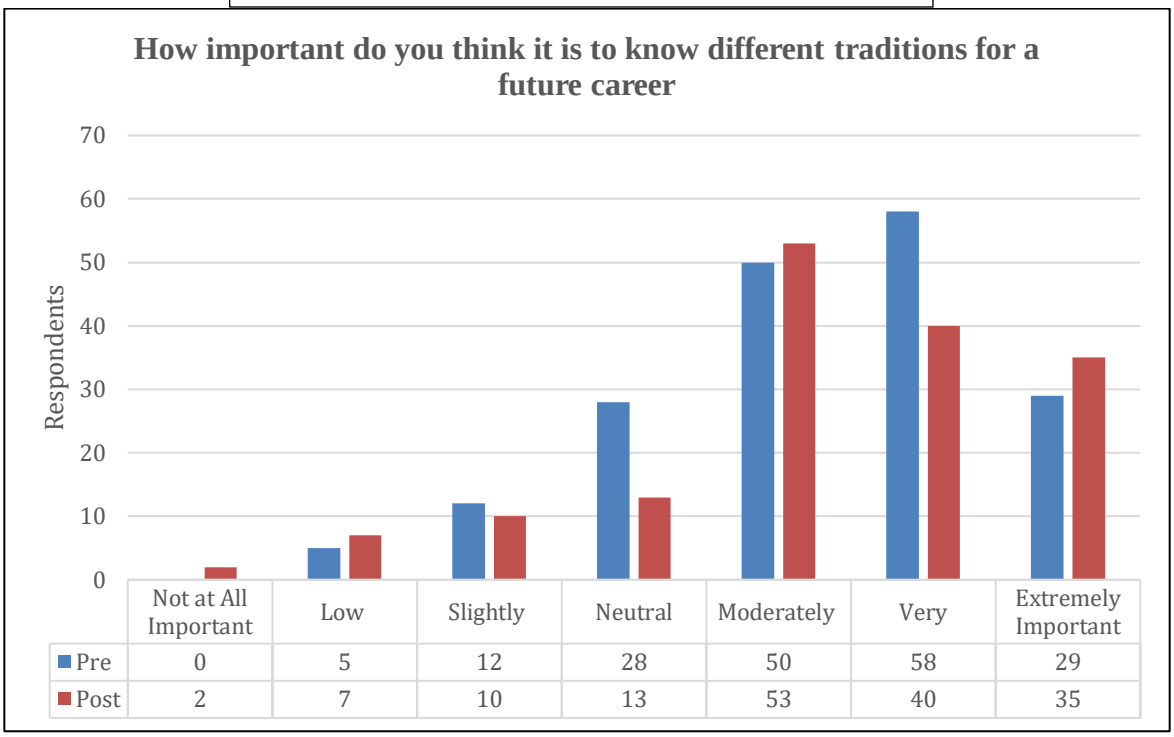
Table 4.16 ANOVA for Aggregate Q2

		Sum of Squares	df	Mean Square	F	Sig.
Interplay b/t CS & WS	Between Groups	0.450	1	0.450	0.559	0.464
	Within Groups	14.500	18	0.806		
	Total	14.950	19			

Question 3. Importance to Know Cultural Traditions

This last question reflected the similar trend with the first two questions with the majority of the classes clustered between moderately to extremely, 75% for the pre and 80% of the post. With this question the peak was at very important.

Figure 4.23 Frequency results for Aggregate Q3.



There was no significant difference as it related to the change within the aggregated classes.

Table 4.17 ANOVA for Aggregate Q3

		Sum of Squares	df	Mean Square	F	Sig.
Importance to know cultural traditions	Between Groups	0.050	1	0.050	0.138	0.714
	Within Groups	6.500	18	0.361		
	Total	6.550	19			

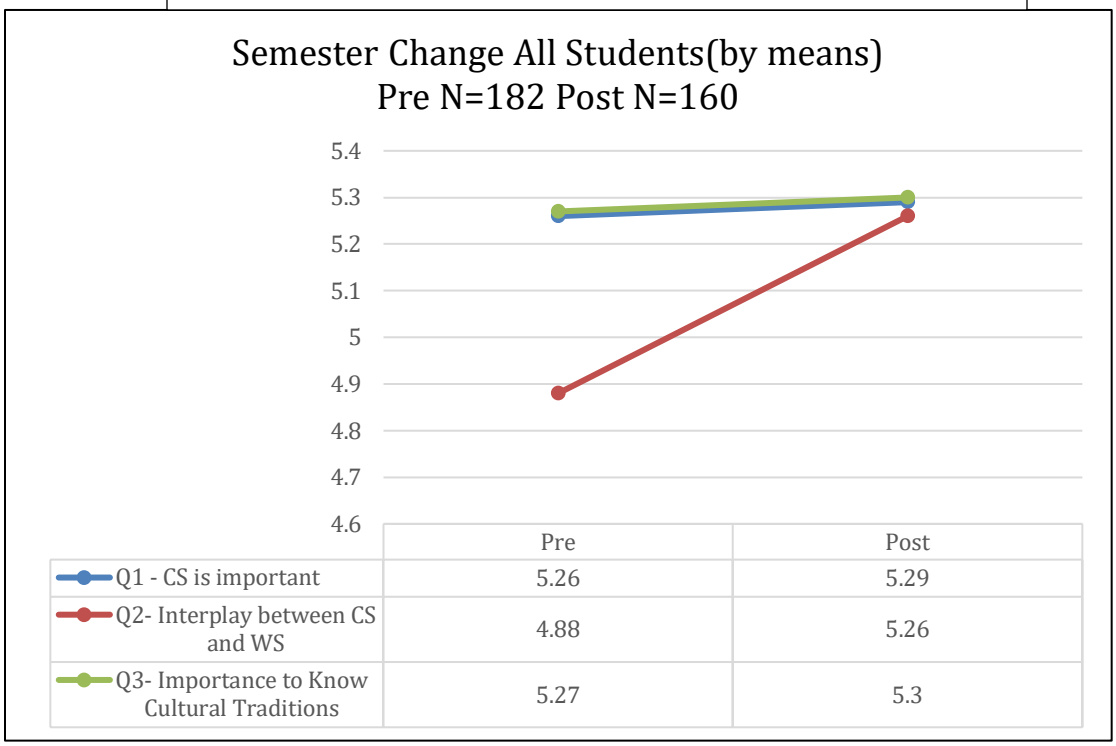
The final data analysis looked at overall mean for the three questions as an aggregate. I felt that it was important to look at as a collective group as it related to CS question as a whole, where were the benchmarks, where were students starting from and ending up as a collective voice.

The results showed the following:

Table 4.18 Mean for Aggregate Q1-Q3

Pre	Mean	5.26	4.88	5.27
	N	182	182	182
	Std. Deviation	1.372	1.431	1.248
Post	Mean	5.29	5.26	5.30
	N	160	160	160
	Std. Deviation	1.420	1.343	1.404

Figure 4.24 Semester Change for Aggregate by means



The data indicates a positive change between the pre and the post questionnaire, with the most significant change occurring with Q2. Why Q2 sparked the change needs further research. It would be important to understand what it was about this question for students that initiated such change.

The reflections helped support that overall, students felt that inclusion of CS in the curriculum was of value.

Utilizing NVivo to quantify the reflections and learning based on student reflection, the code hierarchy summary below.

Table 4.19 NVivo Codes for Aggregate

Codes	Number of coding references within files	Number of items (files) coded
Change in ideology	33	29
Change in perception	131	102
Enhanced learning	338	227
Relevance of TEK	166	122
Not enhanced learning	7	7

The WaYS Students.

Questionnaires.

The four students interviewed also participate in the questionnaire. They were given only the post-questionnaire as all of them had already participated in similar questionnaires during prior earth camps in high school and they have already been introduced to the topic of CS. There were three women and one man who were interviewed.

The questionnaires showed one thing for all the participants: They all answered all three post questionnaire questions as "extremely important. Providing a graph would not be of value in this instance.

The Interviews.

Within the interviews, students shared details how the inclusion of CS has enhanced their post-secondary education. As an example, one student mentioned "it [WaYS] has helped out a lot actually because in classes here at the University I feel like I know a lot more going into them especially ones that are geared towards plants or just like things that we talked about at earth camps and stuff. I feel like that I have been really well prepared when it comes to stuff like that and going over dbh[diameter breast height] and things that we have done through internships

have been really helpful for classes and like that kind of like I know how to do it already going [in] to them".

A number of students shared how participating in WaYS in high school, helped with the transition and academics in college. A second student said "It's made me a lot more interested. Obviously with the WaYS program when we learn about medicinal plants we need to learn the scientific aspect too. We need to learn where it grows, how to identify it."

Four interviews were conducted. Six questions were asked of each interviewee with a couple of questions being expanded upon based on the direction of the discussion (ex: Question 5 with Student 1).

I did seek clarification from each student in order to improve the questions in subsequent interview. Because of the familiarity I had with these particular students who had been a part of WaYS for many years, I had high confidence that they would be honest with me. And I believe they were. Minor editing occurred from the first interview to the second interview as Traditional Ecological Knowledge (TEK) was changed to Cultural Knowledge (CK). I am using CS to mean the same thing.

Rubin and Rubin (2012) mentioned that the initial interview process could "start the coding with concepts and themes that you explicitly asked about" (p. 195). The initial foray into coding the interviews did lead me to have two major themes, connection (to land) and culture. Students felt that CS reflected a connection to who they are through having Cultural Knowledge/TEK. The second theme is culture. TEK/CK raised the students awareness of what culture was with examples including drumming, singing, dancing. This is highlighted with examples:

Student 1 shared “it’s knowing the history of where I’m from and relating that to science.”

Student 2 felt that “Indigenous knowledge is culture”.

A code classification chart related to the interviews was created for help guide further analysis. This is in Appendix E.

Student Responses to Specific Questions

During the interviews, students shared a number of insights that helped develop the coding themes. In particular, when asked “How has including TEK/Cultural Knowledge in your science education helped you?”

One theme came out strongly, having the culture connection that enhances the science education for Native youth. Including TEK/CK as a part of the knowledge base allowed students to have a more holistic approach to the western science perspective. To paraphrase Student 1, they felt that knowing TEK helped them not only know how to identify the plant (western science) but what part of it was used to for medicinal purposes. This brought more contextual life to the plant than just reading it out of a book.

This was reinforced by Student 3. Her thoughts were “Everything is changing and we obviously can't live the way that we used to -- we can't escape western science and we don't want to and I think that it would be really beneficial to understand how they go hand in hand and how the Natives were practicing science and people didn't even realize it and how it was a lot healthier for the earth and how we can do that now with more back up from western science and show that what they were doing was actual right. Then we can learn more through science but also having like the culture aspect [so] I feel you are more connected to the earth and what you are doing.”

The students that were interviewed, as indicated in the methodology were selected because they had been long term participants of WaYS high school program and now in college. Their input and voice was important to be shared to understand from their perspective what has helped enhance their learning. Through their eyes, the WaYS model has helped enhance their learning. Replicating this where feasible within postsecondary education may well enhance the learning of others.

Talk Story (if I may)

There are two stories that have come out of the observations related to the specific focus of enhancing learning for Native and non-Native youth by including CS. One story was from a CKK who participated in SFR 107, Fall 2018, and his unexpected value as a teacher of his culture. I felt it was important to share his insight. The second story is about Erik (pseudonym) who was in two courses that were a part of the study, SFR 479 and SFR 477.

Valuing One's Impact.

It was Fall 2018. We were waiting for Dr. Livingston's SFR 107 students to gather in one large classroom as a pre-meeting to the lab. There was a small group of us, four CKK and myself, chatting casually in the hallway of Nutting Hall prior to dispersing to the different classrooms or outdoor venues where each CKK would have a group of students for a specific amount of time to share their knowledge about a specific topic. Two of the CKK had helped with a freshmen forestry course in the spring 2018 to share their knowledge, in this case about pounding ash. Neither CKK had been involved with teaching before and was not sure this would be comfortable for them. This opportunity was small enough to fit within their comfort structure and also provide insight if presenting ash pounding would be of interest to the students. It was an opportunity for a trial run.

One of the CKK shared during the time we were in the hallway the fall 2018 SFR 107 class, that he had had mixed emotions after the spring course. He didn't feel like he had connected with the students. There had been no useful preliminary information that had been given the students prior to his arrival and presentation. It was more like – here, show up, do your thing and leave. Oh and thanks.

Understandably, this CKK didn't feel like it had been a really good fit for him. I had chatted with him and the other CKK presenter right after the Spring course to see what their thoughts were, what worked or didn't work. I asked what could be done differently the following Fall (2018), when the official research would be kicking off.

Based on that conversation, we did change how information was presented in the Fall 2018, course and we included, with the help of Ms. Greenlaw, specific lectures prior to the labs to provide students with more of a foundation to what would be happening in the lab and to give the students information for asking relevant questions. The CKK agreed with this plan.
But still …even after he left in the spring, he shared that he had reservations about participating.

Until he was at a local fair during the Summer 2018. At the fair, three students from the Spring 2018 forestry class came up to him as he was displaying his baskets at this fair. The CKK could not get over how enthusiastic the students were, how much they had remembered and shared back with him, but also, they thanked him for his time. That single encounter with the students changed his perception as he approached the Fall 2018 class.

He shared that he felt better about sharing with the students, even if it wasn't evident that they were "getting it" that day. The connection had been made - even if it hadn't been felt immediately. From his expression and eagerness, you could see that it was important to him and why he came back in the fall. (Personal reflection 11/5/2018).

Enhanced Learning.

I will be honest, with as many reflections that needed to be read, if a student's name was there it didn't register. Content, yes. Themes, yes. Names, not so much. But as I was going through the detail of the reflections, I kept coming across "oh wow" moments. There were many of those but when I went back through to synthesize the reflections further, one name was constant, Erik. Erik seemed to epitomize what I feel we are working towards - bridging a gap in science to enhance learning through CS to give students, both Native and non-Native, a more holistic and broad perspective. Erik's reflections, when one can take a step back and view them from the lens of a student and the changes from the student's perspective, help to cement this work. Some examples are below. I submit them in a sequence from early reflections in Dr. Daigle's to later reflections in Dr. Crandall's. This spans two semesters.

The first quote, by way of background, is in response to readings in Nash's Wilderness and the American Mind (2014).

There was definitely a lot to process from these few chapters varying from economic ventures to transcendentalism. However, I think the most interesting idea of these chapters, besides the idea of venturing out to nature and treating it as though it were a religion, would have to be the non-inclusion of the Native Americans by Nash. My group did not talk about this and I did not think about out while reading, but when another group in class was sharing their findings, they mentioned how Nash refused to mention how the Native Americans had been worshiping and appreciating nature all along and did not get any praise for it. Not that Native American people necessary want praise and or fame for being people who respect nature, but it would have been nice if the author had decided to mention some positive attributes about the Native American culture at this point in the text. Reflection 2/1/2018

The second quote is from reading Daniel Wildcat's Red Alert (2009). Specifically Erik is referencing Chapters 3 & 4.

> In these two chapters, alongside the supplemental material, I was really interested in the connection of cultures to the environment. Though it makes so much sense now, and seems almost common sense, I never had the idea that culture was so tied to the natural environment in which people live and interact. The video in class as well as the readings and discussions on sweet grass have

helped me formulate this idea into my knowledge and I think it is an idea and concept that I strongly agree with and will communicate to others in conversation and in writings. I think raises an interesting question, however, whether if moving people does destroy or alter their culture? I am thinking back to the Industrial Revolution time period when many people from all different cultural background were moving to the Americas and attempting to bring their culture with them to the melting pot that is America. I would argue, that even though they were in a totally different natural environment, they were still able to succeed in transferring aspects of their culture; it may not be the entirety of the people and the past culture, but there are also new aspects as the melting pot worked its wonders and mixed different cultures together. This could be perhaps though how the Indigenous people and Europeans/ Americans differ as we do not look to nature for our culture as much as the Indigenous. I cannot help but think if the Native Americans had sailed across the Atlantic first and colonized Europe somehow, the world would be a very different place than it is today. And I think this would be the only way for Indigenous Knowledge to have the strong involvement that Wildcat desires and asks of man."

Reflection 3/30/18

Class was very interesting today and greatly helpful in understanding the topics we have been researching lately. The smudging had to be one of the greatest cultural experiences I have had at college and will be one that I will remember into my adulthood. I have already shared the experience with my coworkers and my mother and explained to them what the purpose of smudging is and why it is important. It is hard to explain a culture that is so different from ours and I find myself struggling for words sometimes when trying to express the culture in conversation; this is something we touched on today in class. Our American culture is so strong with using words and ideas and concepts as concrete, correct points with little to no variances in meaning or purpose. This creates a culture that is very cut and dry and unimaginative. Whereas the Native American culture does not use words as things, it uses descriptions as things. I liked the example of a table is a table in English, but in Passamaquoddy culture a table is a tool in which to hold plates and to work upon; this give[s] meaning to the table and makes the table significant within everyday life. By giving a description to the table, the table is given life and a purpose.

Reflection 04/10/18

Traditional Ecological Knowledge (TEK) is slowly being incorporated into modern forestry systems and is being embraced for its overall knowledge of sustainable practices as well as its ability to act as a co-management body. TEK stems from the Native American view on the ecosystems within the American continent and is supported by a past of many millennia where Native American populations managed the forest prior to colonization; the forest that was "discovered" by the colonizers was actually a forest that was being managed by the

> Native American populations present through use of fire and other best management practices (Crandall, 2018). Being the original forest managers, TEK should be valued for all it has to offer for the fact that it was guiding the forests of America for centuries before the colonizers cut down their first trees (Fraver, 2018).
>
> TEK is a different view point on forest management, stemming from a culture that evolved differently from European colonization and is a collection of cultures, in its entirety, that believes in sustainability and living from the land; not simply attempting to turn a profit and exploit the land. Within TEK there is a vast history of knowledge, there are practices that are sustainable, there are practices that give back to the land, there are practices that more sustainably beautify and protect the differing components of a forest ecosystem (water, soils, wildlife, et cetera), and there is a cultural connection to the land (Daigle, 2018). TEK is experience and knowledge, whereas modern forest management is efficiency and technology; but both are needed to provide the greatest amount of product, sustainably. To summarize what TEK can bring to the table and the value of incorporating TEK into modern forest management, there is not a simple answer, but to make an analogy, incorporating TEK into modern forest management is like asking an older sibling to guide you while you attempt to ride a bike for the first time; they already know the mechanics and functions, have a few secrets and tricks up their sleeves, have a few healed scars and stories, and have been doing it much longer and have much more experience.Reflection 11/11/18

> By following TEK and a natural disturbance regime, the different nations have been able to see populations return and populations numbers rise (or have started the wheel). This is starting to be introduced and managed for more frequently in institutionalized, commercial forestry, but should be more common place. Based on land owner objectives, foresters can play a crucial role to the establishment of healthy, complete habitats for threatened and endangered species of plants and wildlife.
>
> An important theme that should also be mentioned is the idea of balance across the different branches of management. As managers, we should not be managing all of the forested land strictly for one specific outcome. We can allow different sections of land to be managed differently for different outcomes and different principles (such as in TRIAD). According to the different TEK presented, we can manage for wildlife, human dimensions, production, economic returns, ecosystem service, and preservation across our landscapes. Reflection 12/5/2018

His stories resonated change which I wanted to share which spoke to the core of what this project was about, enhancing learning. When I read through these I get the sense that this student has had that “aha moment” and will continue to seek out a more holistic approach to management but also have a broader understanding and respect for CS that would not have

occurred without the inclusion of CS in the curriculum. In particular, in the March reflection, he wrote “I never had the idea that culture was so tied to the natural environment in which people live and interact.”

There were a number of students that had similar comments such as “I never had the idea” or “It never occurred to me” or “I learned” which leads me to intrinsically or qualitatively understand that there have been some transformational moments within these classes. This understanding is also based on observations. To quantify this, I went back to NVivo. In doing a word search f or “I learned” students had mentioned it 259 times in reflections. For some, this number may be important. I believe the reflections speak volumes for what was truly learned.

Lessons Learned

Overall, based on the questionnaire’s and the reflection, student experiences have changed and become more receptive to the value of CS and other ways of knowing. It will necessitate continued examination of the role that inclusion of CS may have within post-secondary education and student’s future endeavors. The results, both qualitative and quantitative, reflect an overall positive change with regards to non-Native students enhanced learning as a result of having CS integrated as an equal part of the course curriculum. Through the WaYS students and the students in the ANT290 class, their voices have strongly reinforced the benefits to them based on the interviews and focus groups shared.

The results did raise more questions. As an example, why was there a change as it related to Q2 when the classes were aggregated? I would also like to go back and ask the CKK that were involved if this would have been what they had expected for results, why or why not? This perspective and voice will be critical as this research moves forward with the development of the Best Practices. What would be their thoughts, which has not been heard with this study.

There were challenges that surprised me. One was the degree of control professional licensing has over some curriculums. This does not directly effect the study's questions but it will effect how CS may (or may not) be integrated within a given curriculum, which may ultimately effect student learning. As noted earlier, the necessity to meet licensing requirements, was observed in the engineering class as part of the limitation for the inclusion of CS. There was little room to fit CS in. It was also expressed by the faculty member teaching the freshmen forest vegetation class, SFR 107. the School of Forest Resources is a Society of American Foresters (SAF) accredited school. As such, there are specific guidelines that students need to meet for professional licensing that require graduation from a SAF accredited school.

A final lesson learned as it relates to the research was the different methods that were taken by the faculty and CKK in order to accomplish similar outcomes. SFR 479 was completely invested in co-teaching, co-development and multiple presentations by the same CKK (except for one). SFR 477 was not. This latter course followed a format aligned with multiple one-time guests with integrated readings. SFR 107 followed a more structured format. CKK presentations happened when the tree aligned with a Cultural Keystone species (ex: Birch, Ash). ANT 290 had multiple case studies that revolved around one-time guest lecturers.

Though there were different manners in which they were presented, there were clear benefits to having CKK present. This information will be helpful in the next phase with the development of Best Practices. But it is important to acknowledge that in whatever format it is presented, students benefited from the connection with CKK and it enhanced their learning and their perspective.

CHAPTER 5

KA LĀ HIKI OLA:
"The dawning of a new day."
The value of hope and promise.

Introduction

To follow the western paradigm this would be the "Conclusion" section. It would include, at a minimum, three sections called research objective, recommendations and contributions to knowledge. Check the boxes.

It would not start with " The dawning of a new day" or in Hawaiian, ka lā hiki ola.

First, it is difficult to fathom that this is the "conclusion" of this study. I don't perceive this to be anywhere near the end. In fact, I see this as a new day, thus the chapter title. I feel like I have made a brief stop along the river, perhaps in need of a rest, but awaiting to see what is around the bend with the new information that has been learned. In one sense it is quite exciting, even exhilarating. It could also be an abyss --- the flip side --- because of the potential labyrinth of change in behavior that may be required. Or, maybe it is a plunge pool that awaits around the bend?

I'll try and do my best to check the last of the boxes.

Research Objectives

The information that has been gleaned from the questionnaires, the reflections, observations, interviews and focus group provide interesting as well as important perspectives with which to continue this journey. The main question that was initially asked - if the inclusion of CS would enhance Native and non-Native students learning (which may be more fluid than originally conceived) in post-secondary science education, the answer would be simply, yes.

Based on the means from the pre and post questionnaire, both Native and non-Native students felt the inclusion of CS within their course work enhanced their learning. Question 2 saw the most increase within the classes. This will require further research to answer the question of why this increase revolving around question 2. Was it the wording or something else?

The quantitative data based on means showed significant difference, though slight. What enriched and substantiated the results were the reflections and interviews – the qualitative aspect. This additional data validated the importance of including CS within specific course curriculum to enhance learning for Native and non-Native students. Without this additional perspective, the research would not have had the depth of knowledge and information from the students.

Box checked.

Recommendations

Based on what was observed, read and analyzed for this study, students seemed to take in information when a CKK was involved whether it was a one-time interaction with the CKK or multiple times. The last two years of this graduate study supported by 30-plus years of personal observation --- that many students are eager to learn --- have also reinforced the conclusion that CS is advantageous for both Native and non-Native students. Native youth would have the added benefit that CS provides reinforcement, validation and acknowledgement of the value of CS. This is a critical piece that is currently missing within many predominately white institutions (Makomenaw, 2014; Mayhew et al., 2005).

How rich the student experience is, could be determined by curricula structured by the faculty working with CKK. For example, evidence indicates that the structure provided by SFR 479 with multiple CKK contacts and group discussions enriched the students' learning of CS.

Learning still occurred, but to a lesser degree, with students in courses with less CKK contact such as in SFR 477 and SFR 107. Ultimately, the design of the curriculum comes down to the collaboration between the CKK and faculty member. That connection is paramount.

Another recommendation is to offer a class similar to ANT 290 that is required for all environmental studies students. There is precedent for this at other predominantly white institutions such as the University of Vermont. With such a course, the CKK would be able to develop their own curriculum, there would be multiple connections, and all students would be afforded this learning opportunity. Box checked.

Contributions of Knowledge, or, the Next Leg of the Journey

Through almost daily interaction with community members on some level and more intensely while working with students at mini camps and week-long earth camps over the last six years, I have developed a level of trust among many Native participants. This real-life experience and the knowledge that this mutual trust created will continue over the coming years and will help maintain the persistence needed for the commitment to this project of study.

Additional information, gleaned beyond what has been described here, will help with the next steps of this journey. For starters, the baseline information from this study will be utilized in the next phase of the INCLUDES grant to assist in the development of Best Practices to include CS within post-secondary education. Assuming that one survives this academic journey, even if it is one paddle stroke at a time.

For many months, I was already on this next leg of the journey without finishing this first leg. Intuitively and through years of observation while working with other under-represented groups it was obvious to me that inclusion of CS would enhance learning for Native

and non-Native students. This was validated through my work with the high school WaYS program. My saying it, however, has no validity. If 1000s of years of Indigenous Knowledge is often not validated, why would 35 years, the equivalent of a Nano-second, be validated?

Thankfully, with Dr. Darren Ranco's guidance and tutelage, that "aha moment" arrived -- that we needed to first prove, through the western academic paradigm, that yes, inclusion of CS in post-secondary education will enhance learning for Native and non-Native students and should be a valid component of curriculums. Fortunately, it has also been obvious to and written about by others who have validity. (Armstrong, Kimmerer, & Vergun, 2007; Bartlett, Marshall, & Marshall, 2012; Kimmerer, 2002, 2012). The knowledge gap was closing there but no numbers to quantify it for western ideology. This research has provided the bridge to fill that gap with the quantifiable knowledge. Box checked.

One of the challenges that I personally had with this research (and which has been alluded to prior), is the requirement that I compartmentalize my thoughts in order to fit into the western paradigm thought patterns. My belief systems do not align with the linear views whether in academia or outside of academia. This power struggle remains. That box is not a good fit.

The irony is not lost here that in order to make a change within the western paradigm, one has to become knowledgeable about, if not a part of, the western paradigm. Thus, this journey. As I look ahead, downstream, I anticipate that the next leg of the journey probably won't be as smooth as the first leg, not that there haven't been a few rapids and rough water along the way, so far.

Creating the behavior change needed to change the curricula may be where the plunge pool is. Many educators and faculty are excellent teachers but they have forgotten how to be

good students. They haven't had to be. Many faculty have reached a pinnacle in their career and are content. In my opinion, when we stop learning, we stop growing. I see the framework that Belcher (2002) utilized to change the paradigm at Washington State Department of Natural Resources (DNR) as a good starting point. The work that Issacs (1993) provided helps to frame the next steps in this change process.

Finally, I want to share three stories that remind me that there are daily opportunities to change the paradigms and associated behavior. They reinforce the notion that the change needed for the next steps must come from within us.

A Story: The Evaluators.

Early on in my Ph.D. program, but after the INCLUDES grant had been received, a small group of us met with the external and internal evaluators on June 18, 2018. The purpose of the meeting was to share the overarching goals of the project, develop a plan of forward movement, roles and responsibilities. The external evaluator, a man, was well recognized for his prior work as an evaluator of NSF grants, as well as for his long tenure as Education Research Director at a renowned institute. He came well qualified. The INLCUDES internal evaluator, a woman, was equally well qualified, if not more. She had spent over three decades working for a prestigious university on the east coast, was Assistant to the Provost for Community Outreach and Partnership, and the list goes on. She was thoroughly committed to change.

The meeting got started with the external evaluator taking charge. No one spoke up or objected. He then turned to the internal evaluator and asked her to please take the notes for the meeting. To say there was a pause in the conversation is an understatement. After the initial shell-shock worked through and the brain processed what had just happened, the internal

evaluator accepted the request with grace and poise that I don't think I would have had. Again, no one spoke up or objected even though I think we were all aghast at what had just occurred.

Since much of the focus of the INCLUDES grant is about changing the academic paradigm through individual behavior change (at least that is the vision) that small group had just showcased an integral part of the change process, the need for agents of change, namely, themselves.

I spoke with the internal evaluator afterwards as well as the other person left in the room. We realized that if future meetings were to happen, the "note taker" would be clearly identified beforehand and it would not be that internal evaluator. Upon reflection, there were a lot of dynamics that were happening related to the power struggle at that meeting that belies the underlying current to the next steps with this grant.

This background is provided because of the relevance it has to changing the western paradigm. This incident was almost a microcosm of what we are trying to change. I look back on that meeting with much regret. Someone should have spoken up. I bit my tongue because during my work career, prior to return as a graduate student, I tended to be a tad outspoken on this issue of women expected to fill certain roles. But I had already fallen into the box of being the "grad student," at a large, state university, and at least while in that role I assumed my comments would have no validity. I still regret that I did not speak up. My apologies to the Internal Evaluator for not speaking up. That was on me.

The incident made me realize that if change is going to occur when opportunities like what occurred at this meeting appear on the horizon, it shouldn't matter who you are; that the

right educational moment should not result in a lost leader. Which brings me to my second story.

Another Story: Graduate student role.

I am not a traditional graduate student. Truth be told, I don't do well when asked to conform or fit within others' defined expectations. This does have its plusses and minuses which exceed this reflection. Suffice to say, staying within the parameters of preconceived boxes can be way too limiting. How can one learn if one is stuck in a box all the time? I think way out of the box and I am usually two steps ahead of where I ought to be because, in my mind, I have already resolved the problem and have to move forward to the next challenge of trying to put the solution into action. Thus, as a Ph.D. candidate, my initial inability to focus on the need to define and defend the importance of CS when I was already focused on the next challenge of its integration in the academic paradigm. Didn't everyone already know that CS is important?

I also came to the graduate student role with over 30 years of work experience. Clearly, I don't fit into the typical graduate student parameters either. One would surmise that there is value in that work experience, just as there is value in CS and the life experiences that the CKKs presented to the students. It was important that many students acknowledge the lessons that were being shared by the CKK. It was even more important to understand that the CKK were gracious to share the stories. They didn't need to. But they did. That experience has value – priceless value.

It seems that when one becomes a "grad student" any work experience is null and void. The barriers go up. To me this is an odd way to function or maybe it is just my unique circumstance and institutions of higher learning have a tough time handling anomalies. But perhaps there is a correlation here with the challenges of others heartily embracing CS?

Regardless, prior to going back as a graduate student, I worked part-time for WaYS supported by university funding. With this position, I had responsibility for program development and budget administration among other things. These were all things that I had done since 1986. It was now 2017. When I decided to transition back to graduate school, it took many months for the university to fill the WaYS position I held. In the meantime, I continued to do the job plus graduate school. When someone was hired, the expectation was that the new person would work on the WaYS curriculum but I would still handle grant and financial matters, the same work I do with the WaYS organization.

Time passed. The paddling was smooth on the river. One day, while I was meeting with my immediate supervisor I learned that since I was now a grad student, the university unit that had been supporting the paid position that I formerly held, no longer wanted to work with a grad student with regards to budget matters but only with the new staff person.. I disagreed with the decision and, unlike the meeting described in the first story above, I spoke up. It was pretty clear how I felt about the matter and the fact that they were discounting my years of knowledge.

I was living my Ph.D. research.

I share this story because it highlights the inability of western academics to think out of the box and embrace some new or different things. The next phase of this project will require a hard look at how this can be done. It will require more voices to speak up. It would be sad to think that when I move from Ph.D. candidate to Ph.D. graduate that my life experience will have more validity. I still have the same amount of work experience. Why do three initials make that much difference? Why do any initials make a difference? Only within the western science pedagogy.

The Last Story: Mauna Kea.

During the summer of 2019, I was very fortunate, grateful and humbled to have had the opportunity to go to the Island of Hawai'i, aka the" Big Island," one of the five Hawaiian Islands. I had never been to this particular island but was born on O'ahu (one of the other five islands) where I spent the first seven years of my life. I am not Native Hawaiian but Hawaiian Native, also called, "Kama'aina" or child of the land. Kailua Beach was my front yard; the back drop was the Ko'olau Mountain Range. Perhaps this is, in part, why I do not understand the western paradigm.

This trip was a part of research for the next phase of the INCLUDES grant. The University of Hawaii and the Pacific Internship Programs for Exploring Sciences (PIPES) have included CS into the western science pedagogy for many years. As it happened, my time on Hawai'i overlapped with protest of the Thirty Meter Telescope (TMT) that was occurring on Mauna a Wakea (Mauna Kea), a scared inactive volcanic mountain. A Wakea is a part of the Hawaiian creation story. Wakea is the Sky father, partner to Papahanaumoku, earth mother. Wakea and Papahanaumoku gave birth to the islands. Mauna Kea is considered that child's "piko" or navel. (Excerpt from Mauna Kea-Temple Under Siege). To say Mauna Kea is a sacred mountain would be an understatement. Words are difficult to find to do the experience justice. Just being there was life-changing for me.

A valuable lesson was learned there including but not limited to the protocols and the protests, both crucial. Protocols are "a code of correct conduct, particularly within ceremonies" (Crabbe, 2002). The ceremonies happened multiple times during the day to request permission to enter a sacred place, Mauna a Wakea. Awareness had been needed to acknowledge and respect the value of Mauna Kea.

Native Hawaiians used this opportunity to share this sacred land and to help educate all people who were there. A language instructor from the University of Hawaii at Manoa realized the opportunity to educate and created “teach in[s]”. Puuhonua o Puuhuluhulu University, a community-driven educational opportunity was initiated. Topics included indigenous rights, history and a variety of other subjects taught through a Hawaiian perspective with Mauna Kea being the focus and backdrop. Classes occurred in the morning and in the afternoon. The wealth of knowledge that was there inspired this to happen.

I share this story because it is an instance where someone realized there was an opportunity that should not be wasted. They spoke up. They seized the day. They did something. Being there to see this made me realize that standing idly by accomplishes little. Many use the phrase “knowledge to action” but often times that action is slow to come because it requires a change in the paradigm; it requires a change in behavior of those in positions to make change.

The power and energy that was flowing from Mauna Kea was flowing to and from those who were there to embrace her energy. The next phase of the INCLUDES grant will need that energy and guidance as we move forward. We will need to make sure that we “Ike i ke au nui me ke au iki he alo a he alo –“Know the big currents and the little current” (Olelo No’eau 1209). Creating the change that is needed to fulfill the goals outlined in the grant will require strong paddlers.

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APPENDIX A

Pre and Post Questionnaire

Pre Questionnaire

Question 1 Do you think learning about Traditional Ecological Knowledge is ….?

☐ Not at all important □ Neutral □ Low importance □ Slightly important

☐ Moderately important □ Very important □ Extremely important □ Unsure of terminology

Question 2 How important do you think it is to understand the interplay between western science & Indigenous Knowledge for a future career?

☐ Not at all important □ Neutral □ Low importance □ Slightly important

☐ Moderately important □ Very important □ Extremely important □ Unsure of terminology

Question 3 Do you think learning about forestry is…?

□ Not at all important □ Neutral □Low importance □□Slightly important

□ Moderately important □ Very important □ Extremely important

Question 4 Do you think learning about wildlife is…?

□ Not at all important □ Low importance □□Slightly important □ Neutral

□ Moderately important □ Very important □ Extremely important

Question 5 Do you think learning about fish is ….?

□ Not at all important □□ Low importance □□Slightly important □ Neutral

□ Moderately important □□ Very important □□ Extremely important

Question 6 Do you think learning about water quality is ….?

□□Not at all important □□Low importance □□Slightly important □ Neutral

□ Moderately important □□Very important □□Extremely important

Career

Please list 3 careers that might interest you some day:

a. _____
b. _____
c. _____

Question 7 I am interested in a job involving: (check <u>all</u> that apply)

__the environment __animals __lakes, rivers, & oceans
__plants, flowers, or trees __rocks & earth __astronomy
__numbers or math __designing new things __creating diagrams
__figuring out how things work __using specialized tools & equipment

Do you think you would be interested in a future career that uses math or science skills?
___Strongly disagree __ Disagree ___Neither agree or disagree ___Agree ___ Strongly agree

How important do you think it is to know about science & mathematics for a future career?

☐ Not at all important ☐ Low importance ☐ Slightly important ☐ Neutral
☐ Moderately important ☐ Very important ☐ Extremely important

How important do you think it is to know diverse cultural traditions as a part of your future career?

☐ Not at all important ☐ Low importance ☐ Slightly important ☐ Neutral
☐ Moderately important ☐ Very important ☐ Extremely important

Personal Information

Gender: __male __ female (Please check box that applies)

Age:_____
Major: _____
Year Anticipate Graduating:_____
Undergraduate___ Graduate___

Are you Native American?_____
If yes, what is your Tribal Affiliation:

☐ Maliseet

☐ MicMac

☐ Penobscot

☐ Passamaquoddy (Indian Township) ☐ Passamaquoddy (Pleasant Pt)
☐ Other (please list):_____

POST QUESTIONNAIRE

CLASS DATE

Question 1 After this course, do you think learning about Traditional Ecological Knowledge (aka Indigenous Knowledge) is…?

☐ Not at all important ☐ Neutral/Not Sure ☐ Low importance ☐ Slightly important ☐ Moderately important ☐ Very important ☐ Extremely important ☐ Unsure of Terminology

Question 2 How important do you think it is to understand the interplay between science & Traditional Ecological Knowledge for a future career?

☐ Not at all important ☐ Neutral/Not Sure ☐ Low importance ☐ Slightly important ☐ Moderately important ☐ Very important ☐ Extremely important ☐ Unsure of Terminology

Question 3 After this course, do you think learning about forestry is…?

☐ Not at all important ☐ Neutral/Not Sure ☐ Low importance ☐ Slightly important ☐ Moderately important ☐ Very important ☐ Extremely important

Question 4 After this past course you think learning about wildlife is…?

☐ Not at all important ☐ Neutral/Not Sure ☐ Low importance ☐ Slightly important ☐ Moderately important ☐ Very important ☐ Extremely important

Question 5 After this course, do you think learning about fish is ….?

☐ Not at all important ☐ Neutral/Not Sure ☐ Low importance ☐ Slightly important ☐ Moderately important ☐ Very important ☐ Extremely important

Question 6 After this course, do you think learning about water quality is ….?

☐ Not at all important ☐ Neutral/Not Sure ☐ Low importance ☐ Slightly important ☐ Moderately important ☐ Very important ☐ Extremely important

Question 7 After this course, what type of job are you interested in pursuing? (check <u>all</u> that apply)

__the environment	__animals	__lakes, rivers, & oceans
__plants, flowers, or trees	__rocks & earth	__astronomy
__numbers or math	__designing new things	__creating diagrams
__figuring out how things work	__using specialized tools & equipment	

Question 8 After this course, do you think you would be interested in a future career that used math or science skills?

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

Question 9 How important do you think it is to know about science & mathematics for a future career?

☐ Not at all important ☐ Neutral/Not Sure ☐ Low importance ☐ Slightly important
☐ Moderately important ☐ Very important ☐ Extremely important

Question 10 How important do you think it is to know different traditions for a future career?

☐ Not at all important ☐ Neutral/Not Sure ☐ Low importance ☐ Slightly important
☐ Moderately important ☐ Very important ☐ Extremely important

11. Careers

Please list 3 careers that might interest you some day:

a. _____
b. _____
c. _____

Personal Information

Gender: ☐ male ☐ female
Age:_____
Major:_____
Year Anticipate Graduating:_____
Undergraduate_____ Graduate_____ (please mark which one)

Are you Native American?_____
If yes, what is your Tribal Affiliation:
☐ Maliseet

☐ MicMac

☐ Penobscot

☐ Passamaquoddy (Indian Township) ☐ Passamaquoddy (Pleasant Pt)

☐ Other (please list):_____

APPENDIX B

Reflections By Class

Environmental Attitudes and Behaviors (SFR 479)
Students were required to submit weekly reflections based off of the week's readings and in-class discussions. Students were asked to reflect upon the in-class discussions. Students should carefully consider and articulate their opinion(s) based on what was discussed in class. Please also relate your opinion or stance to the assigned reading(s).
Final reflection
The final assignment is your evaluation of the class (total of 3 paragraphs) in combination of all readings/class work/guests for class. Craft a paragraph of your thoughts on how the readings (books and articles) assisted you in learning about environmental attitudes and behavior. Craft a paragraph of thought on how guest speakers assisted you in learning about environmental attitudes and behavior. The final paragraph base your thoughts on how the class organization (discussion/reflections/class and group discussion/reports) assisted you in learning about environmental attitudes and behavior.

Forest Vegetation (SFR 107)
Reflection 3

Reflecting on Traditional Knowledge and Trees lecture (Topic 03 September 14) and the Garibaldi 2004 paper on Cultural Keystone Species, describe something new that you have learned. How does/does not the concept of Cultural Keystone Species help you better understand traditional knowledge?

Reflection 4

Reflecting on Healthy Use of Plants Lab (Lab 4) describe something new that you have learned. How is this lab different from the previous three labs? How does Indigenous Knowledge guide plant gathering?

Reflection 9-10
Cultural Keystone Species (Brown Ash/Birch)

Explain why Brown Ash and White Birch are Cultural Keystone Species. Use one example for each of the following aspects: shared history/tradition, daily life, spiritual, and economic. Please use as much space as needed to answer the questions completely.

1) Brown Ash
2) White Birch

2) Based on Suzanne Greenlaw's presentations (10/24 and 10/26) and readings for class, provide two questions that would be applicable to invited Cultural Knowledge Keepers Gabe Frey (Brown Ash) and John Neptune and Pam Cunningham (Birch) for lab the week of 10/29

Reflections 13 & 14
Explain why Brown Ash and White Birch are Cultural Keystone Species. Use one example for each of the following aspects: shared history/tradition, daily life, spiritual, and economic. Please use as much space as needed to answer the questions completely.

1) Why is Brown Ash important to the Wabanaki? (200 words expected)

2) Why is White Birch important to the Wabanaki? (200 words expected)

Forest Landscape and Management Planning (SFR 477)

Reflection 1

1. "Jennings (1975) argued that Europeans did not find a wilderness in the Americas, they made one." (Moroshima, 2017 reading). What is meant by this phrase?

2. Indigenous cultures had a different idea of land tenure (tenure means holding or possessing of something) than Europeans. What were some of these differences?

3. James Francis described how the Penobscot language names of places can help us understand the original landscape of this area. What are some examples of things names can tell us? What names from your origin landscape tell you something about the landscape, if any?

Reflection 2

1. In what ways does the inclusion of Traditional Ecological Knowledge impact the planning of Passamaquoddy forest management practices? Examples could include moose, lynx or deer management. What do you see as beneficial and also what could be challenges related to harvest planning?

Reflection 3

1. What is the value of incorporating TEK into forest management?

Reflection 4

1.What were two reoccurring themes within Tribal Resource Management?

Indigenous Science Class (ANT 290)

Focus Group Questions

1. Why is it important to you to understand the interplay between TEK and western science?
2. What are you hoping to gain from this learning opportunity?
3. How do you see this helping you in your career path?
4. What aspect of this learning opportunity created interest to you?
5. What more could be added to the class that would benefit your learning?
6. There were 8 case studies. This included:
    - Invasive Species and Brown Ash – Suzanne Greenlaw & Pam Cunningham
    - Dams – John Banks
    - Plants – Jen Neptune
    - Food Sovereignty – Tony Sutton

- Water Issues (global)/Brownfield concerns (local) – Sean O'Brien/Jason and Karletta Chief
- Water Issues (local) Jan Paul/Angie Reed
- Forest Management
- Climate Adaptation/Tribal Plans

Which one was of most interest to you and why?

APPENDIX C

Interview Questions

Interview Questions

1. What is Cultural Knowledge to you?

2. How has including Cultural Knowledge in your science education helped you?

3. How might it influence your choice of career?

4. Is it important to you to understand the relationship between Cultural Knowledge and Western Science? Why or why not?

5. What have you gained or hope to gain from Cultural science being more integrated into your science classes?

6. What most interests you in including Cultural science into the way science is taught? Why?

7. Is there any thing else that you want to share with me or that I haven't covered that you would like to share?

APPENDIX D

Consent Forms

Letter of Assent

My name is tish carr and I am a graduate student working with Darren Ranco, associate professor of Anthropology at the University of Maine. I am working with Dr. Ranco and others at UMaine to better understand how/if incorporating Cultural Knowledge/Indigenous Knowledge in science curriculum can increase Native American and non-Native student persistence in science programs. I am writing to ask you to participate in a brief survey (15 minutes) on this topic. Your participation in this is completely voluntary and you are free to leave the interview at any time. You must be at least 18 years of age to participate in this study.

If you would like to participate or have any questions, please feel free to contact me at tish.carr@maine.edu or 207.485.0219.

Thank you for your consideration and participation.

tish carr

APPENDIX E

Code Book for Interviews

Codes	Number of coding references	Aggregate number of coding references	Number of items coded	Aggregate number of items coded
Nodes\\Connection	28	37	7	8
Nodes\\Connection\Cultural Connection	4	4	4	4
Nodes\\Connection\Outdoor connection\I think just being outside and kinda gives you like a more appreciation I think TEK would make you appreciate the western science more as well.	4	4	3	3
Nodes\\Connection\Tribal Connection	1	1	1	1
Nodes\\Culture	7	7	4	4
Nodes\\Empowerment	1	1	1	1
Nodes\\Important Quotes	6	6	3	3
Nodes\\Tradition	1	1	1	1
Nodes\\Traditional Ecological Knowledge - Indigenous Knowledge	16	20	5	7
Nodes\\Traditional Ecological Knowledge - Indigenous Knowledge\I can see the other half of it were some body who only knows the western science half might just see as object where I kinda see the life form and how important it is to us as humans.	4	4	3	3

APPENDIX F

Syllabi for each class

Environmental Attitudes and Behaviors
SFR 479 / SFR 613

Spring Semester 2018
3 Credits
Tuesday & Thursday, 12:30-1:45 p.m.
257 Nutting Hall

Instructor: John Daigle, Professor
Email: jdaigle@maine.edu
Office: 221 Nutting Hall
Office Phone: 581-2850
Office Hours: T,TH 2:00-3:00 and by appointment.

Teaching Assistant: James Elliott
Email: james.a.elliott@maine.edu
Office: 251 Nutting Hall
Office Hours: by appointment.

Course Description:
Humans depend on ecosystems for food, water, and fiber; climate regulation; and spiritual, aesthetic, and recreation values. The ability for the natural environment to provide these and other ecosystem services is compromised when humans behave in ways that alter forest, wetland, and marine resources. At the heart of human-environment interactions lay a complex framework of social, political, cultural, and environmental attributes. Embedded within each of these contexts are individual psychological characteristics which further complicate and influence human behavior. In this course, we will explore the relationship between human behavior and the natural environment through a variety of social and environmental psychology constructs including: intrinsic and instrumental values, beliefs, attitudes, perceptions of control, social norms, and cultural knowledge.

Course Goals and Objectives:
Students will:

1. Understand and appreciate the significance of core concepts from the fields of environmental and social psychology; natural resources management; and conflict resolution
2. Gain an understanding of the complexity involved in human-environment interactions in a variety of social, political, environmental, and cultural contexts.
3. Enhance learning through appreciation of different knowledge systems of western science and traditional ecological knowledge.

Expected Outcomes:
By the end of this course, participants will:

1. Understand the complexity of human-environment interactions through social, political, environmental, and cultural contexts.

2. Have a comprehensive understanding of social and environmental psychology constructs and assess environmental behavior in a variety of recreation, wildlife, natural resource extraction, and forest management settings.
3. Develop an appreciation of place based/different forms of knowledge.
4. Refine interpersonal skills required to actively listen, communicate, and reflect upon course material with peers and other professionals.

Required Texts

Nash, Rodericck. 2014. *Wilderness and the American Mind*. Yale University Press.

Heberlein, Thomas. 2012. *Navigating Environmental Attitudes*. Oxford University Press.

Wildcat, Daniel. 2009. *Red Alert: Saving the Planet with Indigenous Knowledge.* Fulcrum Publishing.

Additional texts and readings are posted as PDF files on Blackboard. PDF viewer software (e.g. Adobe Acrobat) is required to access/read additional readings and available for free at: http://www.adobe.com/products/acrobat/readstep2.html.

Course Policies
Participation and Attendance:
Actively engaging with your peers in constructive dialogue is critical to obtaining a comprehensive understanding of course topics. Obtaining the verbal skills required to effectively articulate and potentially debate your views is an important skill. We will spend a considerable amount of time discussing the assigned readings and as such, you need to attend each class and be prepared to share your opinions and insight. Your ability to engage with one another also serves as a gauge for how well you have mastered course topics. Therefore, you are required to submit weekly assignments (described below) which will count toward your overall participation points.

Weekly Assignments: **Discussion topic(s) and reflections**
Before each class period, students will submit one question or one topic of interest they would like to discuss during class. The question (or topic) must be based on the assigned readings for that particular class period and submitted via email by 9:00am the day of class. Comments and/or questions must be carefully constructed **and** include a description of why you would like to discuss that particular question/topic. One word or one phrase items are not considered sufficient and will not be counted toward that individual's participation points. Documents should not exceed one half of one page and should be single spaced, 12 font. These assignments are not meant to be overly burdensome. Rather, they are meant to stimulate your interests and subsequently, in-class discussions.

After each class period, students are required to reflect upon the in-class discussions. Students should carefully consider and articulate their opinion(s) based on what was discussed in class. Please also relate your opinion or stance to the assigned reading(s). Reflection papers are due by 12:00pm the following day and should be between ½ - 1 page in length (double spaced, 12 font).

Use these assignments as an opportunity to voice your opinion and ground your argument with support from the reading(s).

Grades:

Introductions	2 points
Discussion Questions/Topics Assignments	2 points each (at ≈ 25 classes = 50 points)*
Reflections/participation	2 points each (at ≈ 25 classes = 50 points)*
Tri-semester reports on readings/class work • February 22 • April 3 • May 3	 25 points 25 points 25 points 75 points total
End of Term Reflections • Self-evaluations in combination of all readings/class work/guests for class	23 points
TOTAL	**200 POINTS****

*Total number of assignments likely to vary as readings will not be assigned each week.
** **Graduate Students** taking course required to do additional special project (50 points)

LETTER GRADE	TOTAL POINTS (200)
A = 90 – 100	180 – 200
B = 80 – 89	160 – 179
C = 70 – 79	140 – 159
D = 60 – 69	120 – 139
F = 0 – 59	≤ 119

Academic honesty:
Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

Students with disabilities:

If you have a disability for which you may be requesting an accommodation, please contact Disabilities Services, 121 East Annex, 581-2319, as early as possible in the term.

Course schedule disclaimer (disruption clause):

In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

Sexual violence policy:

Sexual discrimination reporting: The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell any of your teachers about sexual discrimination involving members of the campus, **your teacher is required to report** this information to the campus Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity.

Behaviors that can be "sexual discrimination" include sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct, and gender discrimination. Therefore, all of these behaviors must be reported.

Brief Description of Western Science and Traditional Ecological Knowledge Immersion Exercises

Throughout this course you will be provided with and have access to various book chapters, empirical research papers, lecture material, and other resources. These tangible materials help provide the theoretical foundation for understanding human-environment interactions. While this knowledge is critical to understanding why humans behave the way(s) in which they do, being able to apply what you have learned in a "real life" situation leads to enhanced understanding of the complexity surrounding environmental problems.

In order to directly apply concepts learned in class and subsequently to inform decision making around large-scale environmental changes in Maine, students will participate with researchers, natural resource managers, and cultural knowledge keepers with applications of western science and traditional ecological knowledge.

One of the immersion exercises planned involves black ash ecology and processing of black ash for baskets. Importantly we will obtain insights from black ash harvesters to share insights and experiences working with researchers, federal and state natural resource management agencies, as well as other tribal nations in New York and Michigan on adaptation and planning strategies around the invasive insect Emerald Ash Borer (EAB). First detected in Michigan in 2002, EAB has now been found in at least 31 states and three Canadian provinces with millions of trees being killed by the invasive insect.

For the Wabanaki nations of Maine (the Penobscot Indian Nation, Passamaquoddy Tribe-Pleasant Point, Passamaquoddy Tribe-Indian Township, Aroostook Band of Micmacs, and the Houlton Band of Maliseet Indians), black ash serves critical roles in the social, cultural and economic spheres of contemporary life. The cultural importance of black ash is reflected in Wabanaki origin stories, wherein Gluskabe, the Wabanaki trickster hero, shot an arrow into the basket tree (the black ash), giving rise to the people who came into the world singing and

dancing. Given this context, there is no substitute for the Fraxinus or ash in Wabanaki culture. Moreover, baskets made of black ash are the oldest art form in New England and represent an original "green," value-added, sustainable forest product. The loss of ash and the associated basketry tradition would have deep economic, cultural, and spiritual effects on tribes. Sales of ash basketry exceed $150,000 each year and many tribal household incomes are partially dependent upon this resource (Daigle and Putnam 2009).

Another immersion exercise involves the efforts to protect access and management of another cultural keystone resource of Sweetgrass. Sweetgrass is a perennial plant that grows in rhizomatous (underground stems that send out roots and shoots) mats. It is classified as a wetland plant and typically inhabits riverbanks, moist meadows, and places along the coast. Acadia National Park provides an area for the scientific inquiry into the health of species such as sweetgrass and especially those that have critical importance to peoples who have had a long and sustained relationship with that species. Monitoring through an initial resource inventory process will assist managers in gauging the success of cultural resource management objectives. This effort has been aided by the involvement of traditional harvesters to identify environmental setting characteristics. Monitoring will help to evaluate the effectiveness of management strategies employed to reduce cultural resource impacts by capturing early-warning signs or other conditions that may have a negative effect on the cultural resource. By regularly assessing the condition of the cultural resource, an optimal strategy among various management alternatives can be selected and executed to help preserve and sustain the condition of the cultural resource. This study effort incorporates traditional ecological knowledge in developing a monitoring program around ecological cultural resources and stands to be a model program for other parks and protected areas as well as other entities in developing programs of management for ecological cultural resources. Given the expected changes in rising sea-level and increased competition of invasive species will undoubtedly affect the future health of sweetgrass.

Assignments and Readings

Note: Weekly assignments (i.e. discussion topic(s) and reflections) are not included in the breakdown below. It is your responsibility to submit them when they are due.

Date *(≈28 meetings)*	Theme	Topic(s) description	Readings (required for class)	Additional Readings *(Not required)*
Week 1 Tuesday, Jan 23	Introduction to course	Instructor-student introductions Review handouts: Syllabus, Active listening, Student assessment	N/A	N/A
Week 1 Thursday, Jan 25	Early ideas of wilderness	Early ideas of wilderness	Nash Chapters 1-2. pp. 1-43	
Week 2 Tuesday, Jan 30	Changing environmental attitudes	Western cultural influences	Nash Chapters 3-4. pp. 44-83	
Week 2 Thursday, Feb 1		Publicizing protection and conservation	N. Chapters 5-7. pp. 84-121	
Week 3 Tuesday, Feb 6		History of wildlife conservation	Video	
Week 3 Thursday, Feb 8		Publicizing protection and conservation	N. Chapters 8-11	
Week 4 Tuesday, Feb 13		Toward a philosophy of wilderness	N. Chapters 12-13	
Week 4 Thursday, Feb 15		Alaska	N. Chapter 14	
Week 5 Tuesday, Feb 20		The irony of victory	N. Chapter 15	
Week 5 Thursday, Feb 22		International perspectives	N. Chapter 16	

Week 6 Tuesday, Feb 27	Introduction to psychological constructs: Values and beliefs	The importance, role, formation, and organization of intrinsic, instrumental, and terminal values and beliefs	Heberlein (2012), ch's 1-2, pp. 3-33 De Groot & Thøgersen (2013), ch 14, pp.141-151	Shwartz (1992) Dunlap et al. (2000) Van der Werff et al. (2013)
Week 6 Thursday, March 1	Quantitative Social Science Research Methods	Introduction to social science research methods (e.g. participant observation, interviews, focus groups, social science surveys)	Marshall & Rossman (2006), ch. 97-126 Babbie (2010), ch 9, pp. 254-273	Dillman, Smyth, & Christian Babbie (2010), ch's 1, pp. 2-31; ch 2, pp. 31-61 (2009), ch 7, pp. 234-299
Week 7 Tuesday, March 6	Environmental Attitudes	Definition and description of attitudes and the role they play in decision making and human behavior	Heberlein (2012), ch's 3-5, pp. 34-89	Fishbein & Ajzen (2010), ch 3, pp. 75-95
Week 7 Thursday, March 8	Subjective norms	Definition and description of social norms; The role norms play in individual decision making in society	Heberlein (2012), ch's 6-8, pp. 90-139. Leopold (1949), pp. 201-226	Rokeach (1968) ch. 5
Weeks 8 March 12-16	SPRING BREAK			
Week 9 Tuesday, March 20	Subjective norms	Definition and description of social norms; The role norms play in individual decision making in society	Heberlein (2012), ch's 6-8, pp. 90-139. Leopold (1949), pp. 201-226	Rokeach (1968) ch. 5
Week 9 Thursday, March 22	Subjective norms Theory of Planned Behavior	Continued	Heberlein (2012), ch's 9-11, pp. 140-170. Hrubes, Ajzen, and Daigle (2001) Visitor Survey Insturment Collum / Daigle (2014) Daigle Book Review	Fishbein and Ajzen (2010) ch 1, 17-27 Rokeach (1968) ch. 5
Week 10 Tuesday, March 27	Large-scale environmental changes and socio-cultural implications	Climate impacts and past human relationships	Wildcat, ch's 1-2, pp. 1-38.	

Week 10 Thursday, March 29			Wildcat, ch's 3-4, pp. 39-72. Daigle and Putnum (2008) National Climate Report	
Week 11 Tuesday, April 3			Wildcat, ch's 5-6, pp. 73-112. Pretty and others (2004) Lynn et al. (2013)	
Week 11, Thursday April 5			Wildcat, chapters 7 and conclusions pp. 113-139 Yale climate study Voggesser and others (2013)	
Week 12 Tuesday, April 10	Bridging western science and traditional ecological knowledge	Climate change, access issues, management of Sweetgrass	Suzanne Greenlaw Kimmerer (2013)	
Week 12 Thursday, April 12		Climate change, access issues, management of Sweetgrass	Suzanne Greenlaw Ginger and others (2012)	
Week 13 Tuesday, April 17		Invasive species, access issues, management of Black Ash	Butch Jacobs Newman (2010) Gabriel Frey Chapter	
Week 13 Thursday, April 19		Invasive species, access issues, management of Black Ash	Butch Jacobs Costanza (2017)	
Week 14 Tuesday, April 24	Additional Topics in Environmental Psychology	Sense of place (place attachment) with positive and negative dimensions; Public access on private lands	Vaske & Kobrin (2001) Ednie and others (2010) Manzo (2014), ch. 14, pp. 178-190 Kuentzel (2017)	Kyle, Bricker, Graefe, & Wickham (2004) Davenport & Anderson (2005) Lewicka (2012)

Week 14 Thursday April 26	Bridging western science and traditional ecological knowledge	Sweetgrass research collaborations with Acadia National Park and Sweetgrass harvesters	Cole-Will (Acadia NP) NPS Plant Gathering Guide (2017) Federal Registrar Regulations NPS management policy
Week 15 Tuesday, May 1		Growing network of western science and cultural knowledge keeper collaborations	Darren Ranco (Department of Anthropology and Director of Wabanaki Center) Ranco and others (2012)
Week 15 Thursday, May 3	Knowledge systems contributions	Future collaborative models involving western science and traditional ecological knowledge Teaching evaluations	tish carr carr, Kenefic, and Ranco (2017) (Education)
Tuesday, May 8		Students submit to blackboard final reflection covering full semester activities	

SFR 107 – Forest Vegetation

Syllabus – September 2, 2018

Fall 2018

Lecture:11-11:50 pm; Wed., Fri.; Little Hall 140
Labs: 1-4:50 pm, Thursday OR Friday, Nutting 213

I. Course Information

SFR 107 – Forest Vegetation

An introduction to the identification, distribution, taxonomy, silvics and utilization of North American tree species. Emphasis on the dominant forest cover types typical of each region of the U.S. together with their associated shrub and herbaceous communities. Course may include field work during and outside of the course's scheduled times.

Credits: 3

II. Instructor Information.

William H. Livingston, School of Forest Resources.

Office: 201B Nutting Hall

Phone: 581-2990

E-mail: WilliamL@maine.edu

Dept. office: 201 Nutting Hall

Office hours: By appointment

Guest instructor

Suzanne Greenlaw, PhD Student, School of Forest Resources

E-mail: suzanne.greenlaw@maine.edu

III. References

A. Required.

Maine Forest Service. 2008. Forest Trees of Maine: Centennial Edition. Maine Department of Agriculture, Conservation and Forestry, Augusta, Maine. 176 p.

Farrar, John H. 1995. Trees of Northern United States and Canada. Iowa State Univeristy Press, Ames, Iowa. 502 p.

B. Recommended.

Mittelhauser, G.H., L. L. Gregory, S.C. Rooney, and J.E. Weber. 2010. The Plants of Acadia National Park. University of Maine Press, Orono, Maine. 542 p.

IV. BlackBoard

Blackboard is a web based course management system that makes the creation, organization, and management of course content on the web relatively simple.

The content page on the SFR 107 Blackboard site is where you can find assignments, links to lecture recordings, and links to download lecture outlines. You will also need BlackBoard to access Discussion pages and Assignment submission pages.

Computer Software: BlackBoard is accessed through browsers.

How to log into Blackboard: Login with your MaineStreet user ID, the portion of your '@maine.edu' email address to the left of the '@' sign, at http://bb.courses.maine.edu. Use your current MaineStreet password as your Blackboard password. You must activate your MaineStreet email account before you can login to Blackboard.

V. Other Technical Requirements

1. *Use of a computer is required*. Students must be proficient in using internet browsers and downloading files. The computer must also be capable of playing videos with sound.
2. *Documents are in MS-Word.* To view them, you can download a copy of MS-Word and other Office products at https://mycampus.maine.edu/group/um/home.
3. *Recordings require a high speed internet connection for viewing.* A high speed internet connection can be a DSL connection, a cable connection, or a T-line connection such as that found on the UMaine campus. *Warning*: Without a high speed internet connection, you will not be able to view the recordings; please make sure you have access to high speed internet before registering for the course.
4. *Windows Media Player or other application is required for viewing recordings.* Recordings are in mp4 format; your player needs to be compatible with this format.
5. *E-mail address.* You will be receiving E-mail messages through your MaineStreet E-mail address (@maine.edu). If you want the messages forwarded to another e-mail address, be sure to configure your MaineStreet account so that the messages will be forwarded. E-mail will be used for sending questions to and messages between the instructor and students.

VI. Student Learning Outcomes

After successfully completing the class, a student will be able to:

A. Identify major tree, shrub, and herbaceous species in Maine
B. Identify major tree species and forest types in U.S.
C. Use scientific nomenclature for each species
D. Describe significant characteristics (ecological, economic, cultural) of a species

VII. Course Grading.

Lecture questions	15%
Exam #1	15%
Exam #2	15%
Final exam	20%
Lab grade	35%

VIII. Answering Questions for Lectures

A. Lecture recordings and readings
   1. Students are expected to view assigned lecture recordings and read assigned material prior to the class period.
   2. An assigned question or list of questions must be answered and brought to the assigned class period. If you make sketches as part of your answer, bring the sketches with you to class.
   3. Students need to bring a complete set of notes on the topic to the class as well.

4. **<u>If:</u>**
   a) You do NOT the answer to the questions, or
   b) Your answer is too brief and/or
   c) Your answer lacks information from the topic,

   you will receive 0 points for the day's assignment.

B. Scheduled class periods
   1. Students will work in groups of 2-3. Partners will be assigned.
   2. You will use the materials brought to class to answer questions in class. Each group will turn in one answer sheet.
   3. Answers will be graded.

IX. Lecture Exams.

A. There will be two lecture exams, one at approximately each third of the semester. The exams will cover all the material on the topic slides, even if the topics weren't discussed during the lecture periods. Exam format will use short answer questions.

B. Make-up exams will be available for excused absences only.

C. You can use YOUR notes for exams. Photocopies of web pages, text book pages, figures, etc. are NOT acceptable and can't be used.

D. You will turn-in your notes after taking the exam. Points can be added or subtracted from your exam based on the quality of the notes:
   1. Add points (up to 10): Text and sketches in notes go beyond what is shown in the recording.
   2. Subtract points (up to 10): Text in notes is limited to that on the recordings (or less).

X. Final Exam: Wednesday, December 19, 9:30-11:30 am, Little Hall 140.

A. The final exam will be comprehensive in that questions can cover any topic from the course.

B. You can bring notes to the exam (same restrictions as above).

C. The exam will be of 2 parts
   1. 100 points on the last third of the class
   2. 100 points on the material covered by exam 1 and exam 2. These exam questions will be based on previous lecture questions and lecture exam questions.

XI. Lab Grade.

A. Each week you will work with a partner.

B. Labs
   1. Prepare needed information for the species list given to you the prior week: Family, Latin name, common name, significance, key characteristics for identification
   2. Work with your partner to identify tagged plants in the field. Take pictures of the plant that will help with identification
   3. Each team will upload the species information and pictures to a Google Form
   4. The uploaded information will be graded

C. Practicums
   1. Uploaded pictures and species information will be available for quiz practice on BlackBoard
   2. Practicums will be quizzes based on the material used on the BlackBoard practice quizzes. Practicums will involve proper identification of a plant, proper nomenclature, and significance of the plant.

D. Lab grade

Weekly work	40%
Lab practicums	40%
Lab final	20%

XII. Missed Assignments and Incomplete Work

All missed assignments must be completed or excused in order to receive credit for the class. This includes all lecture work, lecture notes (if needed), and exams. Work not completed by the end of the semester will result in an "F" for the class, or a student can request an "I", an incomplete grade. If the work is not completed within the first 10 weeks of the next semester, the "I" grade is automatically changed to a failure.

XIII. Attendance

"Every student is to accept responsibility for satisfactory attendance in courses," UMaine Student Handbook.

A. Every student is expected to be in class. If you miss a scheduled class period, this will be considered an absence.
B. Excused absences will be accepted under special circumstances such as: Participation in an official University function, illness, poor travel conditions, and family needs.
C. Where possible, such as in University functions or family needs, you must notify the instructor of your planned absence.
D. In case of all planned and unexpected absences, you need the following:
   1. For University functions, you will need a written notice from the University office indicating the activity and its date.
   2. For all other absences, you will need to provide the name of a person or office who can be contacted to confirm the need for you being absent. The one exception to this is poor travel conditions due to weather.
E. Unexcused absences will affect your grade as follows:
   1. 1 absence: 0% reduction in your final grade.
   2. 2 absences: 5% reduction in your final grade.
   3. 3 absences: 10% reduction in your final grade.
   4. 4 absences: 20% reduction in your final grade.
   5. 5 absences: 40% reduction in your final grade.
   6. 6 absences: automatic class withdraw or class failure.

XIV. Other Policies

1. Academic Honesty: Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the

discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

2. Students Accessibility Services Statement: If you have a disability for which you may be requesting an accommodation, please contact Student Accessibility Services, 121 East Annex, 581.2319, as early as possible in the term. Students who have already been approved for accommodations by SAS and have a current accommodation letter should meet with the instructor of the course as soon as possible.
3. Course Schedule Disclaimer: In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.
4. Observance of Religious Holidays/Events: The University of Maine recognizes that when students are observing significant religious holidays, some may be unable to attend classes or labs, study, take tests, or work on other assignments. If they provide adequate notice (at least one week and longer if at all possible), these students are allowed to make up course requirements as long as this effort does not create an unreasonable burden upon the instructor, department or University. At the discretion of the instructor, such coursework could be due before or after the examination or assignment. No adverse or prejudicial effects shall result to a student's grade for the examination, study, or course requirement on the day of religious observance. The student shall not be marked absent from the class due to observing a significant religious holiday. In the case of an internship or clinical, students should refer to the applicable policy in place by the employer or site.
5. Sexual Discrimination Reporting: The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell a teacher about an experience of sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or any form of gender discrimination involving members of the campus, your teacher is required to report this information to the campus Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity.

   If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources:

   For confidential resources on campus: Counseling Center: 207-581-1392 or Cutler Health Center: at 207-581-4000.

   For confidential resources off campus: Rape Response Services: 1-800-310-0000 or Partners for Peace: 1-800-863-9909.

   Other resources: The resources listed below can offer support but may have to report the incident to others who can help:

   For support services on campus: Office of Sexual Assault & Violence Prevention: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040 or 911. Or see the OSAVP website for a complete list of services at http://www.umaine.edu/osavp/
6. Student Behavior: Every student in the class is expected to be familiar with the University's Student Handbook (http://www.umaine.edu/handbook/) and Student

Conduct Code part of which states, "It is expected that students will conduct their affairs with proper regard for the rights of others and of the University. All members of the University community share a responsibility for maintaining an environment where actions are guided by mutual respect, integrity, and reason." If the instructor believes that a student's behavior is violating this code or other codes in the Handbook, the instructor has the option to ask that the behavior cease and will seek advice from the appropriate office on campus on how to deal with the student's behavior. If you have questions about this policy or want examples on what is acceptable and unacceptable behavior, please speak with the instructor.

Use of cell phones and other electronic devices during class for non-class related purposes is not permitted. A student will be asked to leave the class if a device is being used for non-class purposes and will receive an unexcused absence for the day.

XV. Lecture and Lab Topics.

Week	Day	Lecture Topic	Lab Topic
1	**W 9/5**	Introduction to course	Mixed species forest
	F 9/7	Introduction to Forest Vegetation	
2	**W 9/12**	Plant Divisions	Mixed species forest
	F 9/14	Traditional Knowledge and Trees	
3	**W 9/19**	Use of forest in Maine since 1650	Riparian species + planted
	F 9/21	Aceraceae and Cornus	
4	**W 9/26**	Opposite, compound leaves	Healthy uses of plants
	F 9/28	Fagaceae	
5	**W 10/3**	Betulaceae	Riparian species + planted
	F 10/5	Exam 1	
6	**W 10/10**	Salicacea + 2	Hardwood forest
	F 10/12	Rosaceae +3	
7	**W 10/17**	Cupressaceae	Conifer/bog forests
	F 10/19	Abies, Larix, Tsugae	
8	**W 10/24**	Traditional use of birch	TBA
	F 10/26	Traditional use of brown ash	
9	**W 10/31**	Picea	Birch and brown ash uses
	F 11/2	Pinus (eastern)	
10	**W 11/7**	Exam 2	Cones
	F 11/9	Pinus (western)	
11	**W 11/14**	Pinus (southern)	Cones
	F 11/16	Invasive plants	
12	**W 11/28**	Forest types east	Twigs
	F 11/30	Forest types west	
13	**W 12/5**	Forest types south	Twigs
	F 12/7	Review	
14	**W 12/12**	Trees, traditional uses, and values	Practicum 2
	F 12/14	Review and evaluations	
		Final Exam	

Name: _____ **Score:** ___

SFR 107 – Forest Vegetation: Class Notes Rubric

Circle the points earned, 1 value per row

Attributes	Does not meet expectations	Partially meets expectations	Meets expectations	Exceeds expectations
Organized	Materials haphazardly put together; hard to find information; incomplete -1 pt	Material clearly organized by topics; information not organized within topics; few figures. 0 pt	Material organized by topics; notes clearly show major points and explanations; important figures are included and easy to read +1 pt	Notes have been rewritten or typed; figures frequently used and are easy to ready +2 pt +3 pt
Integration of Material Material is included from • recordings • text book • class time/BlackBoard • help sessions • study sessions	Some information is copied from recordings. -2 pt	Information is from recordings and at least 1 more source 0 pt	Information is from recordings and 2 more sources +1 pt +2 pt	Information is from all sources. +3 pt +4 pt
Application • Class Questions • Study groups	The is no application of material -1 pt	Blackboard "Discussions" and class questions are included, but show no revisions. 0 pt	Blackboard "Discussions" and class questions are included with revisions; has revised old exams. +1 pt	Blackboard "Discussions" and class questions are included with revisions; has revised old exams; has responses to questions from study/help sessions. +2 pt +3 pt

SFR 477/577: Forest Landscape Management and Planning Fall 2018

Course description: Integration of biophysical and socioeconomic sciences for multiple use management to achieve desired products, services and conditions of forest lands. Application of modern analytical procedures for strategic, tactical and operational forest planning up to the landscape level. Lec. 3.

Pre- or Corequisite: SFR 409 or 349, Silviculture. FTY majors should also be enrolled in SFR 478.
Credits: 3 (3 hours of lecture/week), M/W/F 10:00 – 10:50, Nutting 102

Faculty: Mindy Crandall, mindy.crandall@maine.edu
243 Nutting Hall (leave messages here)
207.581.2855

Office hours: Wednesdays, 13:00 – 15:00, or by appointment. Email me for an appointment.

Required Textbook: None. Required readings will be provided.

Course overview: Forest management requires understanding the biological conditions, economic realities, and social frameworks that forest landscapes are managed within. Managers face multiple objectives and must articulate, quantify, and monitor provision of desired product and services in an uncertain environment. This course is the integration of biophysical, cultural and socioeconomic sciences for multiple use management to achieve desired products, services, and conditions of forestlands.

By the end of the semester, students will know the essential ecological, economic, and social factors required to manage forests for multiple uses; understand the cultural science component that can enhance and contribute to managing forests for multiple use; understand the market context of forest management; be familiar with tools essential for developing plans; understand the major decision criteria used in forest management and the role that traditional ecological knowledge can have within the decision criteria; and be able to communicate forest information and management objectives in a professional manner.

Learning outcomes for SFR 477/577
Upon successful completion of this class, students will be familiar with the tools needed to manage and create a plan for a forest, including analytical procedures and hands-on practice. Specifically, they will be able to:

- Understand the elements of planning including reasons for planning and key elements of a forest plan, specifically in a landscape setting
- Articulate the information and data needed for forest planning
- Compare the strengths and limitations of tools used in forest assessment and planning
- Compare outcomes for multiple values under alternative management scenarios

- Recognize how laws and regulations govern the practice of forestry & forest operations
- Understand the differences in management across multiple landowner types
- Enhance learning through appreciation of different knowledge systems of western science and traditional ecological knowledge.

Final grades will be based on the following assignments and breakdown:

SFR 477: 200 points total

5 Assignments:

1. 4 reflections, 5 points each (20 total)
2. Quantitative exercise, 20 points
3. Short essay, 20 points
4. State/Tribe report, 20 points
5. State/Tribe presentation, 20 points – 100 points total 50%

2 Midterms at 30 points each, 60 points total 30%
Final Exam, 40 points 20%

SFR 577: 200 points total

Assignments:

1. 4 reflections, 5 points each (20 total)
2. Quantitative exercise, 20 points
3. Short essay, 20 points
4. Research Paper, 20 points
5. Class presentation, 20 points – 100 points total 50%

2 Midterms at 30 points each, 60 points total 30%
Final Exam, 40 points 20%

Grades are assigned based on the percentage of accumulated points out of all possible points:

A	90-100%	D	60-69%
B	80-89%	F	<60%
C	70-79%		

I reserve the right to adjust the grade threshold *down*. If you are absent, come see me and catch up with classmates. **Class discussions will cover the reading assigned for that day**. **No make-up exams are given.** Bring calculators to class.

Expectations:

You are expected to follow the Professional Guidelines and Expectations for SFR Students. You can find it online at: http://forest.umaine.edu/files/2009/05/Professional-Guidelines-and-Expectations-for-School-of-Forest-Resources-Students-2013.pdf

Civility in the Classroom:
The goal of the University of Maine is to provide students with the knowledge, skills, and wisdom you need to contribute to society. My expectations are formulated to guarantee each student's freedom to learn and to protect the fundamental rights of others. People must treat each other with dignity and respect in order for scholarship to thrive. In this class, I expect students to follow a few simple courtesies that will help me teach in an atmosphere conducive to learning.

- **Come to class on time.** If you must be late, please enter as quietly as possible.
- **Come to class prepared.** Be ready to participate.
- **Do not disturb the class** by rustling papers, zipping backpacks, standing up, or leaving while lecture is going on or while students are raising questions for discussion.
- **Questions are encouraged at any time.** Give students who raise questions the courtesy of your attention. If your question requires a particularly lengthy answer, I may ask you to meet me after class.

Students with family or military responsibilities and those for whom English is not a primary language are invited to discuss their situations with me at the beginning of the term.

I am dedicated to establishing a learning environment that promotes diversity of race, cultures, gender/gender expressions, sexual orientations, learning styles, and physical abilities. If you prefer a name or pronoun other than what is indicated on the class roster, please let me know. **Behaviors or language that create a hostile, offensive or intimidating environment will not be tolerated.**

Academic Honesty:
Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

Students Accessibility Services:
If you have a disability for which you may be requesting an accommodation, please contact Student Accessibility Services, 121 East Annex, 581-2319, as early as possible in the term. Students who have already been approved for accommodations by SAS and have a current accommodation letter should meet with me privately as soon as possible.

Observance of Religious Holidays/Events: The University of Maine recognizes that when students are observing significant religious holidays, some may be unable to attend classes or labs, study, take tests, or work on other assignments. If they provide adequate notice (at least

one week and longer if at all possible), these students are allowed to make up course requirements as long as this effort does not create an unreasonable burden upon the instructor, department or University. At the discretion of the instructor, such coursework could be due before or after the examination or assignment. No adverse or prejudicial effects shall result to a student's grade for the examination, study, or course requirement on the day of religious observance. The student shall not be marked absent from the class due to observing a significant religious holiday. In the case of an internship or clinical, students should refer to the applicable policy in place by the employer or site.

Sexual Discrimination Reporting:
The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell any of your teachers about sexual discrimination involving members of the campus, **your teacher is required to report** this information to the campus Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity.

Behaviors that can be "sexual discrimination" include sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct, and gender discrimination. Therefore, all of these behaviors must be reported.

Why do teachers have to report sexual discrimination?

The university can better support students in trouble if we know about what is happening. Reporting also helps us to identify patterns that might arise – for example, if more than one victim reports having been assaulted or harassed by the same individual.

What will happen to a student if a teacher reports?

An employee from the Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity will reach out to you and offer support, resources, and information. You will be invited to meet with the employee to discuss the situation and the various options available to you.

If you have requested confidentiality, the University will weigh your request that no action be taken against the institution's obligation to provide a safe, nondiscriminatory environment for all students. If the University determines that it can maintain confidentiality, you must understand that the institution's ability to meaningfully investigate the incident and pursue disciplinary action, if warranted, may be limited. There are times when the University may not be able to honor a request for confidentiality because doing so would pose a risk to its ability to provide a safe, nondiscriminatory environment for everyone. If the University determines that it cannot maintain confidentiality, the University will advise you, prior to starting an investigation and, to the extent possible, will share information only with those responsible for handling the institution's response

The University is committed to the well-being of all students and will take steps to protect all involved from retaliation or harm.

If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources:

For confidential resources on campus: **Counseling Center: 207-581-1392** or **Cutler Health Center: at 207-581-4000.**

For confidential resources off campus: **Rape Response Services: 1-800-310-0000** or **Partners for Peace: 1-800-863-9909.**

Other resources: The resources listed below can offer support but may have to report the incident to others who can help:

For support services on campus: Office of Sexual Assault & Violence Prevention: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040 or 911. Or see the OSAVP website for a complete list of services at http://www.umaine.edu/osavp/

Course Schedule Disclaimer:
In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

The course schedule may change to accommodate other schedule conflicts or needs.

W	Date	*Reading*	*Assignment*	*Topic*
1	*M 9/3*			*No class – Labor Day*
	W 9/5	Bettinger Ch 1		Planning and Decision-Making
	F 9/7	Morishima 2017		History of FM
2	M 9/10	Skinner Flathead Beacon		Landowner types
	W 9/12	Debo Chs 7; 16 **(577)**		History of US & Tribal land tenure
	F 9/14	IFMAT 3 Exec Summary, Smith 1995	1.A: Reflection 1	**Indigenous historical context & knowledge** **Guest: James Francis, Penobscot Nation (Conf)**
3	M 9/17			Goals & Objectives – group activity
	W 9/19	Bettinger Chapter 10		Disturbance history & FM
	F 9/21	Keane 2009		Desired future conditions
4	M 9/24	Kenefic 2005, Seymour 1999		Silviculture review , Prescriptions
	W 9/26			REVIEW
	F 9/28		**EXAM 1**	**Exam 1 (proctored – Nicole Bernsen)**
5	M 10/1			**MU Mgmt: Keith Kanoti, U Forest Manager (conf)**
	W 10/3			*No class – SAF National*
	F 10/5	Kimmerer 2002	1.B: Reflection 2	**Passamaquoddy Mgmt, GUEST Ernest Carle (conf)**
6	*M 10/8*			*No Class – Fall Break*
	W 10/10	OHara 2013, Corrao 2017	2: Quant given	Stands to Landscapes
	F 10/12	Monserud 2002 **(577)**		Regulated Forests
7	M 10/15	Bett Ch 9, Berlick 2002		Sustainability
	W 10/17		**2 DUE**	BMPs, FPAs
	F 10/19			**RLFF: Alumni guests (req)**
8	M 10/22	Vales 2017		**Wildlife Considerations: Dr. Amber Roth (conf)**
	W 10/24	Cristan 2016, MFS sheets	3: Essay given	Certification, OBF
	F 10/26			Ecosystem Services
9	M 10/29	Sessions 2017		REVIEW
	W 10/31	Dockrey et al 2016	**3 DUE**	**Management of the Menominee, Intro**
	F 11/2	Mausel 2017, Kern 2017		**Menominee mgmt GUEST Chris Caldwell (conf)**
10	M 11/5		**EXAM 2**	**Exam 2**
	W 11/7	Hays 2017		**Tribal Partnerships in Management**
	F 11/9	Costanza 2017	1.C: Reflection 3	**Key species mgmt GUEST Suzanne Greenlaw (conf)**
11	M 11/12			*No Class – Veteran's Day (observed)*
	W 11/14	Excerpt PNW-PR 567	4: States given	Managing for unique stands (OG)/Public Lands
	F 11/16			**Conservation Forestry GUEST Kris Hoffman (conf)**
12	*M 11/19*			*No Class – Independent work time*
	W 11/21			*No Class – Thanksgiving Break*
	F 11/23			*No Class – Thanksgiving Break*
13	M 11/26	Franklin 2003		Fire – issues in management
	W 11/28	O'Connor 2016 **(577)**		**Restoring with fire, CSKT Forestry intro**
	F 11/30	Lake et al 2017	1.D: Reflection 4	**Mgmt with fire GUEST CSKT Forestry (conf)**
14	M 12/3			Student presentations, 1-6
	W 12/5		*(Assign 4 due at*	Student presentations, 7-12
	F 12/7		*presentation*	Student presentations, 13-18
15	M 12/10		*time)*	Student presentations, 19-24
	W 12/12			Student presentations, 25-30
	F 12/14			Student presentations, 31-36
16	**M 12/17**		**FINAL EXAM**	**Final Exam, 12:15, Nutting 102 – Comprehensive**

Readings (all will be made available to you as PDFs.) 577 – additional readings may be added.

1	• Bettinger et al. *Forest Management and Planning.* Chapter 1. • Moroshima & Mason, 2017. Our nation's forests need America's first stewards. *JOF* 115(5): 354-361.
2	• Skinner, Dave. Past, Present, Future, parts 1-3. *Flathead Beacon* July 13, 27, August 10, 2016. • Debo, Angie. 1970. *A history of the Indians of the United States.* Univ. of Oklahoma Press. Chapter 7. • Debo, Angie. 1970. Ibid. Chapter 16. **577 only** • Smith, Burton. 1995. *The Politics of Allotment on the Flathead Indian Reservation.* Salish and Kootenai Papers, Number 2. 28pp. • Indian Forest Management Assessment Team (IFMAT). 2013. *An assessment of Indian forests and forest management in the United States: Executive Summary.* A report for the Intertribal Timber Council. 24 pp.
3	• Bettinger et al. *Forest Management and Planning.* Chapter 10. • Keane, Hessburg, Landres, and Swanson. 2009. The use of historical range and variability (HRV) in landscape management. *Forest Ecology and Management* 258: 1025-1037.
4	• Kenefic & Nyland. 2005. *Diameter-Limit Cutting and Silviculture in Northeastern Forests*. USDA Forest Service NA-TP-02-05. • Seymour & Hunter. 1999. *Principles of ecological forestry.*
5	• Kimmerer, R. W. 2002. Weaving traditional ecological knowledge into biological education: A call to action. *BioScience* 52(5): 432-438.
6	• O'Hara & Nagel. 2013. The Stand: Revisiting a Central Concept in Forestry. *JOF* 111(5):335-340. • Corrao & Andringa. 2017. Anchor Forests and Tribal Lifeways to Improve Ecosystem Resilience and Maintain Working Forests. *Journal of Forestry* 115(5): 341-342. • Monserud. 2002. Large-scale management experiments in the moist maritime forests of the Pacific Northwest. *Landscape and Urban Planning* 59: 159-180. **577 only**
7	• Bettinger et al. *Forest Management and Planning.* Chapter 9 • Berlick, Kittredge and Foster. 2002. The illusion of preservation: a global environmental argument for the local production of natural resources. *Journal of biogeography* 29: 1557-1568.
8	• Vales, Middleton, and McDaniel. 2017. A Nutrition-Based Approach for Elk Habitat Management on Intensively Managed Forestlands. *Journal of Forestry* 115(5): 406-415. • Cristan et al. 2016. Effectiveness of forestry best management practices in the United States: Literature review. *Forest Ecology and Management* 360: 133-151. 477 – Excerpt, **577 – All.** • MFS Info Sheet 15 (Vernal Pools), Maine Woodlands Summary: What is OBF?
9	• Sessions et al. 2017. Indian Forests and Forestry: Can They Play a Larger Role in Sustainable Forest Management? *Journal of Forestry* 115(5): 364-365. • Dockry et al. 2016. Sustainable development education, practice and research: an indigenous model of sustainable development at the College of Menominee Nation. *Sustain Sci* 11:127-138. • Mausel et al. 2017. Menominee Forestry: Past, Present, Future. *Journal of Forestry* 115(5): 366-369. • Kern et al. 2017. Group opening outcomes, sustainable forest management, and the Menominee Nation Lands. *Journal of Forestry* 115(5): 416-424.
10	• Costanza et al. 2017. The Precarious State of a Cultural Keystone Species: Tribal and Biological Assessments of the Role and Future of Black Ash. *Journal of Forestry* 115(5): 435-446. • Hays 2017. Working to Address Complex Forest Issues: A Collaborative Case Study between the Mescalero Apache Nation and the USDA Forest Service. *Journal of Forestry* 115(5): 456-457.
11	• Stankey, Clark, & Bormann. 2006. Chapter 3: The Adaptive management literature: summary of key findings. USDA Forest Service Pacific Northwest Research Station PNW-RP-567.
13	• O'Connor, Thompson, & Silva. 2016. Getting ahead of the wildfire problem. *Geosciences*. **577 only** • Franklin & Agee. 2003. Forging a Science-Based National Forest Fire Policy. *Issues in Science and Technology* 20(1): 59-66. • Lake et al. 2017. Returning Fire to the Land: Celebrating Traditional Knowledge and Fire. *Journal of Forestry* 115(5): 343-353.

Fall 2018

Hydrology

Course ID: 016705
Class Number: 28183
Credits: 3
Days & Times: TuTh 9:30AM–10:45AM
Classroom: Aubert Hall 421
Instructor: Shaleen Jain, *PhD*
Office: Boardman Hall 313
E-mail: `shaleen.jain@maine.edu`

Synopsis

CIE 455/Hydrology is an introductory course in the area of hydrology and water resources engineering. The course primarily focuses on developing an understanding of the key elements of the hydrologic cycle–including description, quantification, and analysis. Physical and empirical relationships, and quantitative analysis using data and models are emphasized. Topics are discussed within the context of engineering applications, resource management, and linkages of hydrologic analysis and modeling to broader issues, such as engineering decision making under uncertainty, impacts of climate change and sustainable hydrologic systems design and management.

Textbook

Chow, Ven Te, David R. Maidment, and Larry W. Mays. *Applied Hydrology.* McGraw-Hill series in water resources and environmental engineering. New York: McGraw-Hill Book Company, 1988. ISBN: 0-07-100174-3

Handouts will available for topics not covered in the textbook.

Objectives

1. Develop a basic understanding of the physical processes within the atmospheric and terrestrial branches of the hydrologic cycle, with an emphasis on water resources sustainability of coupled natural and human systems.

2. Gain a working knowledge of the description and measurement of various components of hydrologic budget and their quantitative assessment.

3. Develop skills to analyze and design hydrologic systems for management and design applications, such as flood frequency, reservoir management, and design discharges for infrastructure design.

4. Develop an understanding of the statistical methods and numerical hydrologic models used for water resources systems analysis at point and watershed scales.
5. Develop an appreciation for the emerging issues in the area of water resources management and engineering.

Outcomes

1. Student will understand the fundamental concepts on how to use continuity equation in the context of water budget and hydrologic analysis.
2. Student will gain comprehension on the assumptions and limitations of standard methods such as flood frequency analysis and SCS methods.
3. Student develop an understanding of how different components of the hydrologic budget (precipitation, evaporation, infiltration etc.) are computed and their importance in watershed-scale studies.
4. Student will developed the ability to organize data and use it in hydrologic modeling, as well as the interpretation of model results.
5. Student will develop the ability to develop streamflow hydrographs based on a rainfall sequence, develop area-averaged precipitation estimates, quantify infiltration, and incorporate land use and soil characteristics using Curve Numbers.
6. Student will learn the use of hydrologic analysis techniques, problem solving skills, and engineering tools necessary for engineering practice, with appropriate considerations to limitations and uncertainties.
7. Student will develop the ability to read journal articles, learn about new and emerging issues, such as climate change, their impact of hydrologic design and the importance of continuing education.

Evaluation and Grading

Grades will be based on: Homework assignments (20%), Quizzes (20%), attendance and class participation (5%), course project (25%) and two exams (30%). Some homework assignments and projects will include an in-class presentation and discussion component. Late homework will not be accepted. Absence during quizzes and exams does not automatically entitle the student to a make-up exam/quiz. Absence stemming from health/family circumstance or other emergencies should be discussed with the instructor in a timely manner.

Anthropology 290/Native American Studies 201/Forestry 345
Indigenous Science Across the Curriculum

Spring 2019
T 5-7:50PM, 232A South Stevens

Dr. Darren Ranco
Phone: 581-1801
Email: darren.ranco@maine.edu

Office: South Stevens 236B
Office Hours: W/Th 2-3PM
(*and by appointment*)

Course Description

This course introduces students to American Indian/Native American/indigenous cultures of North American (Turtle Island) paying particular attention to the issues related to the use of Traditional Ecological Knowledge (TEK)/Indigenous Knowledge (IK)/Indigenous Science (IS) in indigenous and non-indigenous contexts. Using a case study method, we will explore the pathways and barriers related to integrating and emphasizing the use of IS in educational, environmental management, and scientific contexts. Therefore, we will examine various definitions, theories, and uses of IS across a number of ecological, environmental and social contexts, priorities and threats.

Student Outcomes and Reasons for this Course

Students will gain a deep understanding of the different experiences of Native peoples regarding IS as well as the different forms of knowledge and political engagement advocated by indigenous peoples in North America related to its use. Particular attention will be paid to the ways in which IS can be used to understand how ecological changes have, and will, impact indigenous peoples, their health, cultures and well-being.

Learning Outcomes and Assessment

The Department of Anthropology strives to provide students with a well-rounded education about the human experience. This course satisfies all four of the Department of Anthropology Learning Outcomes Criteria 1-4:

1) To understand the intricacies and implications of cultural diversity in the past and present;
2) To understand the important theoretical and methodological issues of the discipline;
3) To have the ability to provide, integrate, analyze, and assess evidence as it applies to a larger theoretical framework (i.e. statistical, historical, ethnographic, archaeological, etc.); and
4) To have the ability to think critically and communicate ideas effectively.

Grading

Grades will be based on two take home midterms, in-class participation, daily reading response questions and an annotated bibliography based on a research project. The midterms will be open-book take home essays in response to a prompt and are due one week after being handed out. The annotated bibliography will be based on an individual proposed research project designed by each

student, and its requirements will be discussed in greater length as the semester progresses. As part of their participation grade, students are expected to attend class and are responsible for both lecture material and all assigned readings. Discussion and engagement with the readings for this course is critical—questioning the readings is as important as gathering the information from them. To this end, each student will submit a 2-3 page Reading Response, as well as a list of three (3) questions related to the reading at the beginning of each class. The grading schedule and percentages of the final grade are as follows:

Two Midterms 30% (March 12th and April 23rd)
Reading Responses and Questions 15%
Annotated Bibliography 40% (Due May 7th)
Participation 15%

Final grades will be assigned as follows:

93-100%	A	80-82%	B-	67-69%	D+
90-92%	A-	77-79%	C+	63-66%	D
87-89%	B+	73-76%	C	60-62%	D-
83-86%	B	70-72%	C-	below 60%	F

Academic Honesty

Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

In the Event of an Extended Suspension of Class

In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to this syllabus that will supersede this version.

Sexual Discrimination Reporting

The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell a teacher about an experience of sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or any form of gender discrimination involving members of the campus, your teacher is required to report this information to the campus Office of Sexual Assault and Violence Prevention of the Office of Equal Opportunity. If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources: For confidential resources on campus: Counseling Center: 207-581-1392 or Cutler Health Center at 207-581-4000. For confidential resources off campus: Rape Response Services: 1-800-310-0000 or Spruce Run: 1-800-863-9909. Other resources: The resources listed below can offer support but may have to report the incident to others who can help: For support services on campus: Office of Sexual Assault and Violence Prevention: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040 or 911. Or see the OSAVP website

for a complete list of services at http://www.umain.edu/osavp/.

Disability Accommodation

If you have a disability for which you may be requesting an accommodation, please contact Ann Smith, Director of Disability Services, at their new location in East Annex, 581-2319, as early as possible in the term.

Required Readings

Required Readings will be available in *pdf* format (or with links) on the blackboard website for the course (go to https://bb.courses.maine.edu and sign in with your MaineStreet ID).

Class Schedule and Reading Assignments

January 22 Overview of course goals, pedagogy, themes, and concepts

IN CLASS READINGS:

"For American Indians, Coping with Climate Change is Ancient History," Lauren Morello, *ClimateWire/Scientific American*, July 19, 2012.

"Traditional Ecological Knowledge for Application by Service Scientists," US Fish and Wildlife Service, 2011.

IN CLASS VIDEOS:

Energy: Traditional Knowledge and Climate Science
https://www.youtube.com/watch?v=dYJC22XnSqw

Hopi-Kaibab National Forest Springs Restoration Project
https://www.youtube.com/watch?v=X5eeAoJVzaI

January 29 Indigenous Science and Traditional Ecological Knowledge: A Primer

Nadasdy, Paul, "The Politics of TEK: Power and the 'Integration' of Knowledge," *Arctic Anthropology* 36: 1-18 (1999).

Fikret Berkes, 2009, "Indigenous Ways of Knowing and the Study of Environmental Change," *Journal of the Royal Society of New Zealand* 39(4): 151-156.

Mazzocchi, Fulvio. 2006. "Western Science and Traditional Knowledge," European Molecular Biology Organization 7(5): 463-466.

McGregor, Deborah. 2004. "Coming Full Circle: Indigenous Knowledge, Environment and Our Future." *American Indian Quarterly* 28(3-4): 385-410.

February 5 Indigenous Science, Storytelling, and Colonial History

Reo, Nicholas, and Angela Parker. 2013. "Re-thinking Colonialism to Prepare for the Impacts of Rapid Environmental Change." *Climatic Change* 120: 671-682.

Whyte, Kyle Powys. 2013. "Justice Forward: Tribes, Climate Adaptation and Responsibility." *Climatic Change* 120: 517-530.

Sakakibara, Chie. 2008. "Our Home is Drowning: Inupiat Storytelling and Climate Change in Point Hope, Alaska." *Geographical Review* 98(4): 456-475.

February 12 Traditional Ecological Knowledge and Ethical Research Guidelines

Bohensky, Erin, and Yiheyis Mara. 2011. "Indigenous Knowledge, Science, and Resilience: What Have We Learned from a Decade of International Literature on "Integration"? *Ecology and Society* 16(4): 6.

Climate and Traditional Knowledges Workgroup (CTKW). 2014. "Guidelines for Considering Traditional Knowledges in Climate Change Initiatives." *http://climatetkw.wordpress.com*

February 19 Indigenous Science in the Classroom

Roehrig, Gillian, Karen Campbell, Diana Dalbotten, Keisha Varma. 2012. CYCLES: A Culturally-Relevant Approach to Climate Education in Native Communities. Journal of Curriulum and Instruction 6(1): 73-89.

Marshall, Albert, Murdena Marshall, and Marilyn Iwama. 2010. Approaching Mi'kmaw Teachings on the Connectiveness of Humans and Nature. *Proceedings of the Sixth International Conference of Science and the Management of Protected Areas*, Acadia University, Wolfville, Nova Scotia, May 21-26, 207.

Hatcher, Annamarie, and Cheryl Barlett. 2010. Two-Eyed Seeing: Building Cultural Bridges for Aboriginal Students. *Canadian Teacher Magazine*, May 2010, pp. 14-17.

Armstrong, Melissa, Robin Kimmerer, and Judith Vergun. 2007. Education and Research Opportunities for Traditional Ecological Knowledge. Frontiers in Ecology and Environment 2007: W12-W14.

February 26 Case Study: Invasive Species and Brown Ash

Darren Ranco, Amy Arnett, Erika Latty, Alysa Remsburg, Kathleen Dunckel, Erin Quigley, Rob Lilieholm, John Daigle, Bill Livingston, Jennifer Neptune, and Theresa Secord, 2012, "Two Maine Forest Pests: A Comparison of Approaches to Understanding Threats to Hemlock and Ash Trees in Maine," *Maine Policy Review* 21(1): 76-89.

Reo, N., K. Whyte, D. Ranco, J. Brandt, E. Blackmer, and B. Elliott. 2017. "Invasive Species, Indigenous Stewards, and Vulnerability Discourse." *American Indian Quarterly* 41(3): 201-223.

Akwesasne Task Force on the Environment. 2015. Akwesasne Mohawk Territory Emerald Ash Borer Community Response Plan.

March 5 Case Study: Dams

Conkling, Philip. 2017. A River Runs Through It: A 16-year Effort to Restore the Penobscot has become a Model for the Planet. The Maine Mag, October, 2017, pp. 1-9.

Brooks, L. T. (2010). The Reciprocity Principle and Traditional Ecological Knowledge: Understanding the Significance of Indigenous Protest on the Presumpscot River. *International Journal of Critical Indigenous Studies*, 11- 28.

Pawling, Micah. 2016. Wabanaki Homeland and Mobility: Concepts of Home in Nineteenth-Century Maine. Ethnohistory 63(4): 621-643.

Take home Midterm handed out

March 12 Case Study: Plants

Menzies, Charles. R. 2006. "Ecological Knowledge, Subsistence, and Livelihood Practices: The Case of the Pine Mushroom Harvest in Northwestern British Columbia," in *Traditional Ecological Knowledge and Natural Resource* Management, Charles Menzies, ed., Nebraska: University of Nebraska Press, pp. 87-104

Cariou, Warren. 2018. Sweetgraass Stories: Listening for Animate Land. Cambridge Journal of Postcolonial Inquire 5(3): 338-352.

Robin Kimmerer Yale University Talk, 2017, https://www.youtube.com/watch?v=ZAH_pqVMZ0Q

Take home Midterm handed in

March 26 Case Study: First Foods

Lynn, Kathy, et al. 2013. "The Impacts of Climate Change on Tribal Traditional Foods." *Climatic Change* 120: 545-556.

Reo and Whyte, Hunting and Morality

Center for Indigenous Environmental Resources [CIER]. 2007. Climate Change Impacts on Abundance and Distribution of Traditional Foods and Medicines—Effects on a First Nation and their Capacity to Adapt, pp. 1-30.

April 2 Case Study: Water and Fisheries, Part 1

Colombi, Benedict. 2012. "Salmon and the Adaptive Capacity of Nimiipuu (Nez Perce) Culture to Cope with Change." *American Indian Quarterly* 36: 75-97.

Jackson, Sue, et al. 2014. "We Like to Listen to Stories about Fish: Integrating Indigenous Ecological and Scientific Knowledge to Inform Environmental Flow Assessments." *Ecology and Society* 19(1): 43.

April 9 Case Study: Water, Part 2

Chief, Karletta, Alison Meadow, and Kyle Whyte. 2016. "Engaging Southwestern Tribes in Sustainable Water Resources Topics and Management." *Water* 2016(8): 350.

Cronin, Amanda, and David Ostergren. 2007. "Democracy, Participation, and Native American Tribes in Collaborative Watershed Management." *Society and Natural Resources* 20: 527-542.

Jackson, Sue, et al. 2015. "Meeting Indigenous peoples' objectives in environmental flow assessments" Case studies from an Australian multi-jurisdictional water sharing initiative." *Journal of Hydrology* 522: 141-151.

Local Issues related to watershed management/brownfields Issues .. Jan and Angie are coming on the 9th to talk about indigenous rights and monitoring Issues

April 16 Case Study: Forests, Part 1

Larry Mason, et al, 2012, "Listening and Learning from Traditional Knowledge and Western Science: A Dialogue on Contemporary Challenges of Forest Health and Wildfire," *Journal of Forestry* 110:187-193.

Moroshima & Mason, 2017. Our nation's forests need America's first stewards. *JOF* 115(5): 354-361.

Lake et al. 2017. Returning Fire to the Land: Celebrating Traditional Knowledge and Fire. *Journal of Forestry* 115(5): 343-353.

Take home Midterm handed out

April 23 Case Study: Forests, Part 2

Indian Forest Management Assessment Team (IFMAT). 2013. *An assessment of Indian forests and forest management in the United States: Executive Summary.* A report for the Intertribal Timber Council. 24 pp.

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***FINAL PAPER (Annotated Bibliography) DUE May 7th by 4PM.

BIOGRAPHY OF THE AUTHOR

tish carr was born on the Territory of Hawaii, April, 1959. She was raised in Kailua, on the Island of O'ahu, a bit in New Jersey, with her formative years in Norway, Maine. tish graduated from Gould Academy in 1977. She attended the University of Maine and graduated with a bachelor's degree in Wildlife Management and a second bachelor's degree in Forestry in 1986. The ensuing years tish spent working in the field of arboriculture and community forestry. She returned to the University of Maine in January 2013 and entered the master's in forestry program, graduating in May 2014. tish started working with the Wabanaki Youth in Science (WaYS) program upon graduation and continues today. That work led to entering the PhD program in Ecology and Environmental Sciences in the fall 2017. tish is a candidate for the PhD in Ecology and Environmental Sciences from the University of Maine in December 2019.