

Gathering Teachers' Ideas and Beliefs About Science
And Creating Space for Traditional Knowledge In the Science Classroom

by

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Bachelor of General Studies, Simon Fraser University, 2003

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Abstract

This study examines science teachers' beliefs and ideas about science prior to and following a one and a half day workshop on Indigenous Knowledge and Traditional Witsuwit'en knowledge of science. It is part of a wider study initiated by the Aboriginal Enhancements Branch of the BC Ministry of Education to determine why Aboriginal students are not enrolling in the sciences. A broad range of qualitative methodologies were applied, including pre and post instructional questionnaires, an experiential field trip to traditional Witsuwit'en territories as well as an instructional workshop and a dialogue process. Aspects of Indigenous methodology were included that were central to the lived experience of the Witsuwit'en people whose territories we were on and with whom the research was being conducted. Post-workshop questionnaire responses indicated that teachers' developed a broader understanding of Witsuwit'en Traditional Knowledge systems and a deeper respect for the contributions of the local First Nations to the sciences.

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Chapter 1: Introduction

Background

My father had been an Indian Agent for 30 years and I had traveled to many reserves with him over the years when, on one of those journeys into the interior (cariboo country) of BC, I was inspired to become a teacher. My first teaching assignment, 20 years ago, was on Witsuwit'en¹ Territory in north central, BC at Moricetown.

Moricetown is situated in one of the most beautiful and pristine settings in Canada. The school was newly built and had big picture windows overlooking some of the most spectacular scenery in BC including the coastal mountain range, hectares of forested lands for as far as the eye could see and a canyon where the Bulkley River ran through. The Witsuwit'en people have lived and traveled these lands, forests and waterways, dependent on their bounty, since time out of mind.

The Bulkley River is a tributary of the larger Skeena River, which flows into the Pacific Ocean on coastal Tsimshian territory. The Bulkley River is host to numerous species of salmon who return every year cycling through a natural order. The first springtime I was teaching found me on the banks of the canyon admiring spring salmon the size of which I've never seen before, as big and bigger than me. The numbers caught by the nets and gaffing hooks were as overwhelming as the size in those days. Neither the canyon river waters nor the number of salmon are as big today as they were then.

¹Witsuwit'en is the new linguistic spelling used more often since the 1990s. Wet'suwet'en is an older spelling used prior to the early 1990s.

I remained at Moricetown Elementary School for the next 5 years (1987-1992). While I was there I experienced an inclusion into a culture and an acceptance into a community I had never before encountered. It is here where I began to understand the word "community". As a teacher in their school I became, kin, family, and clan. The experience of witnessing births, deaths and the business of governing in the feast hall demonstrated the sacredness of the languages, lands and resources to the people. "When today, as in the past, the hereditary Chiefs of the Gitksan and Wet'suwet'en Houses gather in the Feast Hall, the events that unfold are at one and the same time political, legal, economic, social, spiritual, ceremonial and educational" (Gisday Wa & Delgam Uukw, 1989, p. 31). The generosity and teachings of many people led me to form new friendships that continue to this day. This relationship fostered within me a deep respect for the Witsuwit'en Nation.

Moricetown is a remote village, spanning Highway #16 between Hazelton and Smithers. Its 400 odd residents suffer the same housing shortages, low employment, poverty and oppression issues experienced by many other Aboriginal² communities throughout Canada. Moricetown is located some 45 kilometres west of the more prosperous, neighbouring, non-Aboriginal community of Smithers where I have lived and worked for the past 12 years. Many children come into town from Moricetown to go to school and many Witsuwit'en, Gitksan as well as Tahltan and other Aboriginal students make up 22% percent of the total number of Aboriginal students in School District #54. I feel very privileged to have had the experience of teaching in Moricetown and the opportunity to develop relationships in that community. That experience and relationship

² Aboriginal refers to First Nations, Métis and Inuit, who are the indigenous people of Canada.

building as well as a deeper spiritual relationship with my extended Cree family and community in Alberta, has played a big part in altering my own Euro-centric worldview and my ability to accept other ways of knowing. I believe this has had an impact on what, and sometimes how, I teach.

An examination of Aboriginal achievement patterns in British Columbia over the last five years (1997 – 2002) indicates that 36% to 42% of Aboriginal students graduate from grade 12. Of the Aboriginal students who graduate, 8% to 14% have taken biology 12; 5% to 8% took chemistry 12; and, 2% took physics 12. (BC Ministry of Education, 2002)

What is significant is that during this same time period additional statistics showed increasing numbers of Aboriginal students enrolling in public schools throughout BC. The BC Ministry of Education (2004) statistics confirm that in the northern 11 school districts alone Aboriginal student enrollment has increased from 11,729 in 1999/00 to 12,849 by 2003/04 (p.4) to where, “Aboriginal students make up approximately 8.4% of the total student population” (p. 1). Locally, in School District 54, the Ministry of Education statistics show that Aboriginal students are “a growing percentage of all students” in public schools making up about 21.5% of the total student population (BC Ministry of Education, 2004, p.1). Nationally, Aboriginal people are the fastest growing segment of the Canadian population and also have the greatest proportion of young people under 30. (Mullens, 2001, p. 10)

The 2004/05 Aboriginal Report for School District 54 (Bulkley Valley) provides statistics similar to the Provincial data on Aboriginal student achievement in the sciences. Student participation and achievement has returned to lower percentages since experiencing relatively higher rates from 2001-2003. For example, in Biology 12 participation has dropped from 25% in 2002/03 to 8% in 2003/04 and success rates (c-or better) have gone from 71% in 2002/03 to negligible in 2004/05 (the number cannot be displayed because it is based on fewer than five students). While in Chemistry, participation and success rates for 2004/05 have returned to the number zero that dominated the 1990s.

There is good evidence to support the need for more Aboriginal graduates in the sciences. The Anishinaabe scholar Leanne Simpson makes compelling arguments for why environmental science and Indigenous ways of knowing are important to Aboriginal students and communities:

In contemporary times Aboriginal communities within the boundaries of Canada face numerous environmental issues resulting from large scale resource development projects affecting the lands we have for centuries relied on to support our livelihood. (Simpson, 1998, p. 220)

In light of the global greed for natural resources there may be an opportunity for Aboriginal peoples with knowledge of Aboriginal science as well as Western science and technology, to assist their communities from being further marginalized by suspect government policies and scientific practices.

Ideally, First Nations communities should rely on their local expertise and the knowledge of their Elders to deal with these problems. However, with the complexities of new provincial, territorial and federal environmental legislation, compensation negotiations, and environmental impact assessments, community leaders are increasingly forced to rely on the scientific and technical skills of outside experts in order to identify, document, analyze, and plan to protect our lands and resources (Center for Indigenous Environmental Resources [CIER] 1997, p.1). The results of these endeavors are usually satisfactory from a western scientific point of view, but often undermine the rights and knowledge of Aboriginal peoples. (Simpson, 1998, p. 223)

At a time when many nations throughout BC are seeking treaty settlements and moving toward self-government this and the next generations of students with science careers could assist their nation in achieving a successful transition toward self-determination.

The magazine of *University Affairs* identifies a, “critical shortage of Aboriginal people in science and health related fields and maintains that a lack of College and University graduates in science related professions leaves Aboriginal people vulnerable” (Mullen, 2001, p. 9). The research suggests Aboriginal people are needed to provide services in

their own communities (p. 9). Lillian Dyck, who self identifies as “an urban Indian of Plains Cree extraction” (p. 22 as cited in James, 2001) is a full professor in biochemistry at the University of Saskatchewan. She recognizes the importance of science education to community development:

I repeat that we really do need to bring more Aboriginals into science. It is not just an economic issue, nor is it just an equity issue. Rather, Aboriginal students will both better serve our communities and change the way science is done. We must find a way to heal the hurt we have done to Mother Earth and to ourselves; Aboriginal science can lead the way. (Dyck, 2001, as cited in James, 2001, p. 28)

Dyck (2001) echoes the sentiments of many; Alaskan Native scholar Kawagley 1995, Native American scholar Cajete, 1999 and First Nations³ science scholars (James, 2001; Simpson, 1999) agree that the earth’s life forms are endangered. These scholars also agree that the traditional knowledge of Indigenous peoples holds a sacred connection to the environment and a guide to moral and sustainable life ways that can impact how science is perceived and practiced in the future. These Indigenous scholars also agree on the need for Western scientists to develop an understanding of the connection Indigenous knowledge has to ‘home’ place, to building community and to the land. Dyck (2001) argues that Western science is done for the sake of science while Aboriginal science is done for the sake of the community. These academic scholars see the benefits of bridging Aboriginal science and Western science. So why then are so few Aboriginal students enrolling in the sciences? According to the Ministry of Education’s rational (2003)

³ First Nations means people indigenous to Canada, Native American refers to people indigenous to the US and Native Alaska refers to those peoples indigenous to Alaska.

Aboriginal high school students face barriers to success in the sciences because of their low success rates.

In British Columbia, Aboriginal students overall have disproportionately lower rates of academic success than do non-Aboriginal students. According to BC Ministry of Education statistics for 2003, 42% of Aboriginal students graduated from high school compared to 79% of the non-Aboriginal student body. (BC Ministry of Education)

In order for students to enter into post-secondary education or pursue science based careers, this low success for the majority of Aboriginal students creates barriers and limits their career opportunities. (BC Ministry of Education, 2002)

Recent educational efforts have been made locally in response to these statistics.

A major goal of School District # 54's Accountability Contract for 2004-2005 is, "To improve Aboriginal student success" (p.12). The newly drafted Aboriginal Education Enhancement Agreement (2004-05) found within their Accountability contract identifies the importance of cultural relevance including traditional culture and language to Aboriginal student success:

The Board of School Trustees believes that a culturally relevant and positive learning experience is necessary in order to maximize the educational success of Aboriginal students...This Enhancement Agreement highlights the importance of academic performance and relates local Witsuwit'en traditional culture and language to Aboriginal student development and success. Fundamental to this EA is the requirement that schools provide a strong program that rests upon the local Witsuwit'en Nation's culture, on whose territory the schools are located. (p. 12)

A window of opportunity to reach these goals outlined by the local Board of School Trustees may lie in the BC science curriculum (K-7). In BC, the Ministry of Education has recently distributed an Integrated Resource Package (IRP) suggesting examples of ways to include Indigenous science into the (K-7)

curriculum alongside the Western science model. The Ministry recommends, in its report, that teaching Aboriginal concepts of science along with Western science will not only benefit all students, but that, “authentic Aboriginal examples of science and technologies can make the subject more exciting, relevant and interesting” (BC Ministry of Education, 2002, p.1).

The new IRP document adopted in 2004 identifies for the teacher the important elements of working with an Aboriginal community as well as those frameworks that have been put in place in the education system to help in this process.

Working with the Aboriginal Community

The Ministry of Education is dedicated to ensuring that the cultures and contributions of Aboriginal peoples in BC are reflected in all provincial curricula. To address these topics in the classroom in a way that is accurate and that respectfully reflects Aboriginal concepts of teaching and learning, teachers are strongly encouraged to seek the advice and support of local Aboriginal communities. As Aboriginal communities are diverse in terms of language, culture, and available resources, each community will have its own unique protocol to gain support for integration of local knowledge and expertise. To begin discussion of possible instructional and assessment activities, teachers should first contact Aboriginal education co-ordinators, teachers, support workers, and counsellors in their district who will be able to facilitate the identification of local resources and contacts such as Elders, chiefs, tribal or band councils, Aboriginal cultural centres, Aboriginal Friendship Centres, or Me'tis organizations. (BC Ministry of Education, 2004a, p. 11)

I agree with the ministry that through this process the Western and Aboriginal views may find an interface to help determine concepts of science that are relevant to local First Nations students. By recognizing local Indigenous science knowledge alongside Western science models educators could possibly change the downward trend of Aboriginal students registering in the sciences. Judy Thompson (2003), a Tahltan educator and

curriculum developer maintains that,

If school science curricula can find ways of bringing in TEK, a body of knowledge and wisdom that has largely been ignored in regards to its contributions to science, without appropriating it, hopefully science can become more accessible and relevant to a group of students that have been underrepresented in science classes and science related careers.
(p. 65)

Surprisingly, in the year 2000, when presenting my Curriculum Overview to my principal she appeared intrigued by a specific section on Aboriginal curriculum I had included in my overview. She said, "I have never seen Aboriginal content in a teacher's overview" (J. Edinger, personal communication Sept, 2000). I was compelled to consider why this was the case? Why weren't teachers including Aboriginal content into their planning?

The ministry has briefly cited examples of ways to include Aboriginal science in the curriculum (K-7), alongside the Western science model, and has identified for the teacher the important elements of working with an Aboriginal community. Having said this it behooves me to wonder how teachers' are responding to this initiative? What are their thoughts on Aboriginal science? Do they know what 'authentic Aboriginal examples of science and technology' are? Are they achieving the ministry goal of working with the Aboriginal community? In considering all the documentation: the statistics, the vital call for Aboriginal scientists and the ministry rationale, it appears imperative for educators to make every effort to improve the success rate for Aboriginal students in the sciences in our school district. The ministry is clearly calling for 'a shift in the force' a shift to acknowledge and implement Aboriginal ways of knowing and recognizing the relevancy of a local context in science education. How I wonder are non-Aboriginal teachers making the shift to include Aboriginal knowledge? Indeed are they? Personally, I am still

finding it difficult to meet my personal and professional goals to involve Aboriginal students and parents in meaningful projects that honor local Indigenous ways of knowing. Given my background and my relationship with the local Witsuwit'en community I was thinking if it is this hard for me what is it like for other educators? It has taken a great deal of time, education, dedication and persistence to realize even one small bead of success on my all too small necklace of achievements in ensuring local Aboriginal ways of thinking and knowing are recognized and valued in my classroom.

After a review of the literature it is apparent that there is strong discussion going on in Academic circles about bridging Western science with Indigenous knowledge in education, (Aikenhead, 2000; Battiste, 1995, 1998, 2000; Cajete, 1994, 2000; Colorado, 1988; Ignas, 2004; Kawagley, 1995, 2001; Simpson, 2001; Snively, 2000; Snively and Williams, 2006; Thompson, 2003). However, what is of note is that the actual teaching practices in science education have changed very little (Aikenhead, 2000). In fact Battiste (1988) refers to the state of education as perpetuating the status quo of the privileged foreigners and as cognitive imperialism in the education of Aboriginal students:

Cognitive imperialism denies many groups of people their language and cultural integrity and maintains legitimacy of only one language, one culture, and one frame of reference. This has been singularly achieved through education. (p. 20)

Consequently, the beliefs of educators and administrators in science as they concern Aboriginal students are of interest to me. How those beliefs inform teacher practice and how their practice impacts Aboriginal students in the sciences is of further interest. Efforts are being made by BC Universities (UNBC, UVIC, S.F.U. and UBC) to educate new teachers on the knowledge systems and values of Aboriginal peoples. However, as a

teacher of 19 years in northern BC my experience of teacher understanding of Indigenous knowledge and science is limited to a few.

Many teachers in schools have been through a teacher education system that did not consider cultural differences in classrooms as part of pedagogy, or saw the issue of indigenous student 'underachievement' as a deficit in the culture of the person. Furthermore, the vast majority of teachers in front of indigenous students are from a European/white background and few have positive personal resources with regard to indigenous peoples to call on in order to make the necessary changes to their classroom practice. (McKinley, 2005, p. 230)

I began to concern myself with how teachers were accessing local Witsuwit'en knowledge. Since teacher practice in science classrooms is built on the beliefs and ideas of the teachers about science, I chose to inquire into what those beliefs and ideas were. In doing so I hoped to determine how those beliefs impact Aboriginal students and whether or not those beliefs could change.

The Purpose

In 2003 the Aboriginal Enhancement Branch of the BC Ministry of Education and the University of Victoria collaborated to initiate a province wide study to find out why there is a low participation rate of Aboriginal students in high school science classes. Their mandate was to find ways to significantly improve Aboriginal student involvement and achievement in both elementary and high school science leading to post secondary education. And further, to encourage Aboriginal people to consider science related careers. (Snively & Williams, 2006)

This study is embedded within the larger BC Ministry study. The purpose of the study is to survey a core group of non-Aboriginal teachers in School District #54 (Bulkley Valley) to determine their understanding of Aboriginal science, why they think Aboriginal students are not enrolling in high school sciences and to encourage them to incorporate Aboriginal concepts into the science classroom. Science educators, Aboriginal leaders, and the Ministry need to know how non-Aboriginal teachers think – their ideas and beliefs about science - in order to determine the possibilities for teachers to integrate and facilitate Aboriginal science knowledge into their programs. As a teacher, I was interested in what science teachers new about Aboriginal science, how this impacted their teaching of science and to what extent science teachers were incorporating local Aboriginal science knowledge into the science classroom?

A further purpose of this study was to pilot and assess the effectiveness of a set of workshops in which participating teachers explored, experienced and discussed

Indigenous Knowledge including Aboriginal science knowledge. This format would potentially provide a broader understanding of the processes embodied within Aboriginal knowing. “Aboriginal Peoples learn about themselves and their environment through experiences...experimentation and active investigation” (Simpson, 1999, p. 2). The expectation was that this process would also foster stronger alliances within the school district between Aboriginal and non-Aboriginal educators.

Through engaging the participants in the workshops I hoped to present a learning opportunity that had the potential to enhance teachers’ thinking by exploring new experiences and new knowledge. It was my intent in this study to develop an awareness of another way of viewing the world of science, from an Aboriginal perspective. The hope was that this would inspire change in individual science teaching methods such that participants could include an Aboriginal worldview in their science classrooms to meet ministry and Aboriginal student expectations. As teachers we must be able to change our mindset before we can effect change in an educational system that for over a century has had as its’ objective the assimilation of Aboriginal students and the need “to train students to ‘conquer’ the world about them rather than to live ‘in good relation’ to the world around us” (O’Sullivan, 1999, p. xi).

Research Questions

Central Research Question

What are non-Aboriginal science teachers' ideas and beliefs about science education specific to Aboriginal student success? Can teacher thinking include an Aboriginal perspective in Aboriginal science knowledge?

Sub Questions

1. What are teacher's ideas and beliefs about the following:
 - a) What is science?
 - b) What is traditional Aboriginal science knowledge and/or what have Aboriginal peoples contributed to science knowledge?
 - c) Why are Aboriginal students not enrolling in the sciences?

2. Is it possible to change or enhance teacher thinking through the experiential and informational workshop on Aboriginal knowledge and TEK? Do teachers' ideas and beliefs about science change or have the experiences expanded teacher thinking about science?
 - a) Do teachers' perceptions, ideas and beliefs about Traditional Aboriginal science knowledge change or expand?
 - b) Can Aboriginal Traditional Knowledge be considered science?

3. After experiencing two complimentary workshops involving local traditional science knowledge, teacher participants will have the opportunity to determine
 - a) How is traditional science knowledge important to Western science? How is it relevant to their students,
 - b) What are the barriers to teaching traditional Aboriginal science knowledge in the classroom? What are the benefits of teaching traditional science knowledge in the classroom?
 - c) Is it possible to incorporate Aboriginal science knowledge into the teachers' science curriculum? How might it be included in teaching?

Location

Today the Bulkley Valley (overlay on Map 1) includes the communities of Smithers (population 5600), Telkwa (1400), Quick and Houston (combined population of about 4000), located along the Bulkley River on Highway #16 (the Yellowhead Highway) between Prince Rupert on the north west coast and Prince George in the northern interior. Moricetown Elementary School is located within the boundaries of SD#54 but is administrated by the Kyah Wiget Education Society on the reserve at Moricetown (Kyah Wiget). They have approximately 52 students in a K-7 school. Most teachers are of Aboriginal ancestry. The Principal /Special Education teacher is a non-Aboriginal woman.

The other public schools lying within the boundaries of School District # 54 include Lake Kathlyn, a K-7 elementary school, located closest to Moricetown on the west side of Smithers. They have all non-Aboriginal teachers and an Aboriginal Asset (Aboriginal School Support Team) worker who helps with home school communication and facilitates cultural activities. The Aboriginal population is 40% of the student body at this school. Smithers has two additional public elementary schools with grades K-7 and one public high school grades 8-12. The high school teachers are predominantly non-Aboriginal teachers. There are two Aboriginal Asset workers who counsel students and facilitate cultural programming. One of the two public Elementary schools in Smithers is Muheim Elementary School, which has 299 students. All the teachers and the principal are non-Aboriginal, but there is an Aboriginal Asset worker and an Aboriginal Literacy support person for Aboriginal students. There are approximately 92 First Nations students attending this school. The last year I worked at this school 14 of the 24 students in my

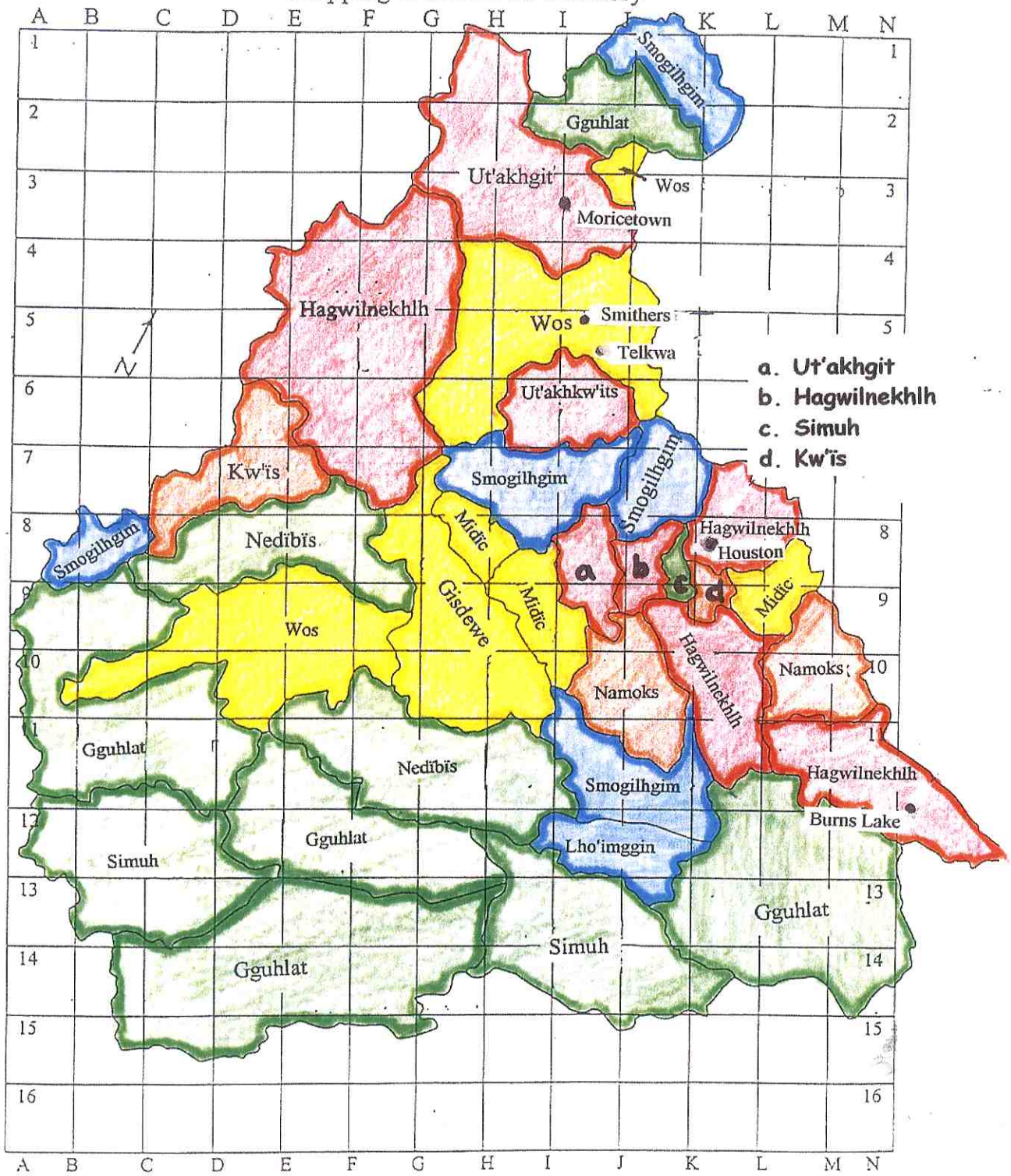
class were of Aboriginal heritage. There is an additional elementary school located on the other-side of town with similar dynamics and another located in Telkwa approximately 20 kilometers east of Smithers. The community of Houston, located 45 km east of Smithers, has two public elementary schools and one public high school. They all have Aboriginal Asset workers. The school district also employs a Principal of Aboriginal Education who is of Witsuwit'en ancestry as well as a curriculum developer from the Tahltan Nation.

According to the School District #54 Review Report, (2003-2004) "approximately 22 % of the Bulkley Valley's student population is of Aboriginal ancestry" (p. 1). Over the past few years there has been a steady decline in overall enrollment in school district #54 but there has been an increase of 1.5% in the number of Aboriginal students since 2002-2003.

The next page contains a map that names the communities of Moricetown, Smithers, Telkwa and Houston as they overlay the map of the Witsuwit'en territories. This Map has been adapted for use in Aboriginal Education by school district# 54. The colored territories differentiate the 5 clans responsible for these territories. The names identify the Hereditary House Chiefs who are responsible for each territory. During our field trip we visited the territories of Gisdewe and Namoks (closest to Gisdewe).

Likhsilyu = red
 Likhts'amcsyu = blue
 C'illts'ekhyu = green
 Tsayu = orange
 Gidimt'en = yellow

Mapping Witsuwit'en Territory



Participants

My target teacher population was a core group of approximately 15 local non-Aboriginal science educators. Prospective participants included men and women, from the various elementary schools and both high schools within School District #54. This population was of interest because they would potentially hold a western view of science and part of the intent of this study was to expand teacher thinking to include another worldview of science. All the participants taught science and may or may not have had Aboriginal students enrolled in their classes. I included primary teachers, intermediate teachers and high school teachers of biology, chemistry and physics. Teacher experience ranged from 3 years to 44 years. Some I knew and some I had never met before this research project. I included the Principal of Aboriginal Education as well as the Curriculum developer for this district in this study because their guidance was important to the success of this project. In addition, while they may carry an understanding of Indigenous Knowledge and Traditional Ecological Knowledge the local knowledge could provide relevant material for science education and curriculum development. I agreed with a number of educators who propose that, "Meaningful curriculum must necessarily be rooted in local knowledge and history and that this is especially so in the case of Indigenous students whose typical experience of mainstream education is one that has distanced and denied First Nations knowledge" (Snively, in press; Snively and Corsiglia, 2000 as cited in Ignas, 2004, p. 49). A significant aspect of this research was for science educators to be able to identify local Witsuwit'en knowledge including science knowledge in order to be inclusive of Witsuwit'en students and better inform all students in their science classes.

Methodology

I applied a broad range of qualitative methodologies, incorporating aspects of the theoretical framework of Naturalistic Inquiry, which acknowledged the existence of multiple realities and the value inherent in the lived experience. In order to find some answers to my research questions, an enquiry was made into non-Aboriginal teachers' thinking, their ideas and beliefs prior to and after a one and half day experiential and informational workshop. The results were compiled from the questionnaires and compared to analyze and identify any changes in teacher thinking. Teacher understanding and sensitivity to Wit'suwit'en Traditional Ecological Knowledge and its connection to Witsuwit'en student success was recorded in a narrative analysis. I chose to use pre and post instructional questionnaires, an experiential field trip to traditional Witsuwit'en territories as well as an instructional workshop and a dialogue process to teach, share stories and possibly enhance teachers' knowledge and perceptions of Indigenous Knowledge, Aboriginal science and Aboriginal student success. The variety of formats for the delivery of Aboriginal science was to provide opportunities to enhance the understanding teachers may or may not already hold about science.

My work was guided throughout by four principles of Indigenous research, relationship, respect, responsibility and reciprocity. In her work, Haig-Brown (1992) discusses these four principles. Relationship is valued as the primary principle on which the other three "Rs" of Responsibility, Reciprocity and Respect rest. She stresses the importance of developing a "reciprocal, dialogic relationship based on mutual trust, openness and engagement, in which self-disclosure, personal investment and equality is promoted" (p. 4). Other researchers working within an Indigenous education context have

also stressed the importance of the four “Rs” in their work (Archibald, 1997; Archibald & Haig Brown, 1992; Haig Brown, 2002; Weber-Pillwax, 1999, 2001).

My teaching experiences in Moricetown as well as my personal life experiences with the northern Cree in Alberta have changed my life significantly. They have provided me with another way of perceiving relationship, education and community. It was through experiencing Aboriginal ‘culture and knowing’ that I was able to come to a greater understanding of First Nations issues, practices and beliefs. I believed that if the participants could have an experience that would move them deeply that they too could develop a broader understanding and sensitivity to the local Witsuwit’en community and to First Nations education. Guedon (1994) highlights this type of learning in her work with the Dene.

I recognized that some of the questions which had followed me since my first field experience in Dene country had to do with basic assumptions about culture, and that my own notion of culture had been, and still was, deeply affected by my meetings with Dene people. (p. 64)

Ideally a successful study would mean teachers would have a transformative learning experience. Freire, concludes that research should not be, “our research on you, but rather a research project in which, together, in dialogue, we will come to know each other better and the reality in which we find ourselves so that we can more effectively transform that reality” (as cited in Colorado, 1988, p. 62). Adult learning experiences, which are transformational in nature in the sense that they speak to how “the individual operates, makes decisions and evaluates” (Kanu, 2005, p. 54) can lead to change in the classroom and ultimately affect individual students. Kanu (2005) supports this precedent. The Coalition for the Advancement of Aboriginal Studies (2003) posits that “teachers

who embark on the journey of integration often credit some sort of transformational experience for helping them acquire the interest and the desire to improve their teaching” (p. 54). As a result of her own research Kanu (2005) found this was indeed the case for non-Aboriginal teachers integrating First Nations curriculum and suggested further work in this area to be important and necessary. “Clearly this data suggests the need for studies that investigate catalytic ways of encouraging this process of transformation for more teachers” (p.55). The Transformative Learning Center in Toronto explains the complexity of such a learning experience.

Transformative learning involves experiencing a deep, structural shift in basic premises of thought, feelings, and actions. It is a shift of consciousness that dramatically and permanently alters our way of being in the world. Such a shift involves our understanding of ourselves and our self-locations; our relationships with other humans and with the natural world; our understanding of relations of power in interlocking structures of class, race and gender; our body awarenesses; our visions of alternative approaches to living; and our sense of possibilities for social justice and peace and personal joy. (Transformative Learning Center, 2003)

By opening ourselves (teachers) to new experiences and new knowledge we are opening ourselves to new beginnings and the prospect of change. O’Sullivan (1999) as well as Aboriginal authors (Barnhardt & Kawagley, 1998; Cajete, 1994, 1999; Kawagley, 1995) present informed arguments about the pressing need for changing what is currently an irrelevant and singular worldview, educational paradigm, in science.

...the fundamental educational task of our times is to make the choice for a sustainable global planetary habitat of interdependent life forms over and against the global competitive marketplace...The educational framework appropriate for this movement must then not only be visionary and transformative, but clearly must go beyond the conventional educational outlooks that we have cultivated for the last several centuries. (O’Sullivan, 1999, p. 45)

Within the methodology of this study pre-questionnaires were distributed to the 17 participants who agreed to take part. An informational meeting was planned to present an overview of Indigenous Knowledge and Traditional Ecological Knowledge as it related to local and global settings. An experiential field trip was organized to take the participants out to the territories of the Witsuwit'en people. This field trip was lead by Witsuwit'en chiefs who are the teachers of traditional Witsuwit'en knowledge. A culminating dialogue session, brainstorming session and feast were held to bring the Witsuwit'en knowledge holders and educators together with the non-Aboriginal educators to share, plan and celebrate. This process could provide a template for further professional development.

Interviews and Questionnaires

Baseline data was gathered through pre-workshop questionnaires⁴ on teachers' prior knowledge and beliefs about science. Key questions included: What are teachers' ideas and beliefs about science and science education prior to, a field trip to Witsuwit'en territories with two knowledge holders and an information workshop on Indigenous Knowledge and Traditional Ecological Knowledge? Later in the study I compared this information to data collected from post-workshop questionnaires⁵. Additional key questions included, "Did teacher thinking change? If so, in what way?" "Is it possible to incorporate Aboriginal science knowledge into the teachers' science curriculum?" "If so, how?"

⁴ See Appendix 3.

⁵ See Appendix 4.

I felt the written questionnaire was the most valuable tool for assessing this information since it gave teachers the privacy to answer honestly as well as providing personal time for comprehensive answers. Within this research I am a teacher, researcher and participant observer. As such, my style of research was to provide participants with anonymous questionnaires. Only the participants were able to identify their written response to the questionnaire by means of a password only they knew and remembered. For those teachers who preferred to do an oral interview, the option to meet and tape teachers' oral responses to the questionnaires was made available to them. All tapings were made with anonymous names.

Journals

I felt it was important to keep a personal reflective journal in order to record my own learning process. Journaling became a significant piece of my research. As Erlandson, David A., Harris, Edward L., Skipper, Barbara L. and Allen, Steve D. (1993) explain, "It is good to cultivate the habit of carrying a reflective journal to daily record notes and ideas. The researcher should continue this reflective writing practice throughout the entire research process." (p. 48) I kept a personal reflective journal in order to record my observations and my own learning process.

Journal Entry April 8th

Phase 1 Yahoo – Journey to the Territories with elders complete! Wow! It happened, it worked! I was really impressed with the teachers – they really wanted to be there – Relaxed, interested, asked many questions. Dan gave us a great introduction, stopping at the place where the two rivers meet, beautiful warm, southern exposure in view of the old camp and cabin now burned. He talked about the line of territory that ran between Tsayu and Likhsilyu territories along the rivers and pointed out the territorial boundaries. He talked about the tradition of rounding up of the cariboo, including the succession of cariboo to moose, seasonal

cycling and climactic zones. It was the first many had heard of the seasonal rounds Witsuwit'en people traditionally made between this place and Moricetown Canyon by foot, the round trip measuring approximately 200 kilometers. It surprises me how few people know about the court case of Delgamuukw and Gisdaywa on land claims and Aboriginal rights. Four long-term residents of Smithers had never heard of it!

Workshops

Two workshops were presented, an experiential and an informational workshop. For the experiential workshop arrangements were made for Aboriginal knowledge holders, from the Witsuwit'en territory, to take the participants to key sites on the land to share stories pertaining to Aboriginal ways of knowing. These stories were grounded in the holistic knowledge of the Witsuwit'en peoples and their use of scientific methods and Indigenous knowledge for their survival on the land in this territory. A key teaching was the interrelationship of all living things as stated by "Wigetimstochol", Dan Michell, Witsuwit'en Chief, "We belong to the land and the land belongs to us. And that is the reason why we are always taught to respect the land and everything that's in it" (Monet & Skanu'u, 1992, p. 73).

The overall intent of this workshop was to demonstrate the Witsuwit'en Nation's relationship to the land and their methods of maintaining subsistence economics since time immemorial. Inherent in those methods are the technologies of Aboriginal science specific to the Chief's territories. Their knowledge of science is evidenced in the food resources and the drying, harvesting, processing of food for the winter months. Science knowledge is in their plant knowledge of the forests and their use of plants for food and medicines. It is in the tools they designed and used for sustainable survival. As well as the overriding values of protection and management of the natural resources spiritually

and scientifically in order to live in balance and understanding with their environment. The Witsuwit'en peoples relationship with the land is an ongoing and complex way of life that is continually evolving and changing with the demands of the environment.

It was also important to provide an informational workshop to build on the journey the non-Aboriginal teachers experienced with the elders. To help teachers broaden their understanding of Aboriginal science, the informational workshop introduced important terms such as Indigenous Knowledge, Traditional Ecological Knowledge and Wisdom and presented examples from the local Aboriginal peoples as well as examples from the global context. These terms will be defined in further sections.

For example a TEK matrix developed for the Office of the Witsuwit'en was used to confirm and validate the work being done locally. A herbarium of important plants compiled by local Aboriginal people was highlighted as a resource for teachers. Important to this presentation was the acknowledgement of the global acceptance of TEK, specifically by the United Nations.

The Director General of United Nations Educational, Scientific and Cultural Organization (Mayor, 1994) defines traditional knowledge:

The indigenous people of the world possess an immense knowledge of their environments, based on centuries of living close to nature. Living in and from the richness and variety of complex ecosystems, they have an understanding of the properties of plants and animals, the functioning of ecosystems and the techniques for using and managing them that is particular and often detailed. In rural communities in developing countries, locally occurring species are relied on for many - sometimes all - foods, medicines, fuel, building materials and other products. Equally, people's knowledge and perceptions of the environment, and their relationships with it, are often important elements of cultural identity. (Retrieved on February 4th 2005 from [www.nativescience.org/html/traditional knowledge.html](http://www.nativescience.org/html/traditional%20knowledge.html))

Dialogue

Another key component of the methodology in this study was to bring the participants together in a dialogue process. Aboriginal people involved in education were invited to share in the dialogue circles to help bring a deeper understanding to the issue of why few Aboriginal students are choosing science⁶. I reiterate Freire maintains that research should not be, “our research on you, but rather a research project in which, together, in dialogue, we will come to know each other better and the reality in which we find ourselves so that we can more effectively transform that reality” (as cited in Colorado, 1988, p. 62). The dialogue was held in the District Staff Center in the Aboriginal Principal’s working room. This is a large comfortable space, which includes a kitchen, so a traditional dinner and refreshments were served as a culminating event.

Invited guests

Additional participants from the community and education were invited to the second workshop. These included Aboriginal people involved in education from the school district as well as community members such as; Aboriginal Support Services Educational Team (Asset) workers, a representative from The Friendship Center, the Principal for Aboriginal Education and the Curriculum Developer. I also invited a Professor of First Nations Studies from the University of Northern British Columbia, to share his doctoral research on a Conceptual Framework of Indigenous Knowing. Those in

⁶ See Appendix 5 for questions

attendance shared the meal with the teachers, helped explain IK and TEK and joined the dialogue circles.

Elders

In order for this research to impact students, various sets of participants were required to create an experience that would impact the teachers. It was necessary to find elders who could lead a field trip out onto the Witsuwit'en territories. "Elders are respected as carriers of knowledge, wisdom and experience. Therefore they are utilized as the first line of teachers, facilitators, and guides in the learning of Native science" (Cajete, 2004, p. 54). The success of the field trip depended on the elders knowledge and background and the synthesis of this knowledge with the other educators knowledge. My intent was to approach two chiefs from the Witsuwit'en community of Moricetown who were Hereditary Chiefs and respected elders of the territories we traveled to.

When House Chiefs take a name, they take on the responsibilities that go with the name. One of them is to make sure that, on the territory you have taken to protect, the people using it make sure there is no pollution, and that the area the animals are using and game trails and beaver dams and fishing sites are free from any obstructions, and you have to make sure that the people using it don't clear out the animals that are there for reproduction. (Gisdaywa (Alfred Joseph) Monet & Skanu'u, 1992, p. 61)

A House Chief with a lived experience on the territories would have an historical background. A chief who continued to hunt and fish on the territories, who carried the stories and knowledge could speak to TEK and Aboriginal science. Where we went on the field trip was directly related to and dependent on which Chiefs I asked and who agreed to make the excursion. The decision of who to ask was very important. After

conferring with the Principal of Aboriginal Education I began to consider the possibilities.

Field Trip Sites

School District #54 is located in north, western B.C. within the Bulkley Valley. The Bulkley Valley is situated between the western Hudson Bay Mountain ranges and the eastern Babine Mountain range, on the traditional land of the Witsuwit'en First Nation. The accompanying map (Map #1) of the Witsuwit'en chiefs' territories overlaying present day communities of the Bulkley Valley suggests the many possibilities available for a field trip into the Witsuwit'en territories. Potential sites for our journey extended in all four directions from the town of Smithers. The original territory of the Witsuwit'en people encompassed vast stretches of land far to the south around Ootsa Lake, their winter territories, all the way to the present site of Moricetown and north and east to summer camping sites including Moricetown and Hagwilget. A possible Chief's territory we could visit was in behind and to the north of Moricetown. The territory belonging to Wahtahkeg'ht, Henry Alfred is located there. The cedar and birch trees were traditionally harvested on this territory to support the fishing and berry picking activities typical of the summers spent there. "They made all sorts of things such as ropes, which they made out of cedar bark, and baskets which they made out of birch bark. They sometimes used the baskets to carry water, usually they carried water a long way in these baskets" (Nazi, 1977, p. 9). There it would be possible to uncover Culturally Modified Trees (CMTs) that carry the layered scars of birch bark harvesting for baskets or pine bark harvesting for pine noodles, their food in the lean months, as well as cedar trees stripped for rope

making. "The inner bark of pine, spruce and hemlock trees was harvested for food. "Pine sap" k'inih was gathered in May or June when the sap rises and the bark is loose. Special tools from bone or hard juniper wood were used to scrape sap in the old days"

(Gottesfeld, 1991, p.18). It will be spring when we are there so I anticipated being able to include an activity of harvesting in our day. In any direction we would be passing traditional village sites where modern cabins have been built on ancient trap-lines.

Alternatively, Moricetown canyon, presently reserve land, was a former summer camp for the Witsuwit'en and offers many possibilities for a study site. There has always been a canyon located there abounding with fish. A 'cornucopia' of traditional ecological knowledge can be gleaned from the original fishing technologies employed by the Witsuwit'en, their engineering feats in the building of cedar bridges lashed by cedar rope across the expanse of the canyon (Gottesfeld, 1991) as well as the food technologies employed in harvesting and drying fish and the clan and family obligations around their seasonal activities.

In the south lay a number of territories including those of Gisdaywa, Alfred Joseph and Wigetinstochol, Dan Michell. Once there our destination could likely be to get to Sam Goosley Lake, a traditional and sacred site for the Witsuwit'en people. The sacred footprint of the Witsuwit'en profit Beni is located there. It is the place from where the peoples prophesy comes. It is also a traditional village site with remnants of spiritual memories for the people of the Beaver Clan. It was their traditional winter site where, it is told, by reading the pattern of snow on the mountains they knew when it was time to leave from the territories in the spring to head north to their summer camp on the Bulkley and Skeena water ways.

All these territories have undergone extensive logging and mining in the last century but the Witsuwit'en still frequently visit their territories to trap, hunt and fish and have in some cases set up traditional camps for the youth on their territories.

Limitations of the Study

Within this study I have indicated that I am a teacher, researcher and participant observer. I was aware of my location as a fellow teacher within school district 54. This had positive and negative connotations. It was positive in the sense that I had established a relationship with some of the participants and negative in the sense that some teachers may have felt uncomfortable in opening up and revealing their personal thoughts. My connection to the Witsuwit'en community may have been perceived as a bias as well as my belief that through relevant teaching practices and informed teacher thinking Aboriginal students interest in science education can improve. However, all studies are open to bias. As a teacher and researcher I tried to overcome bias by using multiple data collecting techniques, including input from elders and other resource persons, and by using teachers' word for word responses to interview questions. Limitations of this study also included:

- a.) Professional resistance to yet another study, especially one that would take teachers out of their instructional comfort zone.
- b.) Whether or not people were open to exploring First Nations Education? In a couple of examples there was resistance from participants to support an education project intended for First Nations peoples.
- c.) It also depended on the time teachers had to give, their awareness and their passion in this area.
- d.) Like many previous research projects it may have had the potential for change, but change may not materialize in practice.
- e.) Funding from government to support the findings of such a project may not be available.

Significance of the Study

I believe the significance of this study lies in its potential to broaden teacher thinking. This research can guide its participants to attain greater understanding and help in the development of curriculum that meets the needs of the First Nations people whose traditional territories we reside on. By understanding teacher thinking about science, we can spark teachers' awareness of Indigenous Knowledge and the traditional science knowledge inherent within IK. Facilitating an exchange between the local Aboriginal culture and the non-Aboriginal teachers about what science is significantly impacts relationship building. "Building relationship is the resource that keeps on going" (Fullan, 2002, p. 37)

Through further collaboration with the Witsuwit'en First Nation to develop a program of study that reflects their values and integrates their traditional knowledge of the environment, we are creating a space in the educational system for traditional ways of knowing and hopefully for Aboriginal student achievement in science. This study has the potential to successfully integrate Environmental science and First Nations ways of knowing. A collaborative effort between Aboriginal knowledge holders and local science educators can partner community and school around important ecological interests and sustainability. Presenting a Witsuwit'en perspective may help all teachers and students to deal effectively with sustainability and resource issues. For example, the late Madeline Alfred former Chief "Dzee" of the Witsuwit'en Nation comments, "We take care of the land and respect it as well as the animals. You don't use one area over and over again and deplete one area, you always take care of the land and go to another area" (Monet & Skanu'u. 1992 p.67).

Initiating questionnaires and engaging teachers in Indigenous knowledge workshops during a Professional Development day with the support of the school district may significantly encourage teachers to acquire and recognize examples of local Witsuwit'en knowledge and their many scientific and technological achievements. This in turn could help teachers identify the possibilities for local Aboriginal students in science.

As science educators we must not forget that our overall task is not merely to present science concepts – as if this were a detached task – but to present an authentic view of science, and to see science education in a social and cultural context. (Snively, 1990, p. 56)

Chapter 2: Literature Review

Research Focus

My literature review is based upon an inquiry into teacher thinking in the sciences as it relates to Aboriginal student success. The essential question is, can teacher thinking expand through their participation in workshops on local Aboriginal science knowledge to where they want to include an Aboriginal perspective in their science programs? This literature review encompasses the relevant literature within three broad categories, Indigenous Knowledge, Traditional Ecological Knowledge and Wit'suwit'en⁵ ways of knowing. Since the education system, in which this study is based, is essentially a Eurocentric construct into which Aboriginal students are being indoctrinated, I believe it is important to review the literature on Aboriginal worldview. I begin with a general, brief overview of Indigenous Knowledge and Western worldview. Out of this discussion of worldviews comes a comparison between Traditional Ecological Knowledge and Western science. The discussion on these two worldviews in turn facilitates a review of the literature concerning the bridging of Traditional Ecological Knowledge with Western science and incorporates literature on non-Aboriginal teachers and Aboriginal student success in science. Important to this literature review will be the relevant literature on the local Witsuwit'en people and ways of knowing. Central to this study is the dynamic of teacher change therefore I have also included a brief review of the literature on teacher and educational change.

⁵ Witsuwit'en is the new linguistic spelling used more often since the 1990s. Wet'suwet'en is an older spelling used prior to the early 1990s.

Locating Myself in the Research

The first time I ever brought to mind the concept of Aboriginal people and education was in the early 70s when I was traveling with my father to a reserve in cariboo country on the central plateau of B.C., around Williams Lake. After visiting an especially bleak and impoverished 3rd world Aboriginal nation we were driving out of the village when we passed a one-room schoolhouse. There was something in that place, that structure that stirred a deep feeling of comfort, security and safety within me in relation to the Aboriginal children we had just visited. The vision of love that feeling inspired would not come to light, until some 20 years later when I took a teaching position in northern BC on Witsuwit'en territory.

I have been teaching now for over 15 years in both Aboriginal and non-Aboriginal communities and I have yet to experience a sense of comfort, security and safety within the education system in relation to Aboriginal children. I know deep within on many levels this has a lot to do with my cultural roots and a lot to do with the educational system I am a part of. I believe I will never feel successful as a teacher until I have worked to help resolve the issues that keep many Aboriginal students from feeling a sense of belonging and equality within a predominantly white education system. Simply put, if I am not part of the solution, I am part of the problem.

I have experienced decades of acceptance into many Aboriginal communities where I have been privileged to create many friendships. As a result of my own experiential learning and healing I have come to understand that there are "two worlds, two ways of knowing" (Cajete, 2000, p. 187). I have learned through this process, that now that I know, I carry a responsibility to involve myself in change. I think it is essential

and long passed time for the educational system to honor the Aboriginal people of this territory and to teach about another way of knowing science that honors the Aboriginal students. Ultimately, my goal is to be able to successfully integrate Environmental and First Nations Curriculum that will partner community and school around important ecological interests and sustainability. In so doing, I hope to find new ways of assessment that would recognize and honor student stewardship of the land.

The Story Behind the Data

As an educator I cannot begin a discussion on the topic of Traditional Ecological Knowledge without an overview of the history of the non-Aboriginal population in Canada and their heritage. This will help to clarify where we have come from, where we are, as well as where we are going. The unraveling of that history and heritage can explain the why of many questions in education and help to express the reality of the challenges Aboriginal students and teachers face in the science classroom.

History and Heritage

A good source for encapsulating the history and heritage of Aboriginal people and their relationship with non-Aboriginal people is in Volume one of the final report in the Royal Commission on Aboriginal Peoples (1996, 1-7). A model⁵ is presented that divides Aboriginal and non-Aboriginal contact into four stages; Separate Worlds, Contact and Cooperation, Displacement & Assimilation and Negotiation & Renewal.

The first stage “Separate Worlds” represents the time before contact, before the 1500s when European Societies and Aboriginal Societies were clearly separate. Europe and North America, with an ocean between them, developed as individual societies based on their own cultural needs and their own specific environments. A variety of Aboriginal creation stories speak about this time as a time when “the Creator gave each people its distinct place and role to perform in the harmonious operation of nature and in a manner and under circumstances appropriate to each people.” (Rcap, Vol. 1, p.5)

⁵ (Appendix1) This model was adapted from the work of Mark Dockstator, 1993-.

Toward the end of this period around the 1500s a great change of proximity and cultural autonomy takes place as the European cultures begin to arrive on the eastern shores of North America. The second stage of this diagram is described as, "Contact and Cooperation". This was a time when the gaps between cultures narrowed significantly. Both societies managed to maintain their distinct lifestyles and worldviews. There were times of friendship and cooperation in the exchange of goods and knowledge. Military alliances formed in adapting to the clear and present challenges of different cultures sharing the same land base. This time period was characterized by an increase in the numbers of Europeans settling first the Eastern coast of North America. Slowly migrating westward through the provinces and territories of what would become Canada. At the same time many Aboriginal peoples were dieing from the diseases brought by these new settlers.

During the next two stages (1600s to the present day) a widening of the gap occurred between Aboriginal and non-Aboriginal worldviews when worldviews collided (Little Bear, 2000 as cited in Battiste, 2000, p. 77). A dissimilar colonial philosophy relative to place of non-Aboriginal people began to change the landscape and the Aboriginal people. Displacement and Assimilation of First Nations people evidenced the pushing apart of these two ways of coming to the world beyond the lines marking their original agreement. This third stage, Displacement and Assimilation, is marked by the intensity with which non-Aboriginal society refused to value the distinctness of Aboriginal people. Instead, they argued a variety of methods, "relocation, residential schools, the outlawing of Aboriginal cultural practices"(Rcap, Vol. 1, p. 5) in the single-minded effort to assimilate Aboriginal people into Western ideology and eliminate or

control the practice of their cultures and their lands. The fourth stage, Negotiation and Renewal shows the arrows moving back towards their placement in the original agreements.

The significance of the continuing dotted line is to show the determination of the Aboriginal people to maintain their identity and to “conduct their relations with the dominant society in the manner Aboriginal people considered desirable and appropriate, in line with the parameters established in the initial contact period” (Rcap, Vol. 1, p.6). Joe Couture, a highly respected Metis academic and elder speaks about the determination of the Aboriginal Peoples to maintain their Indigenous Knowledge and identity despite the repeated efforts of the colonizing government to assimilate Aboriginal People.

That the Natives have managed to retain any traditional values and attitudes at all in the face of violence, dispossession, betrayal, degradation and misguided paternalism, systematically visited upon them since the 1600s is astounding. (Couture, 1996, p. 255)

Witsuwit'en people speaking in court in 1987 on their rights to the land maintained that,

The evidence will show how these new forms of economic opportunities have been layered onto existing and dynamic economic systems. And how that despite missionary activity and the diseases by which they were preceded and aided, the Gitksan and Wet'suwet'en did not give up their own systems. (Gisday Wa & Delgam Uukw, 1989, p.48-49)

During the late 1800s and early 1900s The Indian Act legislated by a now dominant society enacted laws that would serve to oppress and “eliminate the Indian problem” (Battiste, 2000, p. 77) in Canada. This racist document served to further marginalize the Aboriginal peoples in all areas of the spiritual, social, economic and political realm. In 1969 the Federal Government attempted to nullify the remaining democratic rights of Aboriginal people by issuing the infamous ‘White Paper’. This

historical document was to abolish the Indian Act and the 'special status' of Aboriginal people in Canada constitutionally, legally and politically by withdrawing their status as 'Indians' and making them regular Canadian citizens without recourse to language or lands (Rcap, vol. 1, p. 6). The impact of this on the Aboriginal peoples throughout Canada marked a shift in the Aboriginal peoples acceptance of non-Aboriginal societies dominance over them. It marked a turning point for many Aboriginal people who had been pushed as far as they could go. In response to the assimilationist strategies of this document, Aboriginal people began to organize against non-Aboriginal control of their lives. This period is referred to as Negotiation and Renewal and can be seen as continuing today. It is marked by the struggles of Aboriginal people to gain recognition as a 'distinct society' and maintain their original, rightful and equal place on the land and in the laws of Canada.

For the Witsuwit'en this struggle for Aboriginal rights is well documented. It began when the Wet'suwet'en Hereditary Chiefs in Smithers filed suit along side their Gitksan neighbours first in the Province (1984) then at the BC court of Appeals in 1992 and finally in the Supreme Court of Canada (1997) to force the province to recognize the existing Wet'suwet'en title to their traditional territories, approximately 125 years after their original plea for sovereignty rights (Gisday Wa & Delgam Uukw, 1989, p. 2).

My name is Gisday Wa. I am a Wet'suwet'en Chief and a plaintiff in this case. My House owns territory in the Morice River and Owen Lake area. Each Wet'suwet'en plaintiff's House owns similar territories. Together they own and govern the Wet'suwet'en territory. As an example, the land on which this courthouse stands is owned by the Wet'suwet'en Chief, Gyolugyet, in Kyas Yax, also known as Chief Woos' House. (Gisday Wa & Delgam Uukw, 1989, p. 5)

This struggle depicts the contrasts between Aboriginal worldview and Western European worldview. Gisday Wa and Delgam Uukw challenged the Supreme Court of Canada in defending their claim and their right to their original territory. For the Gitksan and the Wet'suwet'en together, "These territories encompass about 22,000 square miles on and surrounding the Skeena, Bulkley and Nechako river systems, and have been occupied and protected by these nations for thousands of years" (Gisday Wa & Delgam Uukw, 1989, p.1). The Witsuwit'en took their case all the way to the supreme court of Canada in an effort to prove their rights to the land. The decision is a hallmark of the 20th century. The courts finally recognized that Aboriginal title had not been extinguished, that it continues to exist and the nature of that title goes beyond the subsistence land use of hunting, fishing and gathering to incorporate economic interests. (Gisday Wa & Delgam Uukw, 1989, p. 88). It showed how an Aboriginal group could in fact establish Aboriginal title. The Supreme Court of Canada also recognized in their decision that Oral history had the same merit as written documentation).

Important to this period of Negotiation and Renewal is the realization by the dominant white society that their tactics may have been wrong and their assimilationist ideologies excessive. In 1998 the Federal Government publicly apologized for the reign of terror and the personal pain the residential school system created for Aboriginal people. A further in depth discussion of the historical relationship that lead to the present day realities in Aboriginal education can be found in two volumes, one by Barman, Hebert and McCaskill (1987) and another by Battiste and Barman (1995). This time of Negotiation and Renewal has also been marked by international recognition of the injustice Aboriginal people face in Canada. When the appalling 3rd world conditions of

the Aboriginal peoples in Canada were brought to the attention of the United Nations, a committee on Indian rights was established that has been working hard to improve the plight of those First Nations who continue to suffer health, poverty and suicide issues at an alarming rate (Battiste & Henderson, 2000). Negotiation and Renewal are evidenced in many segments of society today including treaty and land claims negotiations, health and education, child and family services and in science and justice. Aboriginal people have been fighting for equity for centuries. A look at the history of this struggle is an important background piece to a further discussion on Indigenous knowledge and science education.

Indigenous Knowledge

In order to understand the concept of Traditional Ecological Knowledge (TEK) one needs to understand it as one very important aspect of Indigenous Knowledge or Aboriginal worldview. After a review of the literature, a comprehensive explanation of Indigenous Knowledge is beyond the realm of this paper and my limited ability. What is important to note is that the term itself is an academic concept and the act of defining it is something Western academics do. To that end an effort has been made to name and define what Western economies are beginning to recognize as valuable. The director general of UNESCO has attempted to define Indigenous Knowledge:

The indigenous peoples of the world possess an immense knowledge of their environments, based on centuries of living close to nature. Living in and from the richness and variety of complex ecosystems, they have an understanding of the properties of plants and animals, the functions of ecosystems and the techniques for using and managing them that is particular and often detailed. In rural communities in developing countries, locally occurring species are relied on for many—sometimes all—of the foods, medicines, fuel, building materials and other products. Equally, people's knowledge and perceptions of the environment, and their relationship with it, are often important elements of cultural identity. (As cited in Battiste & Henderson, 2000, p.39)

Indigenous Knowledge is also referred to as 'Ways of Knowing' in the creation stories from the First peoples, Haudenosaunee, Brant, 2001; Anishinaabe, Benton-Benai, 1979; Haida, Reid, 1988; Yupiaq, Kawagley, 2001; Gitksan, Smith, 2004 and in First Nations Literature, Silko, 1986. It is here where Aboriginal beliefs arise and are introduced through the ancestors, their relations and multidimensional worlds. The spiritual axis common to Aboriginal philosophy can be found in the interrelationships between human, plant and animal communities; the elements of earth, air, fire and water; while traveling

through a time that is collapsed over generations and guided by spirit and ceremony. The human beings, in these stories, develop through the process of their survival; through the process of interrelationships and responsibility to all living things they are dependent on. The plants and animals reciprocate with their lives. The human beings reciprocate with thanksgiving and spiritual practice of the good life, by living in good relation to all they depend on. This practice supports the moral and ethical values on which their life is anchored. Maintaining a balance and harmony with the natural kingdom through dreams, mental maps and visions (Cajete, 1999; Brody, 1988; Simpson, 1999; Martin Hill, 2002 and Gisday Wa & Delgam Uukw, 1989) becomes the focus of life and is their lived experience. According to Aboriginal beliefs all of creation is infused with life and spirit.

A fundamental feature of the Aboriginal world view was, and continues to be, that all of life is a manifestation of spiritual reality: We come from spirit; we live and move surrounded by spirit; and when we leave this life we return to a spirit world. All perceptions are conditioned by spiritual forces, and all actions have repercussions in a spiritual reality. Actions initiated in a spiritual realm affect physical reality; conversely, human actions set off consequences in a spiritual realm. These consequences in turn become manifest in the physical realm. All these interactions must be taken into account as surely as considerations of what to eat or how to keep warm in the winter. (Final Report of the Royal Commission on Aboriginal Peoples, 1996, (1) p. 628)

This concept of relating Indigenous Knowledge to dreams and the spirit world is explained locally by the Witsuwit'en, "The authority of the Wet'suwet'en Chiefs derives not only from the assumption of the high Chief's names, but also from individual contact with the spirit realm which comes from dreams, visionary experiences and what the Wet'suwet'en...refer to as *habo'stat*" (Gisday Wa & Delgam Uukw, 1889, pg. 34). While First Nations ways of knowing are founded on a spiritual and moral ethic, Indigenous Knowledge is also informed by language.

What is essential to note is that Aboriginal worldview and acquisition of knowledge by First Nations peoples is based on a different language system. Language is an important element in constructing Indigenous Knowledge. It is their language, which informs their knowing. Many of the Creation stories and those from Aboriginal Literature have either been interpreted through the English language or have been translated into English, the common language of the dominant society. They have had to use a construct of Western worldview to serve as a means to a shared understanding. This end is not always in keeping with Aboriginal worldview. For many Aboriginal scholars the essence of the life giving force is lost in translation and this presents challenges and often confusion for non-Aboriginal people. The lawyers for the Gitksan and Wet'suwet'en Hereditary Chiefs in the infamous court case of *Gisday Wa and Delgam Uukw* spoke to this problem of translation in their opening address.

The second challenge for the court very much related to the first, involves the problems of communication between very different cultures. The problems here are not simply those inherent in the necessity to translate from Gitksan or Wet'suwet'en to English, as would be the case in a situation where the witnesses were Francophone. French and English cultures, although, trace common and historical roots and share a world-view. The Gitksan and Wet'suwet'en world-view is of a qualitatively different order. (*Gisday Wa & Delgam Uukw*, 1989, p. 22)

Underpinning this notion is the knowledge that the English language and French language have their beginnings in Europe where they shared a common context, while Aboriginal Languages developed in their own distinct contexts in pockets all over this continent. Simpson (1999) an Anishinaabe academic explains the importance of the context of language. "Language expresses reality as constructed by the people who are born into it, and it reflects the reasoning, philosophy and values of culture. The structure

of a language is designed to reflect worldviews” (Simpson, 1999, p.69). Just as the English and French communicate their way of knowing through their language it is through the language specific to an Aboriginal nation that they know their way. For the Witsuwit’en speaking their language honors their ancestors, is tied to the land and is their very identity.

The Wet’suwet’en language and culture are critical to our identity—they are linked to one another and to our territory...Our duty is and always has been to respect the land, to protect it and be caretakers of it on behalf of future generations as well as our people today. There must be recognition that this is what makes us Wet’suwet’en: our relationship to the land. This relationship is in our language and our culture. It is who we are. (Office of The Wet’suwet’en, 1997, pp. 6-7)

To summarize, the readings convey the holism of Indigenous Knowledge that is inseparable from the spiritual realm and contextualized by the language of a people that invariably sustains life. The speaking of that language powers the relationship that keeps the people rooted to the land and to life.

...when we change our language to English, we dissociate ourselves from nature. The many English nouns that we learn only give us the idea of an object. Our Native words come from the creatures and things of Mother Earth, naming themselves, defining themselves through the action of words. That is reality. Nature is our teacher. You see information and rationality are a small part of the knowledge and learning that our modern schooling systems espouse. In the use of our Native languages we come to live life intimately, because we are enmeshed in it rather than looking at it from a distance through a microscope. (Kawagley, 2001, p.199)

Western worldview on the other hand is characterized by competition for, conquest and control over people and the natural world. When Euro-centric superiority prevented the Aboriginal languages and their inherent cultures their autonomy a great, profound knowing and understanding of the world was pushed underground. James Dumont (1976)

an Anishinaabe, speaks of these two ways of seeing as “the straight - ahead - vision” of the colonizer and “the all-around-vision” of the Aboriginal and comments that, “It seems as though – right from the time of contact of these two races of men – this difference in vision has been at the source of the difficulties” (p. 11). Little Bear (2000) explains how the colonial impacts of force, terror and educational policy, “left a heritage of jagged world views among Indigenous peoples”(p.84).

Traditional Ecological Knowledge and Western Science

The Anishinaabe philosopher, Dumont (1976) shared an original story that spoke to the separate realities of the White Man and the Aboriginal. Today this story reflects the differences between worldviews that impacts Western science and Traditional Ecological Knowledge or Indigenous Knowledge:

In the beginning, while the races still lived together as one, each of the races had to come to a decision as to what direction he would choose. During this time White Man and Red Man found themselves walking together along the same road. At some point in their journey they came to a division in their path. One of the two possible roads before them offered knowledge and growth through accumulation and mounting of all that could be seen ahead (a one-hundred-and-eighty-degree-vision). This is what White Man chose and he has developed in this 'linear' and accumulative fashion ever since. The other road appeared less attractive materially and quantitatively, but offered a whole and comprehensive vision that entailed not only vision before but also vision behind (a three-hundred-and sixty degree-vision). This was a circular vision that sought to perceive and understand the whole nature of an object or event - its physical reality as well as its soul. The Red Man chose this road and he has developed in this circular and holistic way ever since. (p.12)

This fundamental difference in philosophies underlies the discussion that separates Western science knowledge from Aboriginal science knowledge also referred to as Traditional Ecological Knowledge (TEK). Aboriginal worldviews are based on an assumption that the goodness of human action is based in an ethical and spiritual context as well as being physically and socially situated. While Western science is the practice of "positivist thinking that assumes only observable phenomena matter" (Castellano, 2004, p.103). Of paramount concern for many scholars is the separating out of TEK from the whole (three hundred and sixty degree vision) of Indigenous Knowledge contending it is a Western concept that separates and compartmentalizes Indigenous Knowing.

Aboriginal scholars (Simpson, 1999; Cajete 2000; Kawagley and Barnhardt 1999) suggest a number of concerns about the prospect of separating Traditional Ecological Knowledge from Indigenous Knowledge (IK). Battiste and Henderson (2000) Mi'Kmaq scholars whose research focuses on education have defined TEK as necessarily inherent within Indigenous Knowledge:

...based on awareness, familiarity, conceptualization, beliefs acquired about an ecosystem. Its relationships with an ecosystem are maintained by accumulating experiences, conducting non-formal experiments, and developing intimate understandings of the given consciousness and language, at a specific location and during a specific period of time. Also, Indigenous knowledge is not static but, like the shifting dynamics of particular ecologies, changes over time. It is a learned way of looking at the world that may have different forms of acquisition, transmission and manifestation for different Indigenous peoples. (p. 48)

This discussion supports the view that TEK is inextricably woven into IK. The simple act of trying to separate this body of knowledge from the holistic view of IK disembodies it from its life source and subtly procures a death or a loss. A prolific Aboriginal writer on the subject of TEK, Simpson (1999), has serious concerns about the ethics of separating and compartmentalizing Traditional Ecological Knowledge:

The term "traditional ecological or environmental knowledge" and to some extent the concept of TEK has been invented by non-Aboriginal academics and researchers. It is often described by non-Aboriginals in a way that mis-represents Aboriginal knowledge, that commodifies Aboriginal Knowledge for consumption by the mainstream society that appropriates the power and responsibility that goes hand in hand with possessing knowledge. TEK is not an accurate description of the knowledge that Aboriginal People have about the "environment", rather it is an accurate indication of what the dominant society sees as valuable, reliable and useful, and this is reflected in mainstream definitions of TEK. (p. 49)

Her objection stems from an Anishinaabe way of knowing and points to a continuation of colonization and 'cognitive imperialism' by non-Aboriginal people and their

misappropriation of TEK. In her work Simpson presents both the non-Aboriginal way of viewing TEK as well as the Aboriginal. She notes the difference in their scope:

Many non-Aboriginal authors write about the inappropriateness of the term TEK, usually focusing on debates regarding the meaning of the word traditional and the term ecological. Most Aboriginal authors use definitions, which are broad in scope in comparison, and they include responsibility, values, worldview, Natural Law and spirituality. (Simpson, 1999, p. 52)

Simpson extracts from The Assembly of First Nations (AFN) and the National Aboriginal Forestry Association (NAFA) a statement that does not follow a strict definition of TEK, but presents it in a more holistic way:

Indigenous experts working in this area [Indigenous Knowledge] have made it clear that they do not find any current external expressions or definitions of Indigenous Knowledge to be appropriate. These are seen to be either self-serving, or to exclude certain essential elements – particularly those spiritual aspects which western scientists sometimes find difficult to digest. (AFN and NAFA 1995, p.1, in Simpson 1999, p. 52)

The AFN and NAFA go on to formulate ‘four interlinked elements’ embodied in TEK:

- 1) The creation myths and cosmologies, which explain the origins of the earth and its people.
- 2) Those codes of ritual and behavior that govern peoples’ relationships with the earth.
- 3) The practices and seasonal patterns of resources utilization and management that have evolved as expressions of these relationships.
- 4) The body of factual knowledge that has accumulated in connection with these practices (AFN and NAFA 1995, p. 2)

These two organizations emphasize that non-Aboriginal people tend to pay more attention to the last two elements (3&4) than to the first two, which are more about “worldview and ethical concerns” (Simpson, 1999, p. 53). This is significant information that supports the argument against identifying TEK as a separate body of knowledge

especially when considering the powered interdependency of a holistic knowledge system. Taking only pieces of a whole knowledge system can be dangerous and results in misappropriation. As Witsuwit'en elder Madeline Alfred explains,

You have to know what you are doing when you use these medicines. You have to know how to find the right plants, when to get them, and how to prepare the medicines. Finally, you have to know how much to take and how long to take it. People who know about Indian medicines have learned all of these things. (Gottesfeld, 1991, p. 24)

At present in this time of Negotiation and Renewal Aboriginal voices are trying to negotiate, but are having trouble being heard in the science controversy over the 'tin ear'⁶ of Western ideology. The Witsuwit'en clearly make the distinction between the two points of view.

The Western world-view sees the essential and primary interactions as being those between human beings. To the Gitksan and Wet'suwet'en, human beings are part of an interacting continuum, which includes animals and spirits. Animals and fish are viewed as members of societies, which have intelligence and power, and can influence the course of events in terms of their interrelationship with human beings. (Gisday Wa & Delgam Uukw, 1989, p. 23)

The discourse in science publications argues the differences inherent in the sciences as practiced and understood in the non-Aboriginal and Aboriginal worldview. Some concern themselves with misappropriation and separating TEK out of Indigenous knowledge, while others are working to bridge the gap between Western science and TEK. Both arguments view Traditional Ecological Knowledge as scientific. Kawagley and Barnhardt (1999) present an extensive list of at least fourteen distinct differences between Aboriginal Ways of Knowing science and Western science. Their work

⁶ (Appendix 2) Judge McEachern in the Gisday Wa and Delgam Uukw court case, embodies the old worldview of Aboriginal society specifically annotated in 'The tin ear' cartoon where he is depicted as needing a cultural hearing aid. (Monet D. & Skanu'u, 1992, p. 43).

highlights the values within both points of view and suggests that both worldviews can be recognized in presenting the greatest opportunity for Aboriginal students in the sciences.

Western scientists however have historically challenged the validity of TEK and IK as a science. Battiste and Henderson (2000) support the argument that TEK is science. They write about the Traditional Ecological Knowledge embedded in Indigenous knowledge as “scientific in the sense that it is empirical, experimental and systematic” and different from Western science because “Traditional Ecological Knowledge is highly localized and it is social” (p. 44).

Indeed, we suggest that the knowledge systems of Indigenous peoples are more self-consciously empirical than those of Western scientific thought--direct personal efforts as a hunter, fisher, forager, or farmer with minimal mechanical technology. Since every individual is engaged in a lifelong personal search for ecological understanding, the standard of truth in Indigenous knowledge systems is personal experience. Indigenous peoples may be suspicious of secondhand claims (which form the bulk of Eurocentric scholars' knowledge), but they are reluctant to challenge the validity of anyone's own observations. (Battiste & Henderson, 2000, p. 45)

Battiste and Henderson frame two important concepts; the locally informed knowledge systems of Aboriginal people over generations of living and being on specific tracks of land (Kawagley & Barnhardt, 1999; Riddington, 1990) and the understanding of specialized, or expert in both worldviews. In the first place, Western scientists tend to base their findings on a 'visit' to a location over a limited period of a time and make far-reaching conclusions based on small samples of isolated data.

Indigenous people who have traditionally lived within particular ecosystems can make better predictions about the consequences of any physical changes or stresses that they have previously experienced than scientists who base their forecasts on generalized modes and data or indicators from relatively short-term field observations. (Battiste & Henderson, 2000, p. 44)

For Witsuwit'en elder, Madeline Alfred (Dzee) this translates as, "We take care of the land and respect it as well as the animals. You don't use one area over and over again and deplete one area, you always take care of the land and go to another area." (Gisday Wa & Delgam Uukw, 1989, p. 63)

In the second place, is the discussion over who is considered expert in the Western worldview and the Aboriginal worldview of science. In the Aboriginal worldview according to environmentalist Louis Grenier (1998), "All members of a community have traditional ecological knowledge: elders, women, men, and children. The quantity and quality of the Indigenous Knowledge that individuals possess vary"...(p.2) This depends on an individual's relation to the self, their standing in the community which is immediate to their spiritually derived knowledge (Battiste & Henderson, 1999; Kawagley, 1995; Simpson, 1999; and Gisday Wa & Delgam Uukw, 1989) and the ecology specific to their survival. The Witsuwit'en in tandem with their immediate neighbours suggest the difference and similarities between the two worldviews in recognizing the qualified specialists.

The test of the expert's truth in the Western scientific tradition has two facets: On the one hand, there is expertise by virtue of special training and discipline, while on the other hand there is discovery and truth by virtue of testing hypotheses under controlled conditions. In the Gitksan and Wet'suwet'en system of knowledge, there are properly qualified specialists: hereditary Chiefs and elders, and they have responsibility for facts that are more than individual opinions. Also, a Chief has undergone specialized training and study, thanks to which he or she can be trusted to ensure that facts are stated and ordered in the proper manner. Finally, this stating and ordering amounts over long periods of time, often reaching far beyond the life-time of any single Chief, to a test of truth. By surviving in the Feast system, facts acquire higher status, and come to constitute part of accepted knowledge – much as scientifically verified facts assume the status of knowledge in the Western tradition. (Gisday Wa & Delgam Uukw, 1989, p. 40)

Kawagley (1999) and Cajete (2000) express that what is important to this holistic understanding of the knowledge of people and place is its connectedness to the heart, mind and spirit of the self. Western scientists often prefer to acquire data in isolation; in isolation from the place of origin; in isolation from feeling for the subject being studied; for the sense of life that comes from that subject and from its relation to the whole. Western scientists have been known to take their data from a specific location and then go home (elsewhere) to interpret it. From a Yupiaq perspective this limits the knowing and is incomplete. Yupiaq elder and scholar Oscar Kawagley gives an example of holistic learning by teaching about the element of air:

The weather's dynamic is such that each part is part of a part, which is a part of another part and so on. The local Native elders can explain how they are able to predict weather based upon subtle messages given to them by the wind and sun twenty-four hours earlier. This involves the language of feelings from the inner world coupled with the language of reason. (Barnhardt & Kawagley, 1999, p. 131)

According to Kawagley (1999) and Cajete (2000) the concept of "turning inward" is an important construct of Aboriginal science knowing. Integral to understanding the Spiritual connectedness of life is the knowledge traditional Aboriginal people hold that affirms by knowing oneself one comes to understand their connectedness to the universe. This sense of knowing is based on a deep faith:

To the Yupiaq listening---not only with the ears, but combined with the heart was essential to become aware of patterns and events that natural eyes describe. The sun will rise and descend each day; the earth will continue to revolve around the sun; the spruce seeds will germinate. These recurring phenomena will continue to occur in a given way. We accept these on faith, that life is science... Nature is science. Science is nature. (Kawagley, 1999, p. 203)

The difference between Aboriginal worldview and non-Aboriginal scientific thought and what constitutes science is clarified in the opening address of the 1987 court case in *Smithers, Gisday Wa and Delgam Uukw vs. the Supreme Court of BC*. An argument is made for why it is difficult for Western academics to see Aboriginal worldview as scientific:

In Western society causality is viewed as direct and linear. That is to say, that an event has the ability to cause or produce another event as time moves forward. To the Gitksan and Wet'suwet'en, time is not linear but cyclical. The events of the "past" are not simply history, but are something that directly effects the present and the future.

The Gitksan and Wet'suwet'en believe that both humans and animals, when they die, have the potential to be reincarnated. But only if the spirit is treated with the appropriate respect. If bones of animals and fish are not treated with that respect, thereby preventing their reincarnation, then they will not return to give themselves up to humans. In this way, a person's actions not only interact with those of the animals and the spirits, but also have repercussions for future generations, deprived of the food that will ensure their survival...

It is important to reflect on how such a view of causality would be rendered conceptually from within a Western framework. Such a view would not be regarded as "scientific" and such attribution of events to the powers of animals or spirits would be characterized as "mythical". (Gisday Wa & Delgam Uukw, 1989, p. 23)

Accordingly, Dumont (1976) maintains that what the White Man needs to learn from the original story is, "In modern times, especially, it is the one who chose the straight-ahead-vision who must recognize the ultimate value in the all-around-vision, and, must see the necessity of returning to this more primal and total way of seeing the world" (p.12). At this stage in history, Negotiation and Renewal, the earth and the environment may be the window we look through to see the value in both scientific ways.

Bridging TEK & Western Science in the Classroom

“In the Cree language system, the closest word to interpreting the word “science” is simply, ‘life’” (Mullens, 2001, p. 8).

Bridging these worldviews for the sake of educating Aboriginal as well as non-Aboriginal students in science has become the work of Aboriginal scholars and educators (Battiste 1998; Cajete, 1999; Colorado, 1988; Kawagley, 1995 & 2002; Simpson, 1999 & 2000, Smith L., 1999; Smith, G. 1999) as well as others (Fleer, 1999; Kimmerer, 2002 and Snively and Corsiglia, 1990 & 2000). In the final analysis most of these scientists and scholars have come to accept that both Indigenous Knowledge (IK) and Western science have something to offer to the contemporary world of science education. The suggestion is that together they may have more value than separately. Barnhardt & Kawagley (1999) have built into their work in science and research an educational application for the Indigenous worldview. This includes: long-term perspectives spanning many generations; interconnectedness of all living things; adaptation to change, and commitment to the idea that the whole is greater than the sum of its parts (p. 134). Models, examples, and explanations of the bridging that needs to take place in Western education that recognizes “both Indian science and Western science” are the wellspring of this generation. “Traditional Native science must be articulated in contemporary terms to permit scholarly exchange, growth and to empower Native people in the scientific arena” (Colorado, 1988, p. 49).

The research in this area suggests many reasons for the shortage of Aboriginal students pursuing careers in science. Important among them is the lack of relevance Western science has to Aboriginal worldviews (Cajete, 1994; Ignas, 2004; Kawagley,

1995; Simpson, 2002; Thompson, 2003). The importance of Indigenous Knowledge to local curriculum development is best presented by Oscar Kawagley, a Yupiaq Indigenous science educator, who has dedicated the latter part of his life to finding ways to teach science that will respect traditional worldviews as well as the sciences of the modern world. Respected elder and academic, Angayuqaq (Kawagley, 1995) explains that Western science can be made more relevant if one begins with traditional cultural practices. For instance, the practices in a traditional Yupiaq fish camp can relate to Western science education in Yupiaq schools. He speaks of the fish camps in his homeland as a “Cornucopia of Traditional and modern technologies”(Kawagley in Settee, 2000, p. 2).

Fleer (1999) has constructed a table identifying the elements and giving examples found in Aboriginal science in traditional communities in Australia. They include the concepts of: “A holistic versus a reductionist approach; an ecology based approach; an inclusive approach versus the specialization of knowledge; knowledge as spiritually framed and contextualized versus decontextualized science” (p. 122).

There have been different ways of approaching the interfacing of Aboriginal science and Western science in education, ranging from total conversion or immersion in IK to more of a supplemental adjunct. In BC for example, the government’s Ministry of Education (2004a) has recently distributed an integrated resource package suggesting examples of ways to include Aboriginal science into the curriculum alongside the Western science model. In the table of contents it is stated that there is, “This Integrated Resource Package (IRP) that provides basic information teachers will require in order to

implement Science K-7” and that there has been an “integration of Aboriginal content in the prescribed learning outcomes” (Draft 2 June 2004, p. 3).

Today, Kawagley uses Aboriginal myth and story telling to explore Western scientific and mathematical concepts. He has also developed curriculum for Aboriginal students in Alaska to help them conceptualize their way of knowing. For example, instead of bringing the fish into the classroom to dissect it, his strategy is to take the kids to a fish camp. It is there on the land doing the tasks, relating to themselves as achievers, relating to the elders, to the language and to all of creation that they are able to come back into balance and learn the Natural laws of respect and honesty (Kawagley, 1995). He would call this commonsense knowledge because it is socially situated, context dependent and human centered (Aikenhead, 1996). Like Kawagley and Simpson and others Aikenhead maintains,

If science education is going to contribute to First Nations economic development, environmental responsibility, and cultural survival, students will need to learn, and to eclectically use in practical everyday situations, many ways of knowing: Aboriginal common sense, Aboriginal and Western technology, and Aboriginal and Western knowledge of nature. (p. 265)

Kimmerer (2002) an American educator and ecologist, supports a relationship of the two, based on the benefits for the global community and the holistic understanding of nature when seen in spiritual, scientific and cultural values. However, he believes that the dominant society must make the movement towards an understanding of Aboriginal holistic values.

At the undergraduate level she has experienced students’ frustrations with science...A number of very capable students tell the story of abandoning their science education and a potential place in the scientific community because of the perception that science prohibits the expression of personal connection to nature... But the goal is not

to appropriate the values of indigenous peoples. As an immigrant culture, Americans must start to engage in their own process of becoming indigenous to this place...(p.437)

This is a significant statement in light of the movement taking place in the Dockstator's model (1996) (Appendix 1) of Negotiation and Renewal between Aboriginal and non-Aboriginal worldviews.

The Canadian system of education has been trying to colonize and assimilate Aboriginal people all over Canada since the beginning of residential schools in the late 1800s. Kawagley describes the injustices done to his people by Western colonization in a circle diagram. At the center is the individual being (self). In each direction around the central being he illustrates four major segments, Spirit, Emotion, Mental and Physical. He explains, that first the colonizers divested the people of their Spirit. It was the first to go in those who had a good sense of self and were strong. This was followed by Emotion. Emotion was lost because you felt so bad, then Intellect because you couldn't measure up and finally the last to go is the Physical. So many people are dieing from DIS-ease, cancer, HEPC and diabetes (Lecture, 2004). We are in an era, the fourth stage of contact, when many Aboriginal people are shouting to be heard. The book *Reclaiming Indigenous Voice and Vision* by Battiste (2000) is a testimony to these times. The Eurocentric worldview has produced a very singular society rooted in domination over and alienation from the natural world. In science education, if we compare the Aboriginal worldview with its deep-rooted teachings of respect, responsibility and reciprocity to the three R's (Reading, wRiting and 'aRithmetic) the two worldviews look quite different. Fundamental to these views is the dissimilarity in child centeredness. For Cajete it is the education of the whole child, not just the mind and the physical that creates an informed,

confident and successful person. At the root of this educational perspective is the holistic thought process of Indigenous knowing that encapsulates Indigenous science. Smith (2002) and Cajete (1999) have attempted to speak to the reemergence of the Aboriginal peoples culture and knowledge into mainstream society. Closing the gap on Negotiation and Renewal needs to take place in education. There are clearly two ways of knowing science. It is important to move toward accepting Aboriginal knowledge in the sciences. Cajete (1999) sees the challenge for non-Aboriginal educators in moving toward accepting Aboriginal knowing in science.

Becoming open to the paradigm of Indigenous science has some prerequisites which need to be considered. There must be an understanding and acknowledgment of the history of exploitation of Indigenous peoples by Western culture and science. There must be a willingness on the part of the non-Indigenous teacher to view science from a perspective that is "inside out, upside down and the other way around" or, more simply put, without bias and with deep vision which allows for a deep examination of habitual thought processes. This means reflecting on Indigenous science based on its own terms and methodologies without stereotyping or trivializing its essential components. (p. 185)

Teachers And Educational Change

Teachers' capacities to deal with change, learn from it, and help students learn from it will be critical for the future development of societies. They are now in a position to play this vital role. We need a new mindset to go deeper. (Fullan 1993, p. ix)

Since the 1990s educational reform increasingly appears to mirror the cornerstones of Native education as presented by Cajete (1994). Newly established teacher training programs emphasize moral thought over empirical thought and present a holistic approach that speaks to the power of self-knowing, collaboration and interrelationships. Assessment techniques are expanding to include self-reflection, sharing ideas and stories, observing and modeling all to encourage student/teacher ongoing continual growth and improvement. Cajete (1994) speaks of such a process as 'right education'. "Right education causes change that in time creates a profound transformation of self" (p. 210). For Cajete "Educating and enlivening the inner self is the imperative of Indigenous education embodied in the metaphor "seeking life" or "for life's sake" (p. 209). Cajete explains how "Education for wholeness, by striving for a level of harmony between individuals and the world is an ancient foundation for all cultures" (p. 209). He maintains that "The goals of wholeness, self-knowledge and wisdom are held in common by all the traditional educational philosophies around the world" (p. 209).

Fullan, who has published widely on the topic of educational and teacher change identified in 1993 that:

Teachers and teacher educators do not know enough about subject matter, they don't know enough about how to teach, and they don't know enough about how to understand and influence the conditions around them. Above all, teacher education – from initial preparation to the end of the career – is not geared towards continuous learning. (p. 108)

Researchers and educators Greenberg, Williams, Barnhardt & Kawagley were already engaged in the process of developing models to help teachers teach to a diverse student population with special (including cultural) educational needs. Fullan (1993) wisely identified that one of the missing ingredients in the recipe for educational change and innovation is “knowledge of process” (p. 2). Education and teacher reform in Canada and the broader educational community has evolved to include teachers learning to learn, educational reculturation and restructuring. According to the experts this model needed to be inclusive and holistic, where the whole is seen as greater than the sum of its parts. Senge (1990) refers to it as systems thinking, where “all are concerned with a shift of mind from seeing parts to seeing wholes, from seeing people as helpless reactors to seeing them as active participants in shaping reality” (p. 69). The models for the new millennium are based on a philosophy of holism. Teachers need to see the whole picture and its interrelatedness. Senge (1990) purports that “the essence of systems thinking lies in a shift of mind: seeing interrelationships rather than linear cause-effect chains and in seeing processes of change rather than snapshots” (p. 73).

Educational Change

Kawagley (1998); Fullan & Hargreaves (1992) and Sikes (1992) see successful educational change as necessarily involving the whole system where school districts, staff and community need to buy into effective means of dealing with change, in order to better serve the needs of their diverse client population. As someone who has implemented change within Yupiaq school districts Kawagley (1998) cites, Manuel Gomez’s analysis of the notion of systemic change in education. “Educational reform is essentially a cultural transformation process that requires organizational learning to

occur: changing teachers is necessary, but not sufficient. Changing the organizational culture of the school or district is also necessary" (Gomez, 1997 in Kawagley, 1998 p. 9). For Barnhardt & Kawagley this type of change applies to both the formal education system and the Native knowledge systems in rural Alaska.

The culture of the education system as reflected in rural schools must undergo radical change, with the main catalyst being standards-based curriculum grounded in the local culture. In addition, the indigenous knowledge systems need to be documented, articulated and validated, again with the main catalyst being standards-based curriculum grounded in the local culture. If we are to abide by the principles of complexity theory and seek to foster the emergent properties of self-organization that can produce the systemic integration indicated above, then it is essential that we work through and within the existing systems. (Barnhardt & Kawagley, 1998, p. 9)

How change manifests has become the stuff of educational research and literature for the last two decades. Kawagley (1998) and Fullan (2001) both identify change through the dynamics of the science of chaos and complexity viewing them as catalysts for change. Kawagley and Barnhardt include culture as a catalyst highlighting:

The new sciences of chaos and complexity and the study of non linear, dynamic systems have helped Western scientists to also recognize order in phenomena that were previously considered chaotic and random...Thus there is a growing appreciation of the complementarity that exists between what were previously considered two disparate and irreconcilable systems of thought. (Kawagley & Barnhardt, 1998. P. 4)

The authors of this paper see the partnering of these two knowledge systems as "synergistic".

Barnhardt and Kawagley have also been working tirelessly for cultural and educational reform. Their work is centered in The Alaska Rural Systemic Initiative in concert with the University of Fairbanks and a Federal Science shareholder. They have just completed their twelfth year of implementation across 20 school districts stimulating

a reconstruction of the role and substance of schooling in rural Alaska while achieving success for Native students.

The educational reform strategy we have chosen -- to foster interconnectivity and complementarity between the formal education system and the indigenous communities being served in rural Alaska based on current concepts, principles and theories associated with the study of complex adaptive systems -- has produced an initial increase in student achievement scores, a decrease in the dropout rate, an increase in the number of rural students attending college, and an increase in the number of Native students choosing to pursue studies in fields of science, math and engineering. (1998, p. 18)

Fullan (2001b) has also done extensive work in partnering University and Teacher Training projects with district schools. Along with intellectual content they have also focused on the “the moral purpose” of teachers encouraging teachers in becoming change agents.

Barnhardt and Kawagley (1998) and Fullan (2001) maintain that education needs to lead the way in teaching about change to better reflect the strategies students will need in learning to manage in today’s world. They believe that education can better reflect the fundamental nature of society, which has as its core the agent of change. After over thirty years of educational change research Fullan recognizes the important interaction that needs to take place between society and education at a deeper level.

Education has a moral purpose. The moral purpose is to make a difference in the lives of students regardless of background, and to help produce citizens who can live and work productively in increasingly dynamically complex societies... what is new I think is that to do this puts teachers precisely in the business of continuous innovation and change...to make improvements in an ever changing world is to contend with and manage the forces of change on an ongoing basis. (1993, p. 4)

Fullan saw the possibilities in using teacher education as the tool for improvement and believed strongly that teacher in-service and university education must be the main “vehicle for producing teachers as moral change agents” (1993, p. 7). He clarifies that “Significant educational change consists of changes in beliefs, teaching style, and materials, which can come about only through a process of personal development in a social context” (Fullan, 2001, p. 124). The concern about teacher education and professional development was (and I might add still is) that a common barrier to teacher change was staff development that focused on skills, activities and behaviours. When in reality “many of the reform changes needed a shift in beliefs and values, which would take an intervention like dialogue, sharing stories of teacher practice and interaction with diverse groups involved in education” (Ricky, 1999).

Teacher Change

I chose to provide professional development in programs based on mediated learning because I believed that the most powerful agent for change, the one who is at the most strategic place to effect change, for students, for the school, and for the educational community, is the teacher. (Williams, 2005, p. 78)

There have been a number of projects and interventions initiated in Canada and worldwide in the effort to engage teachers and educators in change and to achieve a greater fruition of teaching innovation. Professor Katherine Greenberg, from the Department of Educational Psychology and Counseling at the University of Tennessee is the Founder of the Cognitive Enrichment Advantage Approach formerly known as (COGNET). Early in 1985 she recognized the systemic flaws in education and in 1988 she adapted Dr. R. Feuerstein’s theoretical work on the *Theory of Structural Cognitive*

Modifiability for implementing the Instructional Enrichment Curriculum. In this model building blocks of thinking and tools for independent learning are taught to empower students and teachers to learn. Similarly Dr. Lorna Williams (1997) has worked extensively on teacher change since the 1980s in her quest to help “ teachers improve their teaching practice to increase school achievement for First Nations learners” (pg. 78). Her work is situated in the theoretical model on structural cognitive modifiability presented by Dr. R. Feuerstein and adapted by Greenberg. Taking her lead from these arenas, Williams has worked with whole school districts, staff and management, to help teachers and administrators in Canada and elsewhere in the world to ‘learn to learn’ demonstrating, “When teachers, like others, are engaged in learning new approaches or new ways of teaching, they must accept that they too must be modifiable⁶ and that a change will occur” (Williams, 1997). Her dissertation (2005) explains the forces involved in the process of changing teacher’s belief, highlighting the success of such a model through the deep, enriching, spiritual experiences of teacher testimonials. Fundamental to William’s work is the necessity of providing a safe sharing environment for participants “We learned that they need a safe space for learning. A safe space helps them to take risks and respond to challenges” (p. 85). She identified (among other elements) a collaborative learning community and critical reflection as central to the success of teacher change.

“We transform our frames of reference through critical reflection. We must become aware of our habits of mind and points of view through reading, experiential activity, and interacting with others where we can compare new knowledge with past knowledge” (p.

⁶ Modifiability means “the openness to change one’s own practice, beliefs, abilities and capacities” (Feuerstein et al. 1988 in Williams, 2005).

70).

When discussing changing teachers' beliefs and values and changing education Fullan (1982) maintains, "Change is a process not an event" (p. 115). Consequently, his work (2001a) prescribes a recipe with key leadership components for change agents (teachers, facilitators, consultants, administrators) necessary to implement change. These include: a moral purpose, understanding change, relationship building, and knowledge creation and sharing as well as coherence making. He emphasizes all ingredients are necessary and must be infused with a sense of hope, enthusiasm and energy to ensure a commitment from teachers/students who at their core are intrinsically motivated such that "more good things happen: fewer bad things happen" (2001a, p. 4). Williams compliments this work with her piece on *The Participants' View of the Facilitator* in her dissertation. By having participants comment on her role as facilitator in the workshops they identified the important aspects of the role of facilitator as creating a safe learning environment, expertly knowing and managing the material, facilitating as a storyteller and as a role model.

O'Connell Rust and Friedus (2001) have listed common factors in successful educational change efforts. These include:

- Collaborative cultures that foster successful learning communities
- Instructional practices that are relevant to and are fully understood by teachers and students alike
- Instruction that is linked to the needs of the individual student as well as the standards of the external community. (p. 3)

In their research of the role and work of change agents they point out that to have cultural sensitivity is not enough by itself. That it takes understanding of both content and cultural sensitivity to be effective (p. 161). Fullan (2001b) believes educational change world wide has reached a new cutting edge the hallmarks of which are contained in the following:

It is a world where change is a journey of unknown destination, where problems are our friends, where seeking assistance is a sign of strength, where simultaneous top-down bottom-up initiatives merge, where collegiality and individualism co-exist in productive tension. It is a world where change mirrors *life itself* in which you can never be perfectly happy or permanently in harmony, but where some people (those with knowledge of how to view, cope with and initiate change) manage much better than others. (p. viii)

The value for non-Aboriginal teachers engaging a local Aboriginal worldview in science programs

Including Aboriginal knowing and science into mainstream education systems can inspire and retain Aboriginal students in the sciences and close the gap between Aboriginal and non-Aboriginal worldviews. Further readings (Ignas, 2004; Thompson 2003;) indicate the value for non-Aboriginal teachers in presenting an Aboriginal worldview in local science programs:

By establishing a connection between theory and the practice of pedagogy educators and researchers have begun to develop a better appreciation of how students construct durable and robust understandings of the world and their place within the world. This is a strategic position that assists Indigenous students in using the education system as a stepping-stone to further education as opposed to a barrier to further education. These advantages accrue not only to Indigenous students for whom the curriculum is designed, but also to multicultural students and all students with culturally diverse backgrounds, science educators and members of the larger community. (Ignas, 2004, p. 49)

To do this, education systems need to develop relationships with the local Aboriginal community and collaborate for better balance between the inclusion of Aboriginal Ways of Knowing and Western science. This means insuring that Western science is not taught to the exclusion of other ways of knowing but indeed looks locally for other ways of seeing that will complete its 180 degree vision. It needs to provide opportunities that honor the hearts as well as the minds of all students. A good example comes from Simpson (2000) who has found Aboriginal student success in Environmental Education programs that have their origins in Indigenous Knowledge systems:

As one of the most important ways of strengthening our cultures, promoting environmental protection, the realization of sustainable local economies, and supporting students through healing and decolonizing processes. It requires the participation and leadership of the Elders in

all aspects of the program, access to the land, the application of Indigenous education models and philosophies of education, the employment of Indigenous teaching and learning mechanisms, and a constant decolonization process for both instructors and students. It is a transformative process in its very nature. (p. 96)

In conclusion, in terms of what teachers need to know to help promote Aboriginal student success in the sciences, my review of the readings suggests the following:

- Teachers working with Aboriginal students learn, acknowledge and appreciate the heritage of Aboriginal peoples
- Paramount in the revitalization of Aboriginal science is the need for non-Aboriginal people to accept not only the knowing but the people and to actively prevent marginalization and misappropriation
- Non-Aboriginal people need to understand the concept of valuing, respecting and honoring the science masters of Aboriginal worldview, the people, the language and especially the Elders
- Aboriginal students and all students can benefit from a more holistic, multidisciplinary approach to education; based on the land, in close relationship to their Elders, their language and community. Education that essentially links ecological knowledge with science education.

The next chapter explains the methodologies used in this study to inquire into non-Aboriginal science teachers' thinking to determine their understanding of Aboriginal science concepts.

Chapter 3: Research Methodology

Introduction

I conducted my research in the Bulkley Valley School District to find out what local Euro-Canadian, non-Aboriginal science educators' ideas' and beliefs' were about science education. This study began in November of 2004 when I applied to the Ethics Review Board and was given permission to begin. At this time I also received written permission from the Superintendent and the Principal of Aboriginal Education to conduct this research in School District#54. From November 2005 to April 2006 I approached 35 teachers and two administrators in the different schools. I included primary teachers, intermediate teachers and high schools teachers of biology, chemistry and physics, in an effort to engage them in the research process.

Subjects were approached and asked if they would like to be a part of a project that would explore Aboriginal student success in the sciences. My introduction incited a wide variety of responses from sincere interest to outbursts of condemnation. One Grade 10 biology science teacher exclaimed, "No way I am not doing any mythological stuff in my class. Just like I wouldn't teach creationism or evolutionism or... no way – not in my class! When I tried to define Aboriginal science for him he thought for a moment and said, "Oh. Well Aboriginal students in my class made a herbarium for a science project once and it was really good. But no I don't have time for this!" On another occasion a high school chemistry teacher lectured me on how he'd, "taught on reserve. I've been out to the land – what exactly do you think I am going to learn there?" "What is supposed to happen that will change my mind?" "I've been out to the land." He was caustic and appeared angry with me. "No I don't think I'll get anything out of this!"

I met personally with individual science teachers in their elementary and high school settings to explain my intentions and to enlist their support. The field trip out to Witsuwit'en territories I was planning with Witsuwit'en elders became the drawing card. It peaked their interest and seemed to pull them in. At the same time I distributed the ethics forms, the questions for the pre-questionnaire and set up dates to record the teacher who chose to respond orally. Teachers needed continuous reminders to complete their questionnaires and return them to me through the email or the inter-school mail. By March 29th, nine days before the scheduled field trip on April 7th and 33 teachers later, I had a definite yes from seven, one maybe and a few (5) completed pre-questionnaires. Right up to the actual day of the field trip I was unsure of the numbers. My intuition told me to rent a van that would seat 15 people. One of the teachers agreed to drive and in Smithers 11 people piled in including the elders. We picked up three more teachers in Houston, 45minutes away. A lead truck guided us out to Witsuwit'en territories two hours south west of Smithers. It held the new Witsuwit'en Treaty Negotiator and was driven by a Witsuwit'en volunteer. Later in the trip, 2 of the 3 teachers we picked up in Houston chose to travel in this truck rather than the rented van. The Principal of Aboriginal Education, her children, the child of one of the teachers and a high school Asset worker took up the rear in another van. We spent the April 7th Professional Development day on the Witsuwit'en territories learning from Witsuwit'en elders. One teacher participant was later to remark, "Thanks, this was a breath of fresh air from many other Pro-Ds!"

Almost three weeks later on April 28th, nine of the eleven participants from this field trip plus two more teachers were able to join us for lunch and the second workshop.

Aboriginal Educators and community members were also invited. This second workshop consisted of an informational session, a dialogue and a brainstorming session and was held in the Aboriginal Learning Center in school district #54. Following this session a post-questionnaire was distributed for participants to respond to immediately (or in their own time) in tandem with a give away (gifting) to all those in attendance.

To accomplish this work I applied a broad range of qualitative strategies, within the methodological framework of Naturalistic Inquiry. The components of the research design included questionnaires, experiential and informational workshops, a luncheon and a dialogical group process to focus on teachers' thinking, specifically teachers' knowledge, understanding and appreciation of science as it relates to Aboriginal worldview and Aboriginal student success. As an individual new to the field of research I was enticed by the practice of "formulating, following, and developing answers to significant questions about social contexts in a manner that would empower not only the researcher but also every individual found within these contexts" (Erlandson, Harris, Skipper, Allen, 1993, p. xviii).

Theoretical Framework

Naturalistic Inquiry

I chose the broad framework of Naturalistic Inquiry as the theoretical base of my work because it is a qualitative methodology that “focuses on understanding an event or situation from the participant’s perspective” (Mellon, 1991, as cited in Robertson, 1991, p. 348). Mellon (1991) encapsulates the Naturalistic Inquiry process as one where, “the researcher arrives at a “working theory” near the end of a cycle in which subjective data are first collected and analyzed and the hypothesis itself is refined during many repetitions of a cycle.” (p.348) These cycles presented themselves in my work within the various strategies and stages of subjective, open-ended questionnaires, experiential learning, feasting, an instructional workshop and a dialogue session presented in the form of a talking circle. It was through these processes, which eventually cycled back to an equally open-ended and subjective post questionnaire, that my findings as a Naturalistic researcher emerged. The application of this theoretical framework is explained by Erlandson, Harris, Skipper and Allen (1993):

Naturalistic findings are, literally created through the hermeneutic-dialectic interaction between and among the inquirer and various implicated groups ... found in the setting being investigated. The interaction leads to destruction and reconstruction all around; the hope is that consensus may be achieved on some emergent construction that provides stimulus and guidance for action (although the hope may well not be realized). (p.xiv)

Activities were purposely created throughout this research process to stimulate interaction among the Aboriginal and non-Aboriginal participants. The circle work methodology of this study that took place informally on the land and more formally in the

dialogue session, contained aspects of what Lincoln and Guba (1985) cite as the 'hermeneutic dialectic process'. The exchanges within the circle work held some of the elements Lincoln and Guba define as interpretive in character (hermeneutic), where divergent viewpoints are compared and contrasted in an attempt to bring about a synthesis (dialectic). The underlying intention was to encourage relationship building. "The major purpose of this process is not to justify one's own construction or to attack the weaknesses of the constructions offered by others, but to form a connection between them that allows their mutual exploration by all parties" (Lincoln and Guba, 1985, p. 149 as cited in Erlandson et al., 1993, p. 124).

The field trip was one way of providing such interaction. It included hours of driving out on the Witsuwit'en territories and back. I rented a fifteen-seater van to allow for all participants including the elders Gisdaywa⁷, (Alfred Joseph) and Wigetimstochol, (Dan Michell) to ride together to the sites. A lunch was planned to gather us together on the land so we could all hear the elders' stories. At an additional workshop the following week, a traditional Aboriginal foods luncheon was prepared to make the participants feel welcome and to encourage further discussion. It was followed with a dialogue process. All of these strategies were employed to, " build rapport, develop trust, understand the [Aboriginal] culture and to allow for quality time for participants to construct shared realities with the people in that setting" (Erlandson et al., 1993, p. 59).

Constructed, shared realities, are an important aspect of Naturalistic Inquiry and pertinent to this research. What was implied in the recruitment of the participants to this study was the expectation that I would be taking a group of people with constructed

⁷ *Gisdaywa*, old orthography *Gisdewe*, new orthography

realities analogous to one culture and putting them together with a group of people with constructed realities analogous to another culture.

In the same way that language constructs experience, it enables constructions to build on other constructions. As this occurs, the human mind devises ways of shaping experience that enable individuals to better adapt to it. Shared construction provides the basis for communication between people, and shared experiences and communication about them generate additional shared constructions. The totality of shared constructions among a human group is the foundation of their language and their culture. When people attempt to communicate with other people, they face increasing difficulty as the number of shared constructions decreases. (Erlandson et al., 1993, p. 24)

I hoped the participants would be able to construct meaning based on their interactions with other constructed realities. It was just this interaction of meaning and thought, “language, values and conceptualizing principles of those who constructed them” (p. 27) that became the source of my data.

I could not expect teacher thinking to change or be broadened simply by asking it to. Rather, I needed to provide the experiences necessary to develop the language⁸ on which the experience would be based. “The experience makes sense only if it is shaped by language. Piaget points to the emptiness of language without a basis of experience” (Erlandson et al., 1993, p. 22). The research demonstrated that as people come together in these shared experiences the possibilities for new realities are shaped.

As people from different cultures and settings come into contact with each other, they begin to share their constructed realities with each other. This sharing is never a straightforward, clear communication of the original constructions; it is shaped by the host of realities already constructed... These shared constructions, in turn, do much to structure

⁸ The term ‘language’ is used here to mean building a common understanding through talk during a shared activity.

the future activities and relationships between the groups. (Erlandson et al., 1993, p. 25)

Early in the field trip when the two Witsuwit'en elders began to converse with each other in their traditional language the chatter of the teachers fell away as they began to listen to the elders. In that moment I became aware that through the elders' talking others were made aware of the space between. Many of the teachers present had never heard the Witsuwit'en language being spoken. "The dialectal relationship between culture and language must be occurring such that it can flow out from its own space into others" (McKinley, 2005, p.238). By speaking their language the elders affected a shared constructed experience, which was serving to build a new constructed reality for those participants who may have never experienced elders speaking their language. One teacher (Participant G) expressed such a moment as becoming aware, "that we are all visitors on land we think of as our own."

The results of 'shared constructions' can be both positive and negative as articulated in the post questionnaires. Individual teachers expressed a change in the way they would proceed in the future in developing curriculum and in building relationships with people they met from the Aboriginal community, while others declined to continue after the field trip experience. Those who withdrew responded with, "it was a waste of time" or that there was nothing related to science they could use in the classroom. While their refusal to continue was offsetting for me I had to let it go. For me it showed an inability for them to be able to construct a new reality based on the field trip experience, and this was based on their own constructed reality, which they were not able to change at that time, under those circumstances.

Agostinho (2004) simply explains,

People perceive the world differently; therefore, reality is relative to each of us. Consequently, multiple constructions of reality exist, and these constructions can change over time as people engage socially in their world and become better informed. Thus, the purpose of [this] social science research is to understand and reconstruct the constructions people initially hold to form a consensus. (p. 5)

While on the surface it may appear that nothing is happening by taking the teachers out to the territories with the elders, a deeper cognitive connection is taking place. According to Mills (2006) the elder and chief Wigetimstochol, Dan Michell calls it a 'healing tradition'. "He ... follows the healing tradition of going out and taking people out to his House's traditional land, where the footprint of Bini is indelibly imprinted into the rock for all time" (p.5). In this exchange the non-Aboriginal people are accepting the elder as teacher and learning from that – from their perspective. "Creation of the emergent construction is a joint effort. That construction can be successful, both in terms of the commitment it fosters and the action it stimulates" (Erlandson et al., 1993, p. xiv). It is from this place of cross-cultural experience and understanding that action can truly occur. When the participant is enabled to consciously or unconsciously take responsibility, to give back, to take action, to care in the classroom. "...the impact of the process is both educative and empowering to those who participate in it, enriching their constructions by bringing them into contact with divergent ones. (Erlandson et al., 1993, p.125)

Naturalistic Inquiry seeks to maintain a 'natural context'. The sense of a 'natural context' was maintained throughout the fieldtrip and the dialogue since I wasn't able to predict what would happen until it happened. Then at that time I was forced to adjust and

to deal with occurrences or variables. "Naturalistic research design remains tentative until it is implemented" (Erlandson et al. 1993, p.68). For example, I was never sure how many teachers would definitely be participating in the field trip until the day of the field trip. The morning of the field trip, one teacher phoned in sick (Participant F). This was problematic for me because I felt I needed at least ten teachers for a core group of participants. I immediately phoned an interested teacher from the Christian high school, however it was too short notice. As it turned out one teacher, who had never previously indicated she was interested in coming, appeared at the pick up site. I also gained an additional recruit that morning, the new Witsuwit'en Treaty Negotiator because our guide and teacher, Alfred Joseph felt she would benefit from this experience. Since the field trip was being held on a Professional Development Day some participants asked that morning and the night before to bring their children. At this point I was glad I had arranged for a fifteen-seat van and the lead truck. The Principal of Aboriginal Education came in her own van that morning and wanted to drive. As much as I wanted her to be in the van with us it worked out well because she was able to bring the kids. Maintaining a natural context for me became synonymous with 'going with the flow'. Including a diversity of techniques meant being open and flexible in my planning.

As the research process unfolded and as I gathered new information I learned to use that information to adjust, to rearrange, cancel events and plans, or build on new knowledge. Originally I had planned an informational workshop prior to the field trip to the Witsuwit'en territories. This workshop was to be the first activity and would build a foundation for the journey. After speaking with 35 teachers in the hope of engaging them in this study I quickly realized two workshops might not be an option. There was a

general sense of resistance among many teachers. For the most part, they were unwilling to commit to multiple events or to attend a Saturday workshop. Due to time constraints on both the teachers and the researchers part the field trip became the hook. For those who expressed an interest the field trip experience became the catalyst for their participation. It also became clear, the fieldtrip had to be on a Professional Development Day in order to ensure teacher participation.

“New information and new conditions raise new questions that require the [Naturalistic] researcher to change plans and strategies” (Erlandson et al., 1993, p.70). I began to put off mentioning a second workshop to teachers until I could find a better time. As a result of talking with teachers and as a result of new information gained through the pre-questionnaires a series of changes to my plans took place at this time. I rearranged the format I had anticipated I would follow and began to initiate new strategies.

- I looked for another Pro-D day that might work, other than the district April 7th one. Many people were already committed to this one or had other plans. It turned out that May 19th was not an option for principals since it was a school based planning session for most schools and most principals expected all their staff to be present. In the end, April 7th was the best option.
- I asked the Superintendent of Education for leave time (.4) so participants could attend the second workshop.
- I had planned to culminate with a dinner feast to celebrate and thank the participants. I decided instead to shift to a luncheon feast of traditional Witsuwit'en foods and build the second workshop from there. It would also give

the participants a chance to re-group after the initial field experience. I found the time to share these new ideas with the teachers during our field trip. They were met with a favorable response.

- Reading the responses I received from the pre-questionnaires helped me bring some of the questions asked by the participants forward into the field trip session if teachers didn't ask them themselves. As a result of the pre-questionnaires and the field trip I had an opportunity to reconsider further aspects of my research such as the informational meeting, the dialogue and gift giving.

Journal Entry, April 10, 2006: On re-visiting the submitted pre-questionnaires I am shifting my plans at this point. Instead of filling out the post – questionnaire first, before the dialogue, I am waiting until after to give the participants a better understanding or more insight into Aboriginal peoples experiences in science. Also, because our day in the field was so long I am shifting the feast from a dinner to a luncheon so as not to further impinge on teacher time.

Naturalistic Inquiry lends itself to a wide selection of data collection techniques.

A significant piece of the data for this study came from the questionnaires. Contained within this method was the decision to give teacher participants a choice between written or oral responses to the pre and post-questionnaires. This included taped or written responses to a series of open-ended research questions. I found those who chose the taped interview, which was loosely based on a series of questions, were prolific in their responses and appeared comfortable in the conversational type of approach. Those who chose to write their questionnaires were given the opportunity to answer questions in their own time and place. Two questionnaires were made available to each participant choosing the latter. One was an emailed questionnaire that allowed for an expanded format and the other was a hard copy. While most responses were brief, both the written

and the oral format allowed for detailed description of participants thoughts and experiences. This contributed to the 'rich, descriptive detail' that added significantly to my research.

Erlandson also cites the dialogue as an area for collecting rich data. The questions in a dialogue are key to obtaining this type of data. Erlandson (1993) creates six categories of good types of questions to ask and explains how important the questions are to the process.

The key to getting rich data in dialogue is in asking good questions and in careful listening and recording. It is important to prepare a list of carefully worded questions that reflect the basic research questions and problem(s) of the study. However, the researcher must be careful not to be bound or overly structured by those questions and to allow them to naturally emerge...(p. 88)

As a result of the social context in which this research took place, observation became a key component of my work and a form of data collection. I was among colleagues, some I knew and some I didn't know, as such I became both a participant and an observer. Finding a balance within that paradigm was often times difficult. However, I agree with Erlandson et al. (1993), that my participation in the group was secondary to my role as information gatherer. "The challenge was to combine participation and observation so as to become capable of understanding the program as an insider while describing the program for outsiders" (Mirriam 1988, p. 93, 94 in Erlandson et al., 1993 p.97). During the field trip circles often formed around the different elders. I found myself involved in only one and often as both a participant and observer. In some cases I would only briefly have a chance to observe the other circles. This same situation presented itself in having two dialogue circles. And again during the informational session where I was presenter I found I became both participant and

observer. It was hard to be in two places at once and to separate between participant and observer enough to get the necessary data. Upon reflection, the difficulty this situation posed may have been alleviated somewhat with the use of a tape recorder to record participant responses during the circle work. At the same time it may have inhibited the free flow participation and compromised participant confidentiality.

Inherent within the process of Naturalistic Inquiry is an element of the unknown, which suggests a reliance on the intuitive responses of the researcher and calls into play an additional skill set called 'intuitive observation'. "...most adults have lost much of the natural ability to learn by careful and intuitive observation. Much is to be gained by looking, listening, feeling, and smelling rather than by merely talking..." (Erlandson et al., 1993, p. 99). Although my research was not centered in the interview process, the variety of social settings including the dialogue session, served as a type of interview such that the dialogue coupled with my observations built understanding of a social context in an interactive way. "...in naturalistic research, interviews take more of the form of a dialogue or an interaction" (Erlandson et al., 1993, p.85). It was the very interaction of these two means of data collection, intuitive observation and interview that enhanced each other and created a foundation for analysis that wouldn't have otherwise been possible.

"The naturalistic researcher will need to plan for anticipated circumstances, but decisions as to how one will deal with them must be left until the context of time, place and human interactions is better understood" (p.67). The plan I had for the field trip became woven into the plans of others. The elder's had their own plan as to what would take place out on the territories; the Principal of Aboriginal Education had a plan for

including children; Gisdaywa had a plan for inviting the new treaty negotiator, as well as the plans of individual teachers. In other words, there was a plan, but the way in which it unfolded was very organic and depended on the people taking part, the places we chose to go and the time frame. Similarly the dialogue process was planned well in advance with invitations, questions, a time frame etc. But it too was a living organic process dependent on 'the context of time, place and human interactions'. My research was closely related to Naturalistic Inquiry within these natural contexts.

Part of the plan for the field trip was to hike into a sacred village site on the shores of Sam Goosley Lake, but there was too much snow, which we knew might be a possibility. So we had to change strategies, midway. This meant finding a different place to stimulate a similar experience. Upon realizing we were not walking into the site, the two elders, were repeatedly questioned by teachers about what we were going to do? Where were we going? Out of respect I waited for the elders' decision. It was not my place to jump in at this time. When some teachers didn't receive an immediate answer they continued to question the chiefs while the driver of the van, having stopped, scarcely paused for directions and immediately began backing up. In watching this exchange, I observed as well as sensed that the hereditary chiefs, Dan Michell and Alfred Joseph who had created this plan were deciding what to do in this case (We had previously discussed stopping at the lake as an alternative). They were contemplating, adjusting to their next move. For many of the teachers in the van the elders' long silence was uncomfortable and their lack of immediate response was taken to mean they didn't know what to do. The teachers' impatience signaled a cultural disconnect. Aboriginal scholar Cajete (1986) explains the perception from an Indigenous worldviews perspective. "All things unfold in

their own time." "Patience revolves around respect for individuals, group consensus and 'the second thought'" (p. 178). For me witnessing this experience it felt like a moment of cross-cultural discord. It highlighted the dissimilarity between cultures in the time/space realities. From a Native perspective Colorado (1988) calls this, "HAASHAGOON, the Historical Now: HaaShagoon is a concept by which Native science collapses time and space (i.e. collapses the distance between the creating and the place" (p. 54). This was a sacred site for these men, which inspired a deep connection to place in the past, present and future, while for the non-Aboriginal teachers it was seen as an historical site, a place on a map that held no connection for them.

In Western thought, history is no more than an objective chronology of the occurrences of events. Where as to Natives, it is a way of experiencing all of the feelings, emotions and responses to events experienced by ancestors, beginning with the creating.
(Woodrow Morrison, Jr. 1987 as cited in Colorado, 1988)

Although in total only a few moments passed, the sense that the elders needed time and space for discussion, to arrive at mutual agreement was lost on the non-Aboriginal teachers. As a consequence a window of opportunity was missed in which Dan could have redirected us. The over zealotness of the teachers had meant we didn't stop to contemplate new ideas as a result of this new situation nor allow time to come to consensus. (In retrospect I wondered how this might transfer to the classroom?)⁹ We ended up down the road far from the lake rather than stopping and possibly hearing the stories in view of the selected site. This disconnected Dan's story and teachings from the sacred place. I make this point because Erlandson et al. (1993) makes the case that in selecting a site the element of time spent there is important. "A brief stay may prohibit

⁹ Avoid "pressure on Indian students to make quick decisions or responses" in class. (Cajete, 1986, p.178)

the time needed to build rapport, develop trust, understand the culture and obtain a sufficient amount of in-depth data, there by diminishing the probability of constructing shared realities with persons in the setting” (p. 59). This seems especially important in light of losing two of the participants after this day in the field. I feel the brief stay at that spot to be significant although I observed additional contributing factors to the withdrawal of these participants. Erlandson et al. (1993) suggests that planning for the right amount of time to be spent at any one site is, “relative to the research problem, to the context’s scope and complexity and the researcher’s abilities and skills” (p. 59). As a novice researcher I found that allowing for just the right amount of time became one of my biggest challenges since it often meant relying on my intuition.

Having said this the lessons of spirit we gained from the elders at this point in our journey remained very powerful and were etched in many of our minds. One participant remarked how, “It was marvelous to hear about the markings at birth. One fellow was marked with a feather and the agility of a squirrel so he would be strong and would be able to walk, climb and hunt for his clan” (Participant J). Another teacher recalled how important this knowledge [the spiritual aspect] is because how else do you get to know about people? (Participant A)

Indigenous Research

The ethical principles embedded in the methodology of Naturalistic Inquiry interface with similar principles found within the Indigenous research paradigm. Indigenous research validates the lived experience and Indigenous knowledge of Aboriginal people. As such Indigenous research carries within it the ethics and protocols of people indigenous to that place. Naturalistic Inquiry's theoretical and methodological perspective,

...is situated in a paradigm that is sensitive to, and open enough, to incorporate Indigenous worldviews within the practice of research. Naturalistic inquiry acknowledges the existence of multiple realities and accepts that not everything is verifiable and can be known by scientific means. Subjectivity, as well as tacit knowledge and values, are recognized as important factors in the research process. (Hoffman, 2005, p. 223)

While my work did not directly research Aboriginal peoples it did include working with the Witsuwit'en people as teachers and leaders to encourage communication and understanding between the non-Aboriginal teachers and the people on whose territory we live and work. Cree scholar, Weber Pillwax (2003) articulates the responsibility University students carry in anchoring their work in the ethics and protocols of the First Nations people they work with.

The language and cultures of Indigenous peoples are living processes. Research and creation of knowledge are continuous functions for the thinkers and scholars of every Indigenous group, and it is through the activation of this principle that Indigenous university scholarship is conducted. Indigenous scholarship reflects inherited Indigenous ontology's and epistemologies and it is the responsibility of Indigenous researchers associated with a university to maintain and continuously renew the connections with our ancestors and our communities through embodiment, adherence and practice of these. (pp. 49-50)

To ensure this research was conducted in a respectful and responsible manner, I endeavored to include aspects of Indigenous methodology central to the lived experience of the Witsuwit'en people whose territories we were on and with whom I was conducting my research. My work was guided throughout by four ethical principles, the 4 Rs of Responsibility, Relationship, Respect and Reciprocity. Other researchers working within an Indigenous Education context have also stressed the importance of the four "Rs" in their work (Archibald, 1992; Battiste, Bell and Findlay, 2002; Brant Castellano, 2004; Haig-Brown, 1992; Haig-Brown & Archibald, 1996; Weber-Pillwax, 1999, 2001). These esteemed educators hold the principle of relationship in Indigenous research as fundamental and central. "Native philosophy of life manifests a characteristic person-centredness, a holistic personalism that regards the human person as a subject in relationships" (Couture, 1987, p. 7).

Indigenous philosophy, or ways of knowing, are built upon and have their roots in relationship. Relationship is the framework within which all life evolves. Relationship is interrelational between the personal as well as the family, house clan, the nation, plants and animals, the cosmos, the creator and all of creation. By your very being you are related. When you are welcomed into a First Nation's community you become a relative. Haig-Brown (1992) stresses the importance of developing a "reciprocal, dialogic relationship based on mutual trust, openness and engagement, in which self-disclosure, personal investment and equality is promoted" (p. 4). Key to the success of this research was establishing a relationship with all participants to build the trust out of which new relationships may form. The same principle of relationship is embedded in Witsuwit'en protocols and expressed in this way. "We believe that the relationships between the

Wet'suwet'en and our neighbours, other British Columbians and Canadians can and must be renewed. The Wet'suwet'en desire to live in harmony with our neighbours" (Satsan, 1995, p. 8).

Additional key concepts of respect and trustworthiness embedded within Indigenous research laid the foundation for my actions and conduct with the research participants and with the Witsuwit'en elders. "Every meeting, every activity, every visit to a home requires energy, commitment and protocols of respect" (Smith, 1999, p. 140). As speaker for the Wet'suwet'en Nation, Satsan, Herb George explains the importance of respect. "We are a unique people. We are the first people of this land. We have a different history, language, spirituality and sense of how to govern our selves. When we speak about respect, these differences between ourselves must be respected. That respect cannot flow from only one direction...the principle of respect applies to us all " (p. 9). From an Indigenous research paradigm respect for Witsuwit'en ethics and protocols was demonstrated at the luncheon feast. Those who carried the songs were asked to sing and drum. In respect of the Witsuwit'en traditions a prayer was offered up. Colorado (1988) explains the significance in recognizing the protocol of prayer. "Prayer is a medicine where all life begins, exists within, without and between us and our relationships. It is an actual place and state of being that marks the endpoint/beginning of our science" (p. 54).

The gifting of the elders and the participants in a way that demonstrated gratitude and respect for their teaching and their participation reflects another practice of Indigenous research methodology. The elders were gifted to demonstrate our gratitude for sharing their knowledge and stories with us on their territories.

Elders typically have been educated in the oral tradition, apart from the colonizing influence of the school system. They carry credentials that

are recognizable within Aboriginal society but invisible to those who assess expertise on the basis of formal education. They enjoy respect as sources of wisdom because their way of life expresses the deepest values of their respective cultures...they have exceptional skills in transmitting these values to those who seek their counsel. (Brant-Castellano, 2004, p. 101)

The participants, including the drivers, the hosts, instructors and knowledge holders were gifted for giving their time and their expertise. This Indigenous practice demonstrates respect but also reciprocity in giving back to those who share and give of themselves for the good of the community. Brant-Castellano (2004) in her paper recommending the principles necessary to develop an ethical code of conduct for Aboriginal research proposes:

Although Aboriginal participation in higher education is rising and bicultural scholars are emerging, the numbers of science specialists is still small. The relatively small size of the Aboriginal population located within a larger society and interacting with it on many fronts, dictates a continuing need for intercultural knowledge exchanges. It is essential that the criteria for ethical intercultural research be developed and distributed. (p. 107)

According to the writings of Weber-Pillwax (2003) Indigenous research is a lived experience. It cannot be done through books catalogued in libraries. "The foundation of Indigenous research lies within the reality of the lived Indigenous experience. Indigenous researchers ground their research knowingly in the lives of real persons as individuals and social beings, not on the world of ideas" (p. 49). When this understanding emerged for me in my research journey it was a terrifying moment. That moment remains exceptionally poignant for me. In my journal I wrote:

October 2005: I feel very sure of what I am putting together, of how the proposal is unfolding in my mind and on paper. It is taking on better shape as a paper.

November 2005: Suddenly, my supervisors' returned my draft asking me probing questions, questions that announced the reality that this proposal has become. I feel skittish – What am I doing? What am I thinking? What made me think that I could ever begin to pull off this elaborate plan and here in this community? There is a closeness to the actual reality of the actual event that gives me pause. Pause to think and ponder on the 'how' of such an ambitious act! 'Who' has become big for me. Who did I think I could pull together to complete such a plan and what makes me think people would even want to do this?

Now in hindsight I see how I was attempting to encapsulate my whole philosophy and very passion for education in a written document while the idea of making it happen was frightening. It was the crystallizing of two decades of ideas making that now required action.

I am frozen in uncertainty. I can't push forward. I'm not sure. I am uncertain as I explore the deeper questions and have become overwhelmed at the enormity of the task. My project so far has been research based. It included some experience from other places but mostly it has been bookwork. It was theory up to this point. The realization that I have to act on these ideas has hit me with the magnitude and force of a tsunami.

The thought of action that was overwhelming me, but which I knew I had to take on this research journey was something Smith (1999) refers to in Kaupapa Maori practice as “Kanohi kitea the seen face, that is present yourself to people face to face” (p. 120). This was to be the most difficult stage of my research journey but definitely the most rewarding. The four Rs of Indigenous Research informed my work by moving me forward in a respectful and responsible way to interact in good relation with the Aboriginal people and the non-Aboriginal people who participated in this research journey with me. It began a five-month journey of visiting with elders, walking with

them on their territories, listening to their stories and sharing this experience with fellow colleagues. All their thoughts, ideas and actions have woven an enriching experience as beautiful and as promising to me as the stories themselves. The laboratory essentially became the territories of the Witsuwit'en people. Indigenous research is about a lived 'face to face' experience that "touches the life and well being of Aboriginal peoples" (Brant-Castellano, 2004, p. 99). In the next chapter I introduce you to that journey and the people who came with me.

Chapter 4: The Workshops

Workshops were conducted on the land and in the Aboriginal Learning Center to provide an experiential learning environment as well as an informational format for participants to engage in. The first workshop was a nine-hour experiential field trip to visit the territories of two Witsuwit'en chiefs. The second workshop was a half-day informational session to share an academic overview of Indigenous knowledge as well as a local and global perspective of Indigenous science including Traditional Ecological Knowledge. This second workshop also incorporated a dialogue and a brainstorm session.

Workshop #1: An Experiential Workshop

The success of the field trip depended on the elders' knowledge and background and the synthesis of this knowledge with educators' knowledge. My intent was to approach two chiefs from the Witsuwit'en community of Moricetown who were Hereditary Chiefs and elders of the territories we would travel to.

When House Chiefs take a name, they take on the responsibilities that go with the name. One of them is to make sure that, on the territory you have taken to protect, the people using it make sure there is no pollution, and that the area the animals are using and game trails and beaver dams and fishing sites are free from any obstructions, and you have to make sure that the people using it don't clear out the animals that are there for reproduction. (Gisdaywa (Alfred Joseph) as cited in Monet & Skanu'u, 1992, p. 61)

For the purposes of the field trip, a House Chief with a lived experience on the territories would have an historical background. A chief who continued to hunt and fish on the territories, who carried the stories and knowledge could speak to TEK and Aboriginal science. Where we went on the field trip was directly related to and dependent on which

Chiefs I asked and who agreed to make the excursion. The decision of who to ask was very important. After conferring with the Principal of Aboriginal Education and my husband, who had worked closely with Witsuwit'en elders, I began to consider the possibilities.

Part 1: Elder Recruitment

The first chief I visited was Gisdaywa. Gisdaywa had been a researcher himself in the famed court case of *Delgam Uukw and Gisday Wa vs. the Crown*. He was instrumental in interviewing and documenting the elders' oral histories for this case. He knew the history of the people. "The history, culture and laws that our chiefs spoke of in the Delgamuukw court case have been handed down for thousands of years" (Mills, 1994, p. ix). Although he didn't know me personally he had worked closely with my husband in the past, who was kind enough to arrange for a meeting and bring me to Gisdaywa's home to introduce me. I was extremely nervous.

Journal Entry November 05:

We stopped in the late afternoon and didn't leave until well after dark. Alfred and his wife Dora were great. We listened to some stories about the area and about the people. He talked about the loss of the blueberry patches near his home. How there was a time when you traveled along the river all you could see for miles and miles was the color blue but now you can hardly find a blueberry. "They (The Ministry of Forests) stopped us burning. We use to burn every year to bring the berries back and ensure a good harvest the next year."¹⁰

It took me quite awhile to work up to explaining why I had come. At one point I had decided not to say anything but finally I overcame my apprehension and blurted out what I called my BIG IDEA. Dora and Alfred listened and nodded. When I mentioned the part about needing an elder to explain Indigenous Knowledge Dora nodded and pointed immediately to Alfred. Afterward she explained she thought it would be a good idea for teachers. "At least they'd learn something." Then she said, she thought it might be good for new teachers to the district. She also thought her people were partly to be held responsible for people not

¹⁰ (Gisdaywa, personal communication, Nov 4., 2005)

knowing. "We just go about our business taking our life for granted. We live it, we live this life and we just take it for granted, other people knowing about it, but they don't!"¹¹ She herself had found out just how little people knew when she went to work for K'san¹² 20 years ago. She was one of the first local people to work there. She went on to explain that people from all over would come and want to know what their culture was about. She found out they were very interested and would ask lots of questions. Some things she herself didn't know and she would have to go and find out and when she would do that she would learn even more! Alfred mostly nodded and listened. I wasn't sure how much he got from the conversation since both his eyesight and his hearing are failing him. I am assuming he got the whole thing! Shortly after, as the dinner hour began to approach and darkness became blackness we took our leave, saying we would return.

February 16th Revisited Alfred Thursday afternoon. Brought more clear direct intentions to him. Ross called ahead to make sure he would be in. Dora did not join us this time. Alfred looked happy to see us. He listened closely to the idea of taking teachers out on the territories and why. At the end of my explanation he asked me...science you said? Yes I said. His response was to tell me how the people traveled this territory and how their smell was left on the land, how their smell was in the forests and with the animals and how the land and the animals have never forgotten that smell! I knew in that instance he was the teacher we needed. He asked where? We determined around Owen Lake, Owen creek area where his land is. I asked about old village sites. He talked about the headwaters (Bulkley River) and how the students don't know that is where they are from. They think that because they live in Hagwilget or Smithers or Moricetown that is where they are from, but they are really from the land at the headwaters. "Students these days don't know this!" he said.¹³ I replied, "Neither do teachers!" He continued talking about Beni, (their profit) as coming from there and being buried just down there (close to his home in the Bulkley river canyon). He talked about how the people couldn't visit that territory at the head waters anymore because the people there would wonder why they were there. He went on to explain that DIA apparently divided the territory up in such a way that it became part of the Carrier Sekani (neighbouring) peoples' territory. He explained that a long time ago DIA was looking for a way to govern or look after the Native people that was easy, so they put a boundary through the territory so half of them could be looked after by the Prince George office and half by the Terrace office. The original territory was too big for DIA. By doing that they divided the Witsuwit'en territory and gave their birthplace to another

¹¹ (D. Wilson-Kenni, personal communication, Nov. 4th, 2005)

¹² K'san is a replica of a traditional village site built on the confluence of the Bulkley and Skeena Rivers in Giksan and Witsuwit'en territories. It houses contemporary and traditional artifacts, a feast house, totem poles and provides an instructional setting for learning about the culture and history of these peoples.

¹³ Gisdawya Alfred Joseph, personal conversation February 16th

nation. They don't go back there, they can't now because those people look at them strangely.

Ross reminded him of the story of Enoch who on coming to the area of Alfred's territory at Owen Lake saw that one lake, Francois Lake had Char in it and on seeing there were none in Owen lake he caught two fish out of Francois lake and transferred them to Owen Lake to introduce that species to the lake.

Just listening to the way he sees and knows was so engaging. It was hard to bring closure, to leave. He appeared to like the idea of me asking Dan Michell to come along, "Oh yes good!" "We could go to Sam Goosley where Dan has been caretaking the land for Florence Hall. There's a cabin there we can drive right to the cabin." As we were leaving I asked him what kind of sandwich he'd like for the journey? He responded, "Peanut Butter an Jam". We laughed.

My next visit was to see Wigetimstochol, Dan Michell to discuss science and more specifically, Traditional Ecological Knowledge and Wisdom with him. I knew Dan and his wife, so I felt a bit more confident in going to see him. We had a good visit that lasted about two and a half hours. Dan was interested in my meaning of science and where the word originated. Dan has been a hunter, fisher and trapper all his life and knows the political and environmental issues that surround these lifeways from a deeply personal and spiritual place. He talked about the 'box trap' and how they used gravity to spear the beaver. Dan gave me a letter from the Ministry of Forests, which stated their intent to log his wife's territory. "They don't even ask, he said, they just come." "One time Kathryn and I went out to our traditional berry patch to pick berries. When we got there, there was a sign saying not to pick the berries along the road because they had been sprayed with pesticides to keep the weeds down"¹⁴. He told the story of the river and the abundant fishing in the canyon before Fisheries put the concrete fish ladder in. He told of how the tributaries to the Bulkley river used to be filled with fish waiting to jump the falls and how that, which is now gone, fed the people. He also talked about the prophet

¹⁴ (Wigetimstochol, Dan Michell, personal communication. March, 2005)

Beni. How he died and came back to life, how he prophesized and set new rules for the people.

Arrangements were made for these two Aboriginal knowledge holders Gisdaywa and Wigetimstochol, Witsuwit'en Chiefs, from Witsuwit'en territory, to take the participants to key sites on their territories. I returned a second time to talk with Dan to firm up our plans for April 7th. He helped me think of many things I'd overlooked, like a lead truck with a radio. There was so much logging in the area he felt this was mandatory. He gave me suggestions for a driver of a van. It was important to him that someone from the Witsuwit'en community drive because he felt they would also benefit from the experience. "Our people need to hear this too," he said¹⁵. I tried hard, but could not find an Aboriginal person with a license who was available on that day. A teacher participant informed me she had a license a few days before the trip and was willing to drive.

The Teachers

It became clear through recruitment process that the teachers who agreed to become involved in this research were there because of who they were. They were a rare breed of life long learners who were willing to take risks and were open to new ideas. I refer once again to Cajete's quote:

Becoming open to the paradigm of Indigenous science has some prerequisites, which need to be considered. There must be an understanding and acknowledgement of the history of exploitation of Indigenous peoples by Western culture and science. There must be a willingness on the part of the non-Indigenous teacher to view science from a perspective that is "inside out, upside down and the other way around" or, more simply put, without bias and with deep vision which allows for a deep examination of habitual thought processes. This

¹⁵ (Wigetimstochol, personal communication, April 4th, 2005)

means reflecting on Indigenous science based on its own terms and methodologies without stereotyping or trivializing its essential components. (Cajete 1999, p.185)

The teachers who agreed to be part of this study included elementary school science teachers, and high school science teachers. They came from as far away as Houston and Moricetown and some were from Smithers and Telkwa. They represented grades one to twelve.

Part II: The Journey

Once out on the territories the elders shared their knowledge through stories pertaining to Witsuwit'en ways of knowing. These stories were grounded in the holistic knowledge of the Witsuwit'en peoples and their use of scientific methods for their survival on the land and for resource management systems in these territories. A key teaching was the interrelationship of all living things as stated by Wigetimstochol, Dan Michell, "We belong to the land and the land belongs to us. And that is the reason why we are always taught to respect the land and everything that's in it" (Monet & Skanu'u, 1992, p. 73).

These two elders who lead the experiential workshop determined the contents of the workshop and the places we visited on the territory. The overall intent of the workshop was to demonstrate the Witsuwit'en Nation's relationship to the land and their methods of survival since time immemorial. Inherent in those methods are the technologies of Witsuwit'en science that are evidenced in the food resources and the drying, harvesting and processing of food for the winter months. The science of survival and sustenance is in their plant knowledge of the forests and their use of plants for food and medicines, in

the tools they designed and used for sustainable survival. As well, the overriding values of protection and management of the natural resources spiritually and scientifically that persist in order to live in balance and understanding with their environment.

Stories from the elders about places, use of place-names and environmental consciousness helped participants to understand that the Aboriginal people here have territory they have been caretaking for centuries and that it is their close spiritual and scientific connection to this territory that has allowed them to sustain themselves and their culture over time. Some key concepts of Aboriginal knowledge as it applies to the Witsuwit'en people covered the vastness of the territory, the seasonal cycling of the people through these lands and many time-honored traditions. According to post-questionnaire information from a teacher participant, "Their knowledge of their land, their connection to nature and their past experiences helped me to understand the deep connection that science plays in their culture" (Participant L).

Of particular note was the way in which each of the chiefs referred to and described their territory. They demonstrated that by continuing the use of places and place names on the land means a continuing of Witsuwit'en lifeways. The territories we were on were defined by house boundaries and place names the chiefs could physically point to and talk about. They used physical features including hills, mountains, rivers and whole watersheds, meadows, trails and migration routes to define their territory.

The territories of the Witsuwit'en "are closely associated with a specific group of people. They are used for a variety of resource gathering activities and are controlled by chiefs on behalf of kinship groups. Chiefs describe their territorial boundaries as 'from mountain top to mountain top' and orient themselves by two directional axes within this watershed framework: vertically up and down from valley bottom to mountain top, and horizontally, upstream and downstream

referred to as watershed-ecosystems-as-territories. (Tyler, 1993 as cited in Berkes, 1999, p. 52)

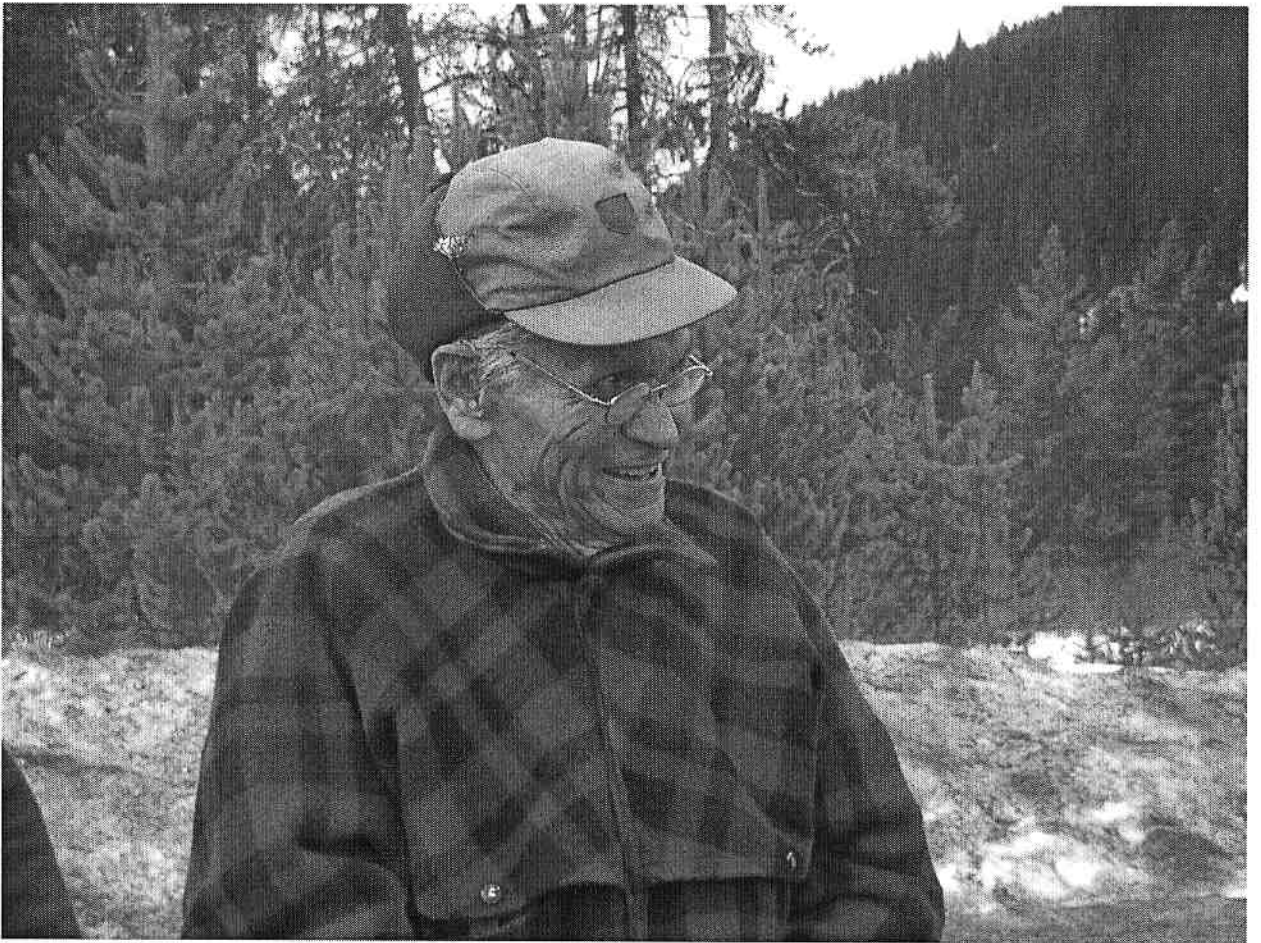
In one interaction with Dan about his trap line and his father's trap line he referred to the hills as a series of step lands or shelves. He pointed them out, big, small and middle sized and how by saying their name the people knew where they were going to trap. I wrote in my journal, "*While I only saw a series of hills, Dan's explanation helped me differentiate between those hills. He drew me closer to them and my relationship to them became more intimate.*"

On our journey neither men would talk about the other's land when they were on it. They differed to the person whose land it was. "Chiefs see it as trespassing on and misrepresenting another's authority over and knowledge of a specific area used for subsistence" (Heikkita¹⁶, 2006, p. 7). One of the teacher participants (L) explained it this way, "It was very powerful to watch these two men light up when they entered each of their Territories. The two men respected each other's stories, beliefs and knowledge."¹⁷

¹⁶ Although much of this information is from the Tl'azt'en First Nation they are a neighbouring nation of the Witsuwit'en in the same language family. They share similar customs, beliefs and values about the land.

¹⁷ Gisdaywa who you see in the next picture is standing outside the circle in the following picture.

Gisdaywa





“On a social level these boundaries are maintained through respect and deference towards family members who carry the inherent rights to the land”¹⁸(Heikkita, 2006, p. 7).

Talking about places in someone else’s land is the same as trespassing. Traditionally, when the people are traveling through another’s territory and /or hunting on it, it is their rule of law to ask permission first. This demonstrates respect for the holders of the land and acknowledges their tenure and authority of their lands. Knowing place names demonstrates knowledge of that territory and stands also as “authoritative symbols of that knowledge” (p. 7). The overriding understanding in this system of land use is that

¹⁸ If you look closely at the above photo you will see Gisdaywa far back from the circle that has gathered around Wigetimstochol whose territory we are on. Gisdaywa is demonstrating respect in allowing Wigetimstochol to tell his stories.

use of the land is controlled and harvesting and regeneration of resources are kept in balance. This knowledge is becoming apparent to present day ecologists who see this balance as a means of insuring sustainability and resource management on traditional territories. I note this because of the relationship this understanding has to the philosophy by which Witsuwit'en elders live and how today Geographic information systems (GIS) technology can "graphically depict those philosophies" (Jhon Goes in Center, 2001, p. 119).¹⁹ This may be an example of the partnering of Western technology and Indigenous knowledge in the future management of resources and endangered ecosystems.

The elders told stories of the former migrations of caribou and ethical stories about the return of the salmon people. This story was very similar to the one told in *Salmon Boy* and the Tsimshian salmon people stories. It taught the lesson that the salmon choose to return depending on how they are treated. There are good hosts and bad hosts along their journey and the importance of that to the return of the salmon. The traditional ecological wisdom the elders shared in their stories demonstrated their ancient knowing and connection to the land.

The extensive logging and mining found along this journey served as a comparison study for sustainability practices between corporate economies and Aboriginal traditional values. Many teachers were moved by the experience of passing the now abandoned silver mine once responsible for the acid rock drainage pollution of neighbouring streams and distant water systems. Only a short twist of the road later we spotted a stream running behind Dan's cabin. He told us he has to bring his water in with him now it's polluted from that acid rock drainage. We were hours from Smithers, off the

¹⁹ This point will be continued under Workshop#2 when I discuss Witsuwit'en science and technology

highway on gravel roads. Coming to Dan's cabin held more disbelief for many teachers since there was such a high level of logging taking place. One of the participants post-questionnaire read, "I can't emphasize enough how profound it was to be with Dan when he discovered the intense logging around his cabin and on his territory. At that moment I became very aware that we are "visitors" on land we think of as our own" (Participant G). All the territories we were driving through had experienced high levels of logging operations. Participant L commented, "I was amazed when I saw for my own eyes how the forest industry has affected the Aboriginal people. The forest company trailer was parked right on Alfred's property without his permission. The trees were being harvested just metres from his home. It is important that people learn the history of how things came to be and just listen to each other." These territories sit in close proximity to Canfor (Canadian forest Products Ltd.) at Houston who boast being the largest producer of softwood lumber in Canada. Another participant found what stood out for her on this trip was the "continued lack of communication and understanding between industry and First Nations" (Participant H).



Dan's concern was for the small animals. "Where do they go when the trees are all down?" Dan told us the reason they gave him for logging his territory was because of the pine beetle bug infestation (a serious issue in central and northern BC currently). This opened up a timely discussion while we were passing by the piles of cut trees. I asked Dan what he thought about the effectiveness of this high grade logging in the attempt to get the lumber before the beetles finished it off. His response was, he didn't think it very effective since the beetles can't fly a long way. In response one of the teachers connected

to the intense logging along the highway 16 corridor where hundreds of trucks per day travel with full loads to the many mills dotting the northern highway. I of course had to ask the question of whether there were pine beetle infestations before this? If he had ever heard the old people talk about pine beetles. No, he said. He thought they came with the white man. One of the science teachers I was sitting with made a noise. He explained himself later in his post questionnaire. "One of the gentlemen we were on the field trip with mentioned that the beetle came with the white people and the scientist in me said, "Aaaaah, well that's probably not true, I am sure they've probably been here for a long time. But I think what he really meant was of course the numbers of them have greatly increased" (Participant A). Upon analyzing this response within the dichotomy of TEK and Western science I came upon a reading in Burkes, (1999) which I agree with. Oftentimes it seems Western science does not value the elders' knowledge.

Scientists, tend to dismiss understandings that do not fit their own...it is the duty of the scientist to remain skeptical, especially when confronted with an area like traditional knowledge, which does not easily lend itself to scientific verification...the Western scientific methodology is but one way, and not the only way to acquire knowledge. (Feyerabend 1987; Nakishma 1998 as cited in Burkes, 1999, p.12)

It wasn't long before this participant was reconsidering his thinking. At our next workshop his knowledge was further broadened and this same participant was able to build on his understanding.²⁰

²⁰ See page 62 for the full story.



Once arriving on Alfred's (Gisdaywa) territory we were closer to the western Witsuwit'en territory bordering their coastal neighbours the Haisla. Alfred shared his knowledge about the history of his people and their relationship with the neighbouring ancient peoples of the coastal Kitimat area. This story the story of Kweese,²¹ (a Tsayu chief name) is important because it demonstrates how groups of Witsuwit'en chiefs acted together to revenge the acts of force by outsiders on one of their territories. In this story Gisdaywa talked about the powerful ones, the warriors. This story tells of "... the collective retaliation of the Witsuwit'en chiefs against the Haisla, who had raided from Kitimat on the coast ... where the wronged Witsuwit'en chief, Kweese, was assisted by the chiefs of all the clans" (Daly, 2005, p.199). One of the older important pieces of oral tradition this story recounts how the "war party that Kweese formed was one made up of all clans and this is where all the different clans got most of their crests because it involved every clan. So when Kweese went on this raid he, as a reward, gave each clan a crest for their participation" (p. 199). It is a story about crests and specifically how the coastal peoples' Killer whale crest became part of the Witsuwit'en feast system. The Witsuwit'en also tribute the "beaver crest of the Tsayu (Beaver) clan to the victory of Kweese over the northern KwaKwaKa'wakw at Kitimat. These people were the only group to have a Beaver clan and to have, like the Witsuwit'en, five clans" (Mills, 1994, p.85). According to Gisdaywa crests were traditionally used as boundary markers on the territories. Their specific purpose is to remind the chiefs of a story (oral history), which aids in the chief's memory and explains "their relationship to events on the land and in the feast hall" (Daly, 2005, p.199). The crests call to mind the sacred oral histories or

²¹ New orthographic spelling is Kw'is

kungakh passed on to the chiefs at a very young age. The underlying teaching was that Witsuwit'en oral tradition depicts their origins and their ancient history in a complex understanding of their relationship to the land, to the animals and to the people. "The Kungax describe the moral order of the Witsuwit'en universe, in which abuse of the animals or people and their territorial and marital rights upsets the moral balance - a balance which must be restored by the people in order to avoid serious consequences" (Mills, 1994, p.75). It is through the crests (songs and dances) that the stories are kept alive. Through telling this story Gisdaywa introduced the grease trails that connected the peoples, the trade routes to the coast and items of trade, how they carried fire and the valued mountain goat resource within the territory.



Following Alfred's teachings I was honoured to be able to thank the elders, who had been our teachers. The BC Ministry project, which this study is a part of, generously donated funds toward supporting the work of the elders. During my proposal process I was given a research grant as part of the grant from the BC Ministry of Education, which I was able to use in gifting our drivers and our teacher elders, for this day. It was a long day 9 hours and 370km. For Gisdaywa who turns 80 in March, 2007 it had been closer to an 11hour day. While driving him home he remarked, "Well I think those teachers learned something today." A few days after the field trip I was speaking with the Principal for Aboriginal Education who was raised by her grandmother in Moricetown, she confided that, " What the elders chose to share is what they wanted us to hear, what they thought we needed to know."

Workshop #2: Informational Session

Upon reading the pre-questionnaires, prior to the second workshop, I found a number of teachers believed that lack of 'relevant materials' were a 'barrier' for them in teaching Aboriginal science. So, I met with the Principal of Aboriginal Education and the curriculum developer to set out local Aboriginal science curriculum materials (including an Herbarium, primary booklets that had been around for a long time) as well as texts, Aboriginal science curriculum and informative readings I had gathered. The curriculum developer was quite concerned the district didn't have any examples of local Aboriginal science curriculum. I showed her what I had but we agreed local Aboriginal science curriculum was scarce. The idea was to have the teachers browse through this material during our traditional foods luncheon. This luncheon was held at noon prior to our more academic session and was generously hosted by the Aboriginal Learning Center. A Witsuwit'en caterer brought traditional foods such as herring eggs, ooligan, half dry (salmon), bannock and berries. One of the Asset workers and the Principal for Aboriginal Education brought drums and sang a welcome song before the meal. I had invited Aboriginal people involved in education from the school district as well as from the community. This included Asset workers, a representative from The Friendship Center who gave the prayer, the Principal for Aboriginal Education and the Curriculum Developer. I also invited a Professor of First Nations' Studies, Dr. Ross Hoffman to share his doctoral research on a Conceptual Framework of Indigenous Knowing. Those in attendance shared the meal with the teachers, helped explain IK and TEK and joined the dialogue circles in an effort to bring a deeper understanding to the issue of why few

Aboriginal students are choosing science.²² While two participants had withdrawn at this point, two additional teachers who had not been on the field trip, but who had filled out pre-questionnaires joined us for the second workshop.

The second workshop introduced important terms such as Indigenous Knowledge, Aboriginal Science and Traditional Ecological Knowledge. It presented examples from the local Aboriginal peoples as well as examples from a global context to help teachers broaden their understanding of Indigenous science. This background information covered the culture, history, geography and all encompassing worldview of the Witsuwit'en people. Oscar Kawagley defines what this means from a Yupiaq worldview.

If we have that kind of worldview, then we must have developed a language of our own. We must have developed an ecosophy, not a philosophy, but seeking wisdom from nature itself, and eco-psychology where we develop our understandings of what nature is capable of teaching us. We believe that everything has a spirit and therefore has a consciousness, an awareness of the world around them. (Kawagley, 2001, p. 203)

Part 1: Indigenous Ways of Knowing

Examples of Indigenous Knowledge and of Aboriginal science as it related to the Witsuwit'en people were provided. Dr. Ross Hoffman presented a model of the components of Indigenous ways of knowing and the characteristics of how this knowledge is transmitted.

1. The world exists in one reality compromised of an inseparable weave of secular and sacred dimensions.
2. The nature of time is not linear. The past and the future coexist in the present.

²² See Appendix 5&6 for dialogue questions and rules

3. The individual is a physical, mental, emotional and spiritual being. Knowledge can be accessed through each of these modalities.
4. All actions must be guided by the principles of relationship, respect, responsibility and reciprocity.
5. Indigenous knowledge transmission is characterized by the existence of an oral tradition, experiential learning, subjective experience and collective knowing. (Hoffman, 2005)

This presentation sparked a number of questions and a great deal of discussion amongst the teachers. Important among them was the question “Is Indigenous knowledge genetic?” “What about those who have grown up in modern times, away from their tradition?” The teachers appeared aware yet very intrigued with the concept of Indigenous Knowledge.

TEKW

Especially during the last 25 years, biologists, ecologists, botanists, geologists ... have labored to develop approaches that are improving our ability to understand and mitigate the impact of human activity upon the environment. By extending their enquiry into the timeless traditional knowledge and wisdom of long-resident, oral peoples, these scientists have in effect moved the borders of scientific inquiry and formalized a branch of biological and ecological science. (Snively & Corsiglia, 2001, pp. 7-8)

Thanks to the work conducted by the House Chiefs and the scientists at the Office of the Wet’suwet’en I was able to present a poster model of a TEK matrix, complete with a map demarcating Witsuwit’en chiefs’ territories on Witsuwit’en traditional lands and the natural resources including food (plants and animals) found within each chiefs’ territory. It demonstrated the extent to which the TEK of these lands have been documented through modern GIS technology. For each of the chief’s territories a

reference is made to the natural resources and where they are found within those territories. The elders and chiefs of the Witsuwit'en territories worked closely with scientists and cartographers to locate and identify plants and animals on their territories. The elders' traditional ecological knowledge and wisdom (TEKW) provided short cuts for researchers researching the local resource base. Endangered species were identified in an effort to prevent further activity on those lands. The Witsuwit'en knowledge holders provided time tested, in depth information about the local area that will hopefully lead to improving the effectiveness of resource management strategies in forestry, fishing and mining (Office of the Witsuwit'en, Poster, 2005). It provided a great example of how traditional knowledge and contemporary science have come together to help protect Aboriginal interests and lands for treaty and against future intensive mining, fish and forestry practices.

I referred to a book by Richard Daly (2005) to touch on the different biogeoclimatic zones that not only showed the seasonal cycling of the Witsuwit'en people through the territories but also the subsistence food resources at various elevations and in different biogeoclimatic zones which allowed the Witsuwit'en to maintain a varied and healthy diet throughout the year. It was a good supplement to what we had learned out on the land. Later, for the post-questionnaire I phoned one of the participants to set up an interview time. He was very enthusiastic about Daly's book . "I got that book *Our Box Was Full* and isn't that part neat about their diet! Wouldn't it be great to try and live like that on that diet?" (Participant A)

I was able to share with the teachers a number of archived pictures of local Witsuwit'en engineering technologies, including bridge building, fish traps, nets and

weirs, drying racks, traditional long houses, totems and canoes. One of the pictures demonstrated the traditional use of a tumpline (a strap used traditionally by Indigenous people worn over the top of the head and attached to a large pack for carrying supplies). Coincidentally, one of the Asset workers had brought a tumpline, which he shared with the participants. It demonstrated the continued crafting and use of this important tool for Witsuwit'en people including the more modern materials of wool as opposed to traditional babiche (moose leather). He also carried a great deal of knowledge about fishing weirs he shared with us. He explained how he had reconstructed original models of the cylindrical willow fish trap with his students. He commented on how precise the original mathematical and technological knowledge was because when they first went to use their model fish trap it fell apart. One teacher responded on the post-questionnaires that she liked seeing the examples of science/technology. "The visuals were powerful! I feel local examples are very important for students." And how " I really hadn't thought of the design of bridges and canoes in the past. Astronomy and navigation/orienteering are considerations for me to explore. I'll try to use physical, biological and technological examples in my science classes" (participant G).

During my presentation I included a TEKW quote from a newly printed BC Science 7 textbook (Mason, Charleson, Grace & Martin, 2004, p.xxi) and briefly explained the concern about the misappropriation of Indigenous knowing by non-Aboriginal scholars. The others who were present were able to add to this understanding.

Traditional Ecological Knowledge is based upon the following ideas:

- The Creator made all things one.
- All things are alive, related and interconnected.

- All things are sacred and should be respected
- Balance and harmony are essential among all life forms. (p.xxi)

Acknowledgement of the global contributions of TEKW were also taken from this BC Science 7 book and enhanced with additional examples. I pointed out additional TEKW and technological references in the BC Science 6 textbook by the same distributors. Although I had planned to include a substantial amount of academic literature on the global aspect of TEKW the prolonged conversations and many questions from the teachers on the material presented earlier limited my time. The invited guests, Aboriginal educators and community members helped me field these questions and comments to provide thought-provoking answers. For instance, one of the guests explained the concept of controlled burns as a means of sustaining the forests and the berries. One of the participants wanted to know the difference between burning slash and burning the forests. The explanation by one of the guests was simply, one was dead and one was alive. Other questions included the issue of the pine beetle and Witsuwit'en technologies. Referring back to the initial conversation that took place in the van on the field trip the following excerpt from a conversation demonstrated the concept of constructed realities and how they can be shared when two cultural groups are brought together. In the post questionnaire participant A, explained a story he learned, which he described as 'eloquent' and which serves as a great example of local TEK.

The whole idea of the balance between the huckleberry bushes and the burning and the woodpeckers and the beetles, I mean that's fantastic! If we can all help our students gain a better sensitivity to balances like that you know we all gain. (Participant A)

What participant A was referring to was a story told to him by one of the invited guests which he paraphrased later in our interview and I have entitled, *Balance and the*

Beetle Infestation. I have included it as an example of local Traditional Ecological Knowledge. Participant A told me this story in the post-questionnaire, which was taped. I have written the following story word for word from his interview.

Balance and the Beetle Infestation

You know of course we have perhaps the greatest infestation of an insect ever recorded probably in the history of mankind with the pine beetle right now. I know about 3 years ago the Chief Forester for British Columbia was up visiting Houston Secondary School and he said that, "Never before in history has an infestation of this magnitude ever been dealt with effectively by people". It threatens the livelihood of all our communities. One of the gentlemen we were on the field trip with mentioned that the beetle came with the white people and the scientist in me said, "Aaaaah, well that's probably not true, I am sure they've probably been here for a long time. But I think what he really meant was of course the numbers of them have greatly increased" and the reason for that was because originally the huckleberry was the king of berries. It is very, very important to survival so the important thing was to maintain the quality and quantity of the huckleberry and so what was done was there would be controlled burnings throughout the territories and not even every clan did their own burning often times there were people who were quite specialized they knew when to light the fires, they knew what kind of atmospheric conditions should exist at that time and what kind of moisture should be present and all this. Then they would light the fires and they would burn the undergrowth of the forest. And when they would burn the under growth they would keep the huckleberry bushes from getting very tall. Since they kept the height of the bushes down then the huckleberries themselves grew in much greater profusion.

The interesting thing though is, they did that to maintain the huckleberries and then we were asked what is the greatest natural predator to the pine beetle and we were told the greatest natural predator is the woodpecker. I was told that lets say a hundred years ago there were many, many more woodpeckers in our forest then there are now and it was interesting because the older, mature woodpeckers what they do is they eat beetles, insects but the young ones, immature ones don't. They eat huckleberries brought to them by their parents. And so by maintaining the growth of huckleberries what they were able to do was they were able to provide a better diet for the young woodpeckers and by being more young woodpeckers then there would be more mature woodpeckers and there would be fewer beetles. Now by intervening into that cycle, by cutting out the prescribed burns, then what happens is the huckleberries wouldn't grow back in as great profusion, and then the little immature woodpeckers wouldn't survive. Then there wouldn't be as many adults

and so then unfortunately there would just be more beetles. Now what a great solution to that problem! I am sure originally people didn't think about it in that way. It's not like, "Oh, we're gonna..." They were just part of that whole system. They were growing more huckleberries so that they could feed their families. (Participant A, Personal Communication, as adapted from Witsuwit'en knowledge holders)

Part 11: Dialogue

The dialogue process brought the participants as well as Aboriginal people involved in education together into a circle of seven or eight people, two of whom were Aboriginal. Each participant was given a short list of about four questions (Appendix 5), which they spoke to one at a time and in turn. The rules, explained ahead of time (Appendix 6) allowed each person to speak without being interrupted and to continue until they finished speaking to the question. I was the facilitator of one group and Ross was the facilitator of the second group. Contained within this dialogue was the process of a talking circle, where each individual spoke and was listened to, uninterrupted. In this way the talking (questions and answers) wove through each individual and returned back to begin again as the participants, Aboriginal and non-Aboriginal, engage in the process of listening. The specific goals of the dialogue were for the non-Native people to connect with Aboriginal people and to broaden their understanding of what it means to be Aboriginal in the school system. As well it provided a forum to help participants make connections to Aboriginal Science and ways of knowing.

One purpose of dialogue is to bring people from different walks of life together. It can come out of the need for cooperation and the need to understand people better through respectful and honourable relationships, which will lead to enhanced community relationships. (Voices of the Valley, 1994)

One result of the final dialogue session, in the circle I was facilitating began with teacher participant (H) explaining her frustration with being unable to locate knowledge holders in the community. "I go out with my limited knowledge to hike and share what I know about plants with the kids but it would be great to have an elder or someone along... but I never know who to ask." Others in the talking circle expressed a similar concern over this issue as their turn came around. When it was the Principal for

Aboriginal Education's turn to speak the point was heard. She could have said well the Asset workers have the list, you can go and see them, but from the teachers' position it did not appear that this was happening at the various schools. From the ensuing dialogue came a suggestion that was later presented during the brainstorming session. It was decided a Tea and Bannock at the Aboriginal Learning Center at the beginning of the school year would be an asset to both teachers and elders. Thoughts built on thoughts until it was agreed upon that invited elders, knowledge holders and teachers could meet and talk and teachers could find out what the elders and/or knowledge holders could teach in their class. Another suggestion to come out of the dialogue session was to start encouraging teachers and students to use the culture camps out on the territories. Through the talking circle the participants were engaged in consensus making and through stating their thoughts, instead of creating arguments they created possibilities. "This new constructed reality could possibly provide the stimulus and guidance for action if it were enacted" (Erlandson et al., 1993, p. xiv).

People were able to answer questions based on their life experience and worldview. The answers were a reflection of each individual's lived experience. The overriding result was a diversity of experience and thought shared and heard and integrated into the circle. It was good to hear from those who had been raised traditionally, to speak about that experience and the difference between their traditional life and their school experiences. One person shared a bit of their traditional background; their life as a child in the fish camp. She talked about the process of preparing fish and of having responsibility for cutting the fish at 10. She talked about the bears and how they always came around. She talked about the importance of prayer in their life, for good

dreams and to be watched over during the night. I sensed a certain pride in her as she shared her stories while the teachers listened.

One teacher shared a project she had just completed with her grade three class. One group had built a model of a traditional First Nations village, with long houses while another group created a colonial village. She couldn't get over the things they were learning from this experience. By building the long houses they asked questions that led them to understand the family groupings in the big long houses as opposed to the single family dwellings of the colonialists. As they plotted the yards of the colonists on streets they compared these to the natural environment of trees and rivers around the native village. The dialogue was a good opportunity for teachers to hear what other teachers were doing to include Indigenous Knowledge or TEK in their classrooms.

Dialogue has been used successfully in bringing Aboriginal and non-Aboriginal people together to discuss important issues. By bringing people of different cultures together in an informal setting, they were able to get to know one another without a predetermined agenda. Different cultures can find "a shared love of place, a sense of common purpose and an expanded understanding of each other, which enables them to chart a more cooperative course for the future" (Solomon, 1994). It was a respectful way to focus on issues and knowledge between people who have in common their shared love for the children.

Brainstorming

Another key component of the methodology in this study was to bring the participants together after the workshops and before the final questionnaire to collaborate on setting goals on where the district needs to go based on what the participants have learned. With on-going district support it could foster cultural awareness, culturally responsive curriculum and affect the necessary steps to encourage Aboriginal students to explore the sciences in the future. This brainstorm session initiated the following responses:

- Home is important
- Reading – students must be able to read texts, materials to progress in “science”. Teach students how to cope with science texts and materials so they don’t get overwhelmed with too much information or big words. “Teach them how to look at an overview of a unit (reading strategies 44) and tell students how to “take the material one step at a time”.
- Tea & Bannock – Partnering teachers with elders and resource people from the Witsuwit’en Community
- Socials 11 – Tea with teachers and elders in Moricetown
- Focus by grade on activities and field trips to have grade specific experiential learning opportunities based on the curriculum requirements.
- More Aboriginal teachers
- Dawson City example – every year a group of grade 9 students go on a caribou hunt.
- Berry picking early September
- Soap berries end of June
- Public school classes have a culture camp experience
- Mandatory workshops in Aboriginal Knowledge for teachers
- Science Fair Incentives
 - \$ Award for “Aboriginal” project or theme – science fair
 - Ecology/Biology – Aboriginal Science Award
 - Contest at Science Fair – whipping soapberries by hand – make it fun.

Chapter 5: Data Collection and Analysis

“The Purpose of naturalistic analysis is to identify and verify themes and to use these themes to construct hypotheses” (Mellon, 1991, as cited in Roberts, 1991, p. 349).

A variety of data collection methods were used for this study. As explained in the methodology section ‘intuitive observation’ was employed in social contexts where it was appropriate, for instance on the field trip and during the dialogue session. Field notes were utilized as well as journal entries. The major body of data came from the written and taped questionnaires. I compiled and categorized all the participant information by each question on the questionnaires. When key dimensions were identified they were coded by means of a coding system I developed. Later I determined the key themes based mostly on the research questions from the pre-questionnaire and then again on the post-questionnaire. These key themes were analyzed and linked to inform my work.

Questionnaires

I gathered baseline data through pre-workshop questionnaires (Appendix 3) on teachers’ prior knowledge and beliefs about science, Aboriginal science and why they thought Aboriginal students were not enrolling in the school sciences. Later in the study I compared this information to data collected from post-workshop questionnaires (Appendix 4) referring to teachers’ workshop experiences and teachers’ perceptions of Indigenous knowledge as it related to teaching science. Participants answered their questionnaires in either a written or oral format. Participants were given the option of anonymity in their choice. Where teachers are quoted a letter of the alphabet is used to protect their identity. These letters were assigned to each teacher at the beginning of the data collection process to ensure their anonymity.

Within this research I was a teacher, researcher and participant observer. As such, I provided participants with the option of writing anonymous questionnaires. I felt the written questionnaire to be the most valuable tool for assessing this particular information since it gave teachers' the privacy to answer honestly as well as to provide personal time for comprehensive answers. However, participants were given a choice between written or taped oral interviews. For those who chose anonymity only the participant was able to identify his or her written responses to the questionnaire by means of passwords only they knew and remembered.

In the final analysis I had gathered 17 completed pre-questionnaires from a wide variety of teacher participants and 10 completed post questionnaires. Eight teachers completed the entire process. Non-Aboriginal teachers were approached for this study because they make up the vast body of public school teachers and their perceptions and views about science and Aboriginal student success have not been adequately explored. I proposed the questions including whether or not teacher thinking could change to include another perspective on science in an effort to "close the knowledge gap in this aspect of Canadian public education" (Yanu, 2005, p.51). This study is part of a wider study recommended by the BC Ministry of Education to determine why Aboriginal students are not enrolling in the sciences.

The Pre-Questionnaire

A number of questions were asked in the pre-questionnaire (Appendix 1) to capture data on individual teacher's current status and to gain insight into the teacher's current beliefs about science, Aboriginal science²³ and Aboriginal student success in the sciences.

The information from the first two questions indicated a wide variety of non-Aboriginal teacher participation. The teaching experience of those teachers who participated in all or part of the research ranged from 3 to 44 years. They all taught science. Six of the participants were from the high schools in Smithers and Houston where they taught one or more science classes including science 8, 9, and 10, Earth Sciences, Chemistry 11/12 and Physics 11/12. Eleven participants were from various elementary schools in the district including Moricetown Elementary and taught all subjects including science. Two of these teachers taught French Immersion. All grades from grade one to grade 12 were initially represented by teachers in the pre-questionnaire.

Questions #3 and #4 asked for the number of Aboriginal students in their individual classes and which Nations they were from. The data indicated that individual teachers taught from 0 to 30 Aboriginal students. On average the number per class worked out to be approximately 6 Aboriginal students. Less than 1/3 (5/17) of the teachers indicated they knew exactly what Nations were represented in their classes. Others weren't sure, never asked or their students didn't know, while some responded using the term 'mostly'.

²³ I used the broader term of Aboriginal science in the questionnaire rather than TEK because teachers didn't appear familiar with the terminology, Traditional Ecological Knowledge.

Of those who knew, the Witsuwit'en, Cree, Tahltan, Métis and Ojibwa were identified with the Witsuwit'en having the largest representation. In the collected data, one teacher (who is working on reserve) had the correct and current spelling of Witsuwit'en. One teacher declined to answer this question and left it blank while another wrote an abbreviated form Wet'.

One of the teachers involved in this research study shared an important story with me that highlighted the importance of knowing who your students are. This teacher was beside herself on Aboriginal Day when she and the Principal for Aboriginal Education were all thumbs trying to demonstrate making a dream catcher. On seeing their difficulty, a young girl normally extremely shy came to the front of the class and explained that her grandmother had taught her how to make dream catchers. She went on to confidently share her abilities and knowledge with the class and the teachers. The student in fact saved the day. The teachers who were sweating over the difficult work were amazed by her calm composure and skill in helping everyone, teachers and students alike. It was June 22nd 2006, this student had been in this grade 3 class since September and had never self identified as an Aboriginal student nor been identified by the teachers. The teacher sharing this with me was mortified.

The lack of acknowledgement of Aboriginal student nationhood by science teachers in their classrooms supports and confirms the literature (Ignas, 2004; Kilman, 2006; McKinley, 2005) some of which were presented earlier in this work. "We deny these are Indian kids. We have teachers that don't connect with the students or where they come from. I think it's extremely vital that if we want our kids to learn, that connection needs to be there" (Kilman, 2006, p. 2). If systemic change is necessary for

Aboriginal student success in the sciences an underlying premise for this change lies in what teachers practice. The importance for teachers to know who their students are and where they come from is expressed by many authors and proponents of change Aikenhead & Huntley, 1999; Ignas, 2004. That effort needs to be made by individual teachers. They need to see the connection between relationship building and subsequently building student success in science. In her experience with designing culturally responsive science curriculum Ignas (2004) recognizes the importance of teachers, sensitivity to Indigenous student knowledge. "Teachers must be fully aware of and build upon the unique background knowledge of Indigenous students in order to best help them to meet the learning outcomes for their particular grade and subject area" (p. 51). Furthermore, Ignas (2004) has found the best way for Indigenous students' to experience success in science is in teacher recognition of an Indigenous perspective in science education. She feels teachers who are able to do this make successful educators. "Recognizing this perspective was consistent with the practice of successful educators who recognized the importance of helping students access prior knowledge as they constructed new knowledge" (p. 51).

Question #5. "Why do you think Aboriginal students are under-represented in the sciences?" The over arching themes that emerged from the responses in the pre-questionnaire in order of most to least teacher responses were:

- Low self esteem
- Lack necessary skills
- Relevancy

- Socio-economic factors

Two teachers did not believe that Aboriginal students were under-represented in the sciences. One teacher suggested that, “This is not the case for elementary school. All my students enjoy and participate in science, because my enthusiasm spills over to the children” (participant O). Participant M stated, “They may have been in the past but I think the doors are open now.” Two additional teachers did not respond to this question (J, N).

- **Self Esteem**

Teachers unanimously believe lack of student self esteem is the reason for Aboriginal students’ under-representation in the sciences (14/15). Teachers believe that under-representation is often due to a lack of confidence in student abilities (C, D, E, F) and in students feeling inadequate or intimidated. Teacher comments included: “High school is a big, scary place.” “They are a minority in these classes. Like, if you were the only female in an all male class or the only gay person in a class...”(Participant E). “Embedded racism within the school system (students may feel inadequate, not welcomed, or cannot identify with the teacher)” (D). Lack of role models for Aboriginal students was a concern as well as, a high drop out rate, which results in a small percent graduating and moving beyond. Teacher (E) also believes that Aboriginal students who “go from school to school-fall through the cracks.” They do not feel encouraged or value their culture or themselves and that “families are too dysfunctional”. One teacher explained that many of the Aboriginal students he/she works with, “have no vision/future for themselves” (P). This was supported by another teacher (Participant E) who believes that, “many do not seem to have any motivation for many reasons. ”

- **Skills**

Ten Teachers identified students' skills including their study skills as reasons for Aboriginal students' under-representation in science related courses. Important among these responses are that; reading difficulties and deficiencies from earlier grades make it difficult for students to read and interpret text language. Students can be quickly discouraged (Q). "Math skills are a pre-requisite for upper level sciences and some Aboriginal students find it intimidating. They don't end up with skills and confidence. They don't think science is important and there is no focus or concentration. Because of lack of focus they end up with little or no skills and show little interest. They don't finish their work and hand it in" (E). "Science has a language of its own which I suspect is more foreign to Aboriginal students" (Participant D). This was supported by another teacher (Participant L) who believed Aboriginal students need extra help with teaching and learning since the language of many of these courses doesn't have similar words or expressions in their [Aboriginal] culture. Further, teachers believe that Aboriginal students don't end up with the necessary skills, including discipline, self-motivation and a capacity to learn. Two teachers concluded that FAS children did not have the capacity to deal with higher-level academics (E, O). Poor diet, nutrition and fitness were seen as impairing learning (E).

Some teachers attempted solutions to Aboriginal students lack of skills. A high school teacher felt that the grade 11 and 12 academic courses should be made an elective because Aboriginal students find themselves in these courses and they can't keep up (B). Some teachers indicated poor academic skills could be because the school system is not

designed for their success, that there is a discrepancy between their own Eurocentric expectations, about the way Aboriginal students are expected to learn and Aboriginal learning styles (E, G, I.). One teacher summarized the importance of skills for Aboriginal students success in the sciences by saying, “If you are struggling in school chances are you won’t be attracted to the sciences because they are seen as more difficult” (K).

- **Relevancy**

Of the 15 responses nine teachers believed the science curriculum lacked relevancy for First Nations students. This was expressed in a variety of ways. Only three teachers connected relevancy to Aboriginality and/or their own (non-Aboriginal) teaching methods. Participant A’s responses were quite significant and worth noting because of the singularity of this type of response.

I think that they may have issues with relevancy. For instance I just had my Earth Science 11 and my top student in Earth Sc. 11 is one of my Cree students. He is a very intelligent fellow and he was a good C+ and B student in science 9 and 10 but he is an A student in Earth Sc 11. He just thinks it is more relevant to him. It means more. For instances last winter I was in Winnipeg for Christmas and we went to a little park and celebrated the Winter Solstice with Cree people who were there. When I was here we celebrated the Summer Solstice at a little park down town with Witsuwit’en people. Today is the first day of spring, so we talked about what that really means, the seasons etc. This particular student was sensitive to those things. I know he spends a lot of time outside. He is attuned with outside, he likes to learn more about the things that are relevant to him. That means a lot to him.

Participant C also commented orally to me, that what he finds works the best for him is to get to know his students. Other teacher responses included a lack of resources and materials that relate to their culture (C, H, D). Still others commented that students don’t see science as important and education is not a priority for many Aboriginal families. Linked to the idea of relevancy were further comments about learning styles and time.

Aboriginal students, “ are not pressured by time to finish projects or high school courses in the same time as we are. They work at a different pace. They often don’t complete work including homework. They don’t see it as important” (Participant E).

Discussion

I return the reader to Cajete’s (1995) quote that explains for non-Aboriginal teachers they need to look at science from different perspectives, “inside out, upside down and the other way around” and in this way examine their own “habitual thought processes”. Teacher A appears to know his students and has taken the time to inquire into ceremony enough to have attended both a Cree and a Witsuwit’ en ceremony involving the seasonal changes. It is an experience he can bring back to his classroom and share with the students or have the students participate in. What is interesting to note is that this Aboriginal student is achieving an A in this course. Participants A and C. took a positive as opposed to a negative approach to explaining why relevancy is important to student success in the sciences.

- **Socio Economic Factors**

Socio economic factors elicited responses from five teachers. For example, Participant K believes among other reasons that it is, “because of socio economic factors that Aboriginal students are struggling in school.” Participant O believes, “education is not a priority for many Aboriginal families. Students are dealing with alcohol, drugs, abuse, neglect and there is no room for anything else. That there is a lack of home and family support is echoed by four more teachers” (D, E, L, O). A high school teacher commented, “Generally kids from the ‘good’ homes end up being in the academic classes. We do not

see many other kids from similar socio-economic homes in the sciences either” (D). A poor diet, poor nutrition, poor fitness and dysfunctional families were cited by participant (E).

Discussion

Overall the teacher responses to question 5 appear to fall into two categories, Category 1.) Systemic failure and Category 2.) Cultural failure. Systemic failure included low self-esteem (in some cases), lack of materials, resources, relevancy and skill while Socio economic factors are seen as cultural failure. Cultural failure included lack of student motivation, low self-esteem, and imparticular socio economic factors. I don't believe that teacher responses are meant to be hurtful or uncaring, they are more importantly, just not knowledgeable. Teachers require education and sensitivity training to understand that poverty is interrelated. They need to be educated on Aboriginal issues, environmental degradation, epidemic health threats, culturally appropriate economic development to name a few (Brant-Castellano, 2004, p 107) to be able to understand and support Native rights and in turn be able to advocate for change. Otherwise, teachers' beliefs are re-victimizing the victims. Teachers, in their role as teachers carry a personal and professional responsibility to make a conscious choice for change (Hingley, 2000). The above data supports the earlier claim by McKinley (2005) that most teacher training and I might add, on going Professional Development sees, “the issue of indigenous student ‘underachievement’ as a deficit in the culture or the person” (p. 231).

Questions # 6, 7, 8.

Two themes emerged in the analysis of participant responses, to the question, what is science? The terminology describing the scientific method was used in part or in its entirety by most participants (13/17). It wasn't so much in the terminology alone, since the words in themselves can also be used to describe Aboriginal science. Rather it was in the lack of connecting and interrelating that terminology to the environment. It usually included a separate list of words which included terms such as; organized, systematic, acquiring and verifying knowledge, factual knowledge, experimentation, investigation, explanation, testing by establishing proof, collecting data, analyzing data and drawing conclusions. Knowledge was usually meant to mean 'of the world' and 'field of study' or "broad general knowledge of the physical world". This terminology appeared fixed, yet unattached to a core, rather isolated, non-interactive, linear and compartmentalized. There was a certain sense of vagueness through generalizations.

The other theme presented a more holistic and future added approach and included interactive terms such as searching for understanding our natural world, preservation of it and benefits we can seek from it, sustainability (Participant H), healing properties, cataloguing thought, interconnected and interrelated. While the scientific method was ubiquitous throughout teachers' responses, the holistic theme was less obvious. Three participants described science in more holistic terminology. Science was seen as connected to nature or the environment and people. For example; "Science is a process for discovering nature and the body of knowledge gained by that process" (F) or " 'Sciencing,' hands on activities that are related to the environment, that surround the

children. Experiencing, experimenting, explaining.” While those who were proponents of the ‘scientific method’ terminology used phrases such as, “The systematic study of why things are the way they are.” “Elementary students learn that findings should be verifiable, and that the scientific method is used to test prediction (hypothesis)” (Participant G). Brant-Castellano (2000) explains the importance of clarifying these two opposing viewpoints to understand what is significantly different and how the different ways of knowing impact our thoughts and understanding.

The holistic quality of knowledge implies that isolating pieces of experience and trying to make sense of them apart from the environment that gave rise to them flies in the face of reality and is bound to lead to frustration. This does not mean that analysis of parts of the circle of life²⁴ is to be dismissed; it simply means that analysis must be balanced with synthesis - placing the part that we have come to know by close analysis in the context of all its relations, which will continually impact on that which we thought we knew, and thereby transform it. (p. 30)

One participant referenced the science IRPs as containing the meaning of science. No other teachers referred to the new science IRPs nor identified Aboriginal worldview in their explanation of science.

Most participants 11/17 said, “No,” they were not familiar with the term Aboriginal science. A few speculated as to its meaning. One teacher answered positively giving an explanation. “The philosophy that all of life is in balance with the environment (and needs to be kept that way)” (Participant M.) Another teacher said they had heard of it and expressed their understanding in these terms. “Aboriginal culture and science are

²⁴ The significance of the circle is that all beings exist within it and no one particular being has pre-eminence. Within the ‘circle of life’ there is a view that life must be understood in cycles. The cycles exist in sacred rather than secular time that melds the present with the past and the future. (O’Sullivan 1999, p. 73)

tightly linked and the terms are often used synonymously” (G). Respondent L, linked Aboriginal science to math because of a workshop on Aboriginal math she had attended that explained they had their own system. Two participants left a blank and one used the term, somewhat familiar.

While most respondents were unfamiliar with the term Aboriginal science most (11/17) teachers indicated they used Aboriginal science knowledge in their science program. Teacher responses identified the study of plants, astronomy, hunting and trapping, plants and animals, local geology, ancient tools, changes in the valley over time, art, fishing, resource use, inventions, transportation, environmental philosophy, medicines, food, extreme environments and math (surface area of snowshoes) as Aboriginal science knowledge they used in their science programs. Some of these are part of the Aboriginal science prescribed learning outcomes (PLOs) the ministry has included in science curriculum. Seven teachers indicated referencing Aboriginal science knowledge on a global level using a generic approach while four teachers indicated using local Aboriginal materials and/or guests. One elementary school respondent identified enlisting the help of the Asset worker to explain Aboriginal environmental philosophy, while another teacher expressed their frustration with not receiving help from the Asset worker when she was looking for an Aboriginal song to teach her students (barriers such as ownership questions were cited). Plants were the most popular. Seven teachers indicated approaching science through native plant identification and use. One respondent (a high school science teacher who self identified) indicated he did not use Aboriginal science in his program because, “there are prescribed learning outcomes in the curriculum that do not include Aboriginal science knowledge”(B).

Question # 9 For the final question on the pre-questionnaire 14/17 responses agreed that Aboriginal knowledge was science. Teachers reasoned that Aboriginal knowledge was science through: worldview, oral tradition, culture, the use of trial and error over 1000s of years, its sustainability in ensuring survival, care of the earth, in the biology of plants, water and animals and their interrelatedness, survival of all living things, Aboriginal tools, building, transportation were all sciences; natural resources, medicines, foods and tools and their conservation philosophy were all concepts, which one participant called “vast, accurate and valuable”. One participant referred to the spiritual aspect of the Aboriginal worldview and saw it as not being science. “Things that are more spiritually based necessarily wouldn’t be science, but things of the practical world that people picked up are” (Participant A.)

Teacher Comments

1. One high school teacher talked about having heritage discussions in their class that make the distinction that while some Canadians are from European countries others are descendants of people who have lived here for 1000s of years. A debate on who were really Canadians ensued (A).
2. Another high school teacher made further comments. I would like to see more Aboriginal students succeed. Some (I’ve seen both males and females) are very good students. Most have a very rough home-life and are busy looking after younger siblings so schooling doesn’t go anywhere. Anyone with support does well, but whether they go on or not...?

I don't deny help to any people but I don't think generations of welfare helps motivate people it hinders it (E).

3. Participant G wanted to know how the link to spirituality fit into science.

Traditional Ecological Knowledge and Wisdom

In the past decade a wellspring of literature (Barnhardt & Kawagley, 1998; Berkes, 1999; McGregor, 2000; Snively & Corsiglia, 2001; Turner, Boelscher Ignace & Ignace, 2000) has surfaced to explain the importance of an understanding of the wisdom component embedded in the concept of Traditional Ecological Knowledge. As I have indicated in my Literature review this spiritual knowledge is the foundation upon which Traditional Ecological Knowledge exists and by which it is infused. According to the literature, Traditional Ecological Knowledge does not exist in the Aboriginal worldview without this essential knowing.

TEKW: knowledge of ecological principles, such as succession and interrelatedness of all components of the environment; use of ecological indicators; adaptive strategies for monitoring, enhancing, and sustainably harvesting resources; effective systems of knowledge acquisition and transfer; respectful and interactive attitudes and philosophies; close identification with ancestral lands; and beliefs that recognize the power and spirituality of nature. These characteristics, taken in totality, have enabled many groups of aboriginal peoples to live sustainably within their local environments for many thousands of years. (N. Turner, M. Boelscher Ignace, & R. Ignace (Oct., 2000), p. 1275)

Traditional Ecological Knowledge and Wisdom is based on the local Indigenous peoples relationship to the land informing their way of life and worldview. During our fieldtrip out on the land teachers were introduced to various spiritual teachings that demonstrated the physical, biological and spiritual fusion of the environment that marks the essential relationship of the Witsuwit'en to their territories and their way of live.

Pre-Questionnaire Findings and Implications

It was important to investigate the current beliefs/views of teachers regarding Aboriginal science because, “internal constructs and prior conceptions can serve as barriers to change as well as provide frameworks for interpreting and assessing new and potentially conflicting information and ideas” (Kanu, 2005, p.55).

Theme 1. Non-Aboriginal Teacher thinking (Euro-centric constructs) about Aboriginal students and their impact on Aboriginal student success in science

a.) Relationship building - According to the data, in some cases teachers in this study appeared to ignore the number of Aboriginal students in their science classes, as participant A states “No, I don’t keep a count, I’ve never really liked that” and in other cases the Nationhood of Aboriginal students in their classes. This suggests that teachers may devalue this information contributing to the invisibility status experience by many Aboriginal students. The non-commitment and general resistance of non-Aboriginal teachers to engage in this study both in the short term and the long term may demonstrate a lack of interest and importance in valuing Aboriginal education. According to the literature (Ignas, 2004; Yanu, 2005; McKinley, 2005) lack of relationship between teachers and Aboriginal students is consequential to student success. According to Kanu (2005) “children’s conceptual frameworks (their learning and thinking processes) are deeply embedded in their own cultures” (p.51). She suggests that when there is a mismatch between the students’ culture and the culture of the teacher and the classroom it sets that student up for failure especially if teachers aren’t able to demonstrate tolerance or sensitivity to the cultural (special) needs of that child.

b.) Non-Aboriginal teachers unanimously believe that Aboriginal under-representation in the sciences is due to a lack of self esteem yet teachers are unaware of any connection between Aboriginal students low self esteem and their own practices. Further, teachers place the blame (albeit unconsciously) for Aboriginal under-representation in science on the system and/or the culture. McKinley (2005) identifies this thinking that pervades the responses to question 5 as an example of what she calls 'deficit models', "where teachers believe the reason for students from some cultures performing poorly in schools is as a result of the cultural values, including the home and/or the student themselves, such as not making enough effort to learn the work" (p. 231). Blaming the education system allows teachers to look outside ones self for the reasons and shifts responsibility away from the teachers. Although this may well be an unconscious act it further marginalizes Indigenous students and prevents teachers from recognizing different worldviews.

Theme 2. Non- Aboriginal teacher thinking about Aboriginal science

(misinterpretation, contradiction, no comment) and the possible impact of their thinking on Aboriginal student success in science.

a.) Misinterpretations

Teachers' understandings of science were based for the most part in the scientific method construct. This is a limited and compartmentalized perspective that fosters only one viewpoint, the perspective of the dominant society. In some cases this can prevent teachers from accepting another viewpoint and there by prevent them from including

another perspective or worldview in their teaching. A case in point is Participant B's comment in the post-questionnaire after all was said and done.

I would like to emphasize the importance of terminology. I have no problem with "Aboriginal knowledge" and "Aboriginal technology". For me "Aboriginal science" and "Native Science" are artificial terms that I would not use. Scientific thinking and methodology was not part of the aboriginal way of thinking and should not be confused with knowledge.

He hadn't answered the question on how you could use Aboriginal knowledge in your science class. He saw Aboriginal knowledge as culture and believed it "would be better off in social studies". He appears to have 'misinterpreted' the holistic, interconnected and interrelational knowledge inherent within Aboriginal science. If he is not able to grasp this understanding how is he to come to understand the nature of the metaphysic that guides and balances this knowledge? Perhaps in time and with continual teaching and learning this participant and others like him will come to know or value the wholeness of Aboriginal knowledge and the relation of that knowledge to science. One of the two who chose to withdraw from the researched emailed me after the field trip and said, "I thought the field trip focused more on what was taken away from Aboriginals, and a lot of negative feelings towards the "white men" (Participant N). While this may have been the case for this teacher the same experience offered additional learning opportunities for other participants. The fact that she was unable to draw more from her experience suggested to me what Stike and Posner (1985) call the "Conceptual Change Theory". This theory explains that "changing teachers beliefs' depends on their recognizing discrepancies between their own views and those underlying new visions of teaching and learning" (as cited in Kanu, 2005, p. 55).

b.) Contradiction

Overall Teachers were not initially familiar with the term Aboriginal science but they overwhelmingly agreed they were teaching Aboriginal science knowledge in their science classes. The evidence indicates that most of the teachers 11/17 appear to include aspects of Aboriginal science knowledge into their science classes although they aren't aware of the scientific implications specific to Aboriginal science or Traditional Ecological Knowledge. This presents a contradiction and can be a result of my questioning technique or can also mean teachers are not familiar with the materials they are teaching. From the responses, many teachers appear to be teaching something they don't believe they know much about. How well then are they teaching it? Previous studies by Aikenhead & Huntley (1999) suggest that for students who "move from their everyday culture into the culture of school science, the move is called *cultural border crossing*... They need a teacher who is a "cultural-broker" (p. 160). This means the teacher would be able to move between the Aboriginal culture (worldview) and Western science culture (worldview) to help students "deal with cultural conflicts that might arise"(p. 160). Other educators (Cajete, 2000; Kawagley, 1999; Haig-Brown, 1992) all speak to the underlying need for this process to occur in a science classroom for Aboriginal students to feel validated.

Furthermore, teachers have taken themselves off the hook by saying they do Aboriginal science, but we are unclear about how much or how well. Possibly as one teacher indicated as it fits into their science curriculum. "Oh yes we do Aboriginal science. When we were studying the environment I had the Asset worker come in and talk about their environmental philosophy"(Participant M, personal communication,

March, 2006). Another teacher admits she doesn't actually link Aboriginal science knowledge in her science program, but includes it where relevant like in her social studies (G). What happens in these cases is that Aboriginal knowledge as a discipline as an entity in itself is lost on the students. "By accepting only that knowledge that 'fits' science/social studies the status quo never changes, power and/or authority is not contested, and extra resources are not required" (McKinley, 2005, p. 229).

Barnhardt and Kawagley's (1998) work speaks to the difficulty non-Indigenous educators and scientists have in understanding Indigenous knowledge, specifically science. This parallels the earlier quote by the Witsuwit'en during the court case:

A key element is the lack of understanding of the cultural differences that exist between the dominant culture (Euro-American) and the Indigenous world.

At the heart of the problem are different worldviews, values, traditions and histories. These differences form a cultural disconnect that triggers and nourishes misunderstandings and misperceptions on the part of both groups.

One result is diminished interest among Native people to embrace science as it is currently delivered by western educational and research settings. Western educational and research settings improperly attribute the lack of participation to disinterest, inability or resistance, explanations that steer them away from self-examination. (p.10)

c.) No Spirit in Aboriginal Science

One teacher referred to an Aboriginal spiritual perspective in understanding the world and quickly stated, "Now that isn't science" (A). No other comments were made about spirituality and Aboriginal science in the questions. One other teacher asked a question about the connection between spirituality and science in her comments. Overall

teachers did not identify or recognize a connection between Aboriginal science and spirituality.

Implications

These results confirm the previous work of many scholars including (Aikenhead and Huntley, 1997; Cajete, 2004; Ignas, 2004; Kanu, 2005; Kawagley, 1999; McKinley, 2005; Snively & Corsiglia, 2001) that recognize similar reasons for Aboriginal students declining enrollment in the sciences. McKinley (2005) expresses this clearly in her work.

Maori participation and performance in science education is undermined through low teacher efficacy and expectations, low student self-expectations, inadequate teacher subject, pedagogic and cultural knowledge and a rigid curriculum frame work that creates little space for Maori determined pedagogy. (p. 235)

Many of these concerns are being addressed by various stakeholders, including the BC Ministry of Education through the BC Science IRPs (2005); BC Science 6 & 7 textbooks (2004); Morin (2004)). Also educators like Cajete, 1999; Corsiglia and Snively, 1997, 1998; Ignas, 2004; Kanu, 2005; Kawagley & Barnhardt, 2005; Snively, 1995; Thompson, 2004) as well as the local school district (Aboriginal Education Enhancement Agreement, School District, 54, 2006; District Review Report 2004/05; Review of Funded Aboriginal Programs, 1999) all address the above themes in their recommendations. The data from this thesis supports the need to continue to implement the recommendations that have come out of these reports. For example, on page 6 of SD 54's Evaluation of Funded Aboriginal Education programs (1999-2001) it recommended for Improvement:

1. Cross-cultural sensitivity training for all teachers. Part of such training, it is felt, should include increased awareness and understanding of:

- Witsuwit'en culture;
- Existence of racism and discrimination in the community;
- Values, and at times unconscious stereotypical views held by non-Aboriginals. (p. 6)

Furthermore this report recommends that there be, "Required in-service training for staff, including cross-cultural training, and knowledge about the Witsuwit'en culture included in the strategic plan" (p. 7). In order for teachers to teach Indigenous science they need instruction and understanding of Indigenous knowledge and Indigenous values (Aikenhead & Huntley, 1999; Barnhardt & Kawagley, 1998; Cajete, 1994; Ignas, 2004).

The Post Questionnaire

Time was set-aside at the conclusion of the second workshop for teacher participants to fill out a Post-Questionnaire. For those who preferred to respond through an informally taped interview we set up another time. Teachers completed the questionnaire at this time or they took it home and faxed it to me. Others sent it through the school mail in their own time.

Again, I collected the data for each question (Appendix 4) word for word from each individual and entered it into a word document. Each participant's responses were collected on an individual page. These pages were later surveyed and analyzed question by question for reoccurring thoughts similar or dissimilar ideas and beliefs that developed big ideas or themes. I categorized the ideas by using different colored highlighters. This analysis presented overriding themes, which were then restructured into a narrative report. The responses from the pre-questionnaire were compared to responses from the post-questionnaire to further inform my work. I received 10 post-questionnaires, two of which were taped.

Question #1 The descriptive words and phrases this core group of ten educators used in expressing their individual experiences created an expansive list. Participants used terms like profound, aware, wonderful, surprised, impressive and powerful to explain their feelings. Overall their responses indicated they had an enriching experience. For example, "It was very interesting to meet Aboriginal elders and, hear them speak about their history, their way of life and to experience their calm, quiet and humorous personalities" (Participant B). " I was surprised by the kindness of the elders and Mel

towards us. They were so welcoming and open with us despite our lack of knowledge and the racism they must all experience at the hands of us whites and the history of the terrible relationship between whites and the Aboriginals in the past”(I). What stood out for participant J was,

the importance of recognizing and acknowledging Aboriginal knowledge and their connection with the land. The opportunity to go with these people and have them say this and this about the land and the catalogue that they have. I didn't know they had territory out there and I certainly didn't know how they interacted with that territory. After that day I got all that knowledge. You get it in a round about way, from listening and not from the traditional WASP ways. It's quite impressive. And the fact that they would all leave from different parts of the territory and all end up at Moricetown canyon within an hour of each other!

Further to this another participant (K) explained,

I appreciated having genuine experts share their knowledge about land management and relationships with the environment...It seemed to me that the day spent on the elders' territory took us into a time/philosophy machine where values of respect, responsibility and relationships were the most important values. It made me realize the amount of technology and science that exists amongst the Native culture; a science that in my view surpasses often what we think is scientific.

Participant L explained that, “It was very powerful...their knowledge of the land, their connection to nature and their past experiences helped me to understand the deep connection that science plays in their culture.” While for Participant Q what stood out for them was that “Aboriginal science can be used to demonstrate many aspects of science.” This person also conveyed strong feelings about the need for more Aboriginal role models and teachers.

Question #2 elicited a lengthy list of positive responders. I am not sure if people are aware enough of their own thinking to know if it changed? “Changing teachers beliefs depends on their recognizing discrepancies between their own views and those underlying new visions of teaching and learning” (Kanu, 2005, p.55).

While not all teachers identified a change in their thinking most were able to recognize that the experiences impacted their thinking, and allowed for new insight. The teachers’ responses included a broad range of qualifiers including; a deeper insight and respect for Witsuwit’en culture; awareness of another point of view; greater awareness of how closely Aboriginal people are linked to the land; motivational in the sense of ensuring more resource people are invited into the class to speak; enhanced thinking about Aboriginal technology and how it is not just out there (Inuit, kayaks) but it is localized. The importance of connecting students to the land was recognized. One participant wrote, “I hadn’t thought in terms of Aboriginal science and knowledge in regards to conservation and sustainability in nature” (Participant I).

The workshop experiences inspired a more positive outlook by non-Aboriginal teachers on Aboriginal people, more hope; a sense that better understanding of the history and culture of the people leads to greater tolerance and the ability to see more possibilities. A teacher of 26 years wrote, “ The dialogue made me very aware of how closely Aboriginal people are linked to the land. I’ve been rethinking my teaching in order to be more “wholistic” (Participant G).

Question # 3. Ninety percent, nine out of 10 participants, agreed that Aboriginal knowledge is important. Responses ranged from ‘extremely’ or ‘absolutely’ important, to

'all knowledge is important'. The areas Aboriginal knowledge encompasses included historical, cultural, environmental, and economic as well as "the efficient use of natural resources and economics on a small scale" (Participant B). Participants noted that Aboriginal knowledge benefits people, locally and globally, but especially the students because it provides another worldview, which is more holistic. Learning about Aboriginal knowledge is important because it fosters pride and respect among non-Aboriginal students as well as between Aboriginal and non-Aboriginal students. One teacher commented,

I think it's very important. I think that whenever we can give our students a more complete picture of what is happening I think that it makes them better people/better problem solvers. To try and make someone aware of the history of Canada, the history of our area in particular, but leaving out that very important part of the picture isn't a good idea at all. I think they should be aware. I think a historical perspective is a very good one but I think for a long time we've ignored a very important part of the history. (A)

A further response of note is the strong feelings and thoughts from participant L.

Absolutely! I just wish I had more of it. I think it is important to share Aboriginal knowledge because the world has learned so much and is still learning from their vast knowledge of plants, animals and the complex ecosystems that exist. How can we do this? Hire the elders to take students and teachers on similar trips...and see the positive affect this has on Aboriginal students.

Question #4 Again 90% of the respondents answered 'yes' to using Aboriginal knowledge in their science class. Two high school teachers saw a great deal of potential while two others saw no possibilities. One high school teacher believed the proper place for it was in Social Studies and that there was really no use for it in high school science (B). While another high school teacher teaching the same science program believed the knowledge was practically based with solutions to problems that work and are at the same time 'eloquent'. He highlighted the importance of balance and explained that if we can all help our students gain a better sensitivity to balances (like between the huckleberry bushes, the burning, the woodpeckers and the beetles) we all gain (A). While a third high school teacher (who self identified) said he had used Aboriginal Knowledge many times in his science classes and it was always very beneficial (C). The elementary teachers believed Aboriginal knowledge was relatively easy to integrate into the science curriculum sighting from the Integrated Resource Package (IRP), sustainability of resources, Aboriginal technology, and resource extraction. One participant acknowledged the new science curriculum and believed it honoured Aboriginal people by including learning outcomes in two, grade three, science themes. Another participant felt that in elementary school anything is possible. Aboriginal science can be integrated into any aspect of the curriculum as long as teachers are trained and are given material they are comfortable with (K)."

The addend to many of these responses was "I need resources", "I am not sure what is appropriate to speak to" or "teachers need to develop specific material alongside the Aboriginal Education Co-ordinator."

Question #5. Teachers were able to identify a broad number and variety of themes by which to integrate Aboriginal knowledge into their curriculum. The responses to this question took less the form of an 'add on' and appeared to integrate Aboriginal knowledge into a more holistic model. In science 8, as a result of the workshops one teacher was already working closely with the Asset worker to make arrangements to take the new students in the fall out on the land. He saw it as a group building exercise for students new to the school and to learn the importance of huckleberries, to pick them and bring them back to class and to can them, learning the science behind that (bacteria) and making jam for the schools Toast program. This teacher planned on working alongside the Asset worker, parents, teachers (foods) and students. He saw it as a win, win, win!

Others broadened their science programs to include an Aboriginal perspective in Forest Ecology, Salmon Enhancement including the technology for selective harvesting. As a result of the second workshop this teacher 'was reminded' of the importance of "taking students out to experience the learning on the land" (Participant C) in studying fish, herbal medicines and the forest. Another teacher suggested Cedar basket weaving - doing the whole process beginning with stripping the bark to weaving the basket working along side an elder. Having seen the local archival photos (at the second workshop) of bridge building, two participants included the study of engineering. Botany, Biology, Technology and Chemistry were also named.

Again teachers expressed concern with the lack of local resources as well as provincial materials. One teacher had asked the local curriculum developer and Principal of Aboriginal Education to look at science outcomes in the IRPs and gather materials or

help teachers find resources in those areas. Overall teachers suggested a broader application and expanded programming as a result of their experiences and were even considering solutions to tackling the IRPs.

Question #6 Barriers Only one teacher was able to find ways around the many barriers. This participant (A) suggested that you can't ignore the curriculum, "But you can be creative and create experiences that reflect certain aspects of the curriculum." He used the example that "reading about berries is a different experience then going out and picking them." He felt the western science system was too textbook and test driven. In his response he acknowledged that, "The elder said, they taught through experience".

Participant C commented that he used aspects of Aboriginal science in science classes, but he believed that, " Pressure to complete the proverbial curriculum is the primary barrier to many approaches in teaching that would stimulate the students." As non-Aboriginal people 70% of the teachers felt unqualified or uncomfortable about speaking to such an important topic. This also manifested as lacking access to knowledge holders, and a lack of accessibility of speakers to come to class. Teachers believed that Aboriginal people should be the facilitators of this knowledge and that it would be more meaningful coming from an Aboriginal person. Consequently, the need for Aboriginal teachers and role models in the school was stressed. This included supporting Aboriginal workers already in the school system by eliminating time constraints, including them in staff meetings and allowing for planning time. Lack of resources was identified by 60% of the participants (B, I, J, K, L, Q) as a significant barrier for teachers who were willing to incorporate Aboriginal science in their classroom. This included financial constraints

on field trips and for knowledgeable guests. Place was identified as a barrier since it should be taught in the bush (B, J).

Time was identified by 50% of the participants (B, C, G, I, Q) as a major barrier to teaching Aboriginal science in the classroom. Prep time, curriculum overload, and pressure to complete curriculum were considered significant factors. Specific teacher responses included,

Time, our timetables are overflowing now, my lack of knowledge, lack of pictures, resource materials websites, etc., financial constraints for field trips and bringing in knowledgeable people" (I). And, "The only barriers I see are the ones I have already experienced. Trying to find the information about Aboriginal topics, to get speakers to come to my class to try hands on activities with my students and not feeling very qualified to teach such important information. I know that I am capable of imparting this knowledge but it is more meaningful when it comes from an Aboriginal person. (L)

Some teachers believed there were no barriers as long as the educators are educated and that "we can easily access a group of people to come into our class." One participant went on to explain how they wanted to teach a Witsuwit'en song in their class as part of a First Nation study integrated with a music class. She found that none of the Aboriginal workers in the school could help her find or teach a song. She acknowledged that there seemed to be too many barriers, such as ownership questions so she ended up teaching a Mayan song instead (Participant K).

A French Immersion teacher participant cited that student attitudes continue to be a barrier for her in her class. Some students continue to resist because of religion or family bias so she felt this may need to be addressed first, in some cases individually to get students to buy in. She went on to explain that relationships between Aboriginal and non-Aboriginal students in her school are not super positive, so when they discuss

Aboriginal Knowledge, students lack 'empathy', 'openness', 'curiosity' towards learning. "Students find many of our Aboriginal students intimidating (so do I) and for many this is their only exposure to local Aboriginal culture. Often the impression our Aboriginal students leave is not one of nurturing respect for each other, adults or for the environment." She ended with. "How can we address this?" (Participant H)

Question # 7 Benefits Although most teachers identified numerous barriers to including Aboriginal science in their curriculum or classes they identified as many benefits and reasons for including Aboriginal science knowledge in their classes. It connected Aboriginal students to their communities, to their knowledge and to their roots. Guest speakers provided role models. Including Aboriginal knowledge builds pride and self esteem in recognizing Aboriginal contributions. "Aboriginal students develop pride in their esteemed role in science" (Participant I). It develops appreciation by non-Aboriginal people of Aboriginal skills and expertise. It can provide an intimate connection and understanding of the land; the connection between humans and the environment; the need to care-take it (Participants A, D, Q). It can build stewardship in all students, for the land and for each other. Teachers believe it is important to know the history of the First peoples to build relationship and understanding amongst all people (A, B, I). "Students can see people lived here for 1000s of years, that there were people who came before who were able to sustain a life and livelihood with the land for 1000s of years" (A). Many teachers' agreed that Indigenous Knowledge, including Aboriginal science, provides another perspective (Holistic) for students to consider in their thinking – that there is not just one way. It broadens students view of science and allows for more

applied science (Participants D, E, J, K). One participant ventured, "The people were tied to the land and they still want to protect the land even though they have lost control of it, maybe there is something in that" (A). "Anybody who lives here should know about the people who have lived around here in the past and their former way of life" (B).

Question #8 Overall, the participants valued the process, the experiential workshop as well as the second instructional workshop and dialogue. They learned a lot from the traditional learning experience (J, A). Teacher A identified that listening to the elders in the first workshop emphasized the ancientness of these ways and broadened his understanding. They appreciated the presentation on Indigenous knowledge (J, K) and believed the whole process opened lines of communication (H, I). One teacher who unexpectedly missed the second workshop commented that she felt she missed a great deal. There was a general feeling from the teachers that they wanted more. They wanted more time in the bush (B); they wanted to spend more time in Moricetown, Hagwilget and Sam Goosley Lake (H). One teacher suggested that, "It would be even more powerful to have more time between meetings in order to try out lessons and to utilize guest speakers" (Participant G). While another felt it wasn't long enough and thinks small workshops on different aspects of Aboriginal knowledge would be beneficial (Participant K).

Post Questionnaire Findings and Implications

Theme # 3 The Power of Experience

Overall teachers believed as a result of their experiences (field trip, informational workshop, dialogue) they gained a deeper, broader knowledge of the Witsuwit'en people on whose territory we live. The participants acquired knowledge on many levels about the local Aboriginal people they didn't previously know and their deep connection to the land. "I think that the complexity of the culture that was certainly here before us, stood out for me. Complexity in diet, in political structure, in rules, you know all those things surprised me, that it would be that complex! It certainly made me interested in looking into it in greater detail" (Participant A).

a.) For the teachers who had no understanding or a vague notion of Aboriginal science in the pre-questionnaire the post-questionnaires demonstrated teachers had developed more clarity and broader understanding. Teachers' thinking and beliefs about Aboriginal knowledge and science were broadened, deepened or enhanced as evidenced in their greater perspective of possible programs. They cited more meaningful and localized examples of Aboriginal science knowledge and an expressed openness to include Aboriginal knowledge including science knowledge in the curriculum. "You know when you start to look into things, *Our Box Was Full*, you realize much of the knowledge was extremely practically based because of experience." As a result of the workshops teachers indicated establishing relationships with the Aboriginal community and designing their science curriculum in a more holistic manner. Overall teachers suggested a broader application and expanded programming as a result of their

experiences. In addition, teachers were beginning to consider solutions on how to incorporate the science IRPs into their science programs by suggesting working in concert with Aboriginal educators.

Theme #4 Barriers or Creative Solutions to teaching Aboriginal science?

Teachers identified numerous barriers to teaching Aboriginal science in their classrooms. Participants overwhelmingly cited lack of time and curriculum restraints as barriers to teaching Aboriginal science. While many are attempting to address Aboriginal science knowledge in their classrooms they are not sure how far they should go or what is considered public vs. private knowledge. Many feel uncomfortable and unknowledgeable in teaching Aboriginal science. They want training and materials they are comfortable with. They are asking for more role models (Aboriginal teachers), resources, materials and ways to connect with the knowledge holders. Teacher participants believe they need support and guidance from First Nations educators, the Principal of Aboriginal Education and the curriculum developer. Some teachers indicated a willingness to work alongside these people to develop curriculum.

One teacher in this study suggested a solution or a creative way around the curriculum barriers. When I asked the same question of a high school teacher from outside this school district who is teaching in southern BC he responded by acknowledging similar barriers previously mentioned. However, he quickly went to a solution. As a teacher of environmental science he saw the teacher as facilitator. He believed that developing strong relationships with local communities including First Nations people is essential to teaching Aboriginal science or TEK since Aboriginal

science or TEK comes from the community. For him facilitating this connection between the students, the elders and the community is the best thing he can do (Participant X).

Theme 5 Benefits provide a win, win, win situation.

This core group of teachers generally agreed Aboriginal science is important to include in science instruction and relevant materials will help the self-esteem of Aboriginal students. As a result of the workshops teachers more readily recognize that the 'scientific method' isn't the only way to view science. Many believe Aboriginal science provides another point of view. Many teachers recorded possibilities and benefits for Aboriginal and non-Aboriginal students by including Aboriginal science in their science programs. Most importantly they acknowledged the connections that could be made for Aboriginal students. Teachers were made aware that Aboriginal ties to the land supported a strong connection to the land, a strong connection to humans, to the environment, to communities, to knowledge and to students roots. By acknowledging this, teachers came to believe including Aboriginal knowledge in their science curriculum would foster, role models, pride, self-esteem and respect, especially non-Aboriginal appreciation of Aboriginal perspectives.

Implications

Evidence suggests that experiential and informational workshops are an effective format for enhancing teacher thinking and learning. Throughout the research process most teachers were experiencing new thoughts and insights that were informing their understanding of the Aboriginal worldview. Participant G explained this process, "I used

the time to make connections between past beliefs and emerging understandings.” Many teachers also expressed they would have liked more time, out in the field for their own learning, but also with students. They would have liked more time to apply what they learned in the workshops in their classes and to invite those Aboriginal people they met through the workshops into their classes. There was unanimous agreement to return to Sam Goosley Lake in the fall to revisit the sacred site with the elder and chief Dan Michell. There was further interest to travel to different Witsuwit’en territories including Moricetown. The teachers and Aboriginal educators of school district 54 expressed an interest in on going education of teachers and students about Aboriginal knowledge including Aboriginal science, as presented in the brainstorming session. These results imply it is paramount that similar exchanges between Aboriginal and non-Aboriginal people continue to take place within school systems.

While teachers believed their knowledge was enhanced or broadened to some degree, lack of time for the sessions in this study significantly impacted the acquisition of science knowledge by the teachers. This implies that to get the most out of a traditional learning experience teachers need more time with the elders and knowledge holders. Barnhardt & Kawagley (1999) address these issues in the following model that could be offered to teachers in this district and others in the summer months. Barnhardt & Kawagley’s (1999) work speaks to the difficulty non-Indigenous educators and scientists have in understanding Indigenous knowledge, specifically science. This estrangement motivated them to help foster two initiatives in Alaska to broaden teacher thinking to include an Indigenous perspective.

Minto elders did agree to work with us to implement a cultural immersion program for teachers, so for the past eight summers we

have been taking about thirty educators out to Old Minto to spend a week to ten days (in the middle of a three-week session) with the elders as the instructors. We make no prior stipulations about what is to go on at the camp—no lectures, no seminars, none of the formal teaching we would normally do. Instead, we participate in whatever activities the elders arrange at the camp. It isn't until about half-way through the week that teachers start recognizing that we are in a different realm. Until then they process the activities through the filters they bring with them, applying what they already know from previous outdoor "camping" experiences to make sense out of the new circumstances. It's when they begin to notice the discrepancies between what they think is happening and what actually happens that they realize there is more going on than they initially recognized. It is at that point, when people start questioning their own presuppositions, that new insights begin to emerge. The elders and the other people from Minto who work with us have a remarkable capacity to open themselves up and draw people into their lives. Even teachers who are initially skeptical when they enter the program come out of it with a new set of lenses through which to view the world. (p. 125)

Teachers and Aboriginal educators in this study suggested that students, and elders come together in a traditional camp setting. They implied this could enhance Western science and Aboriginal science knowledge learning in a culturally responsive format. The following example provides a culturally responsive science initiative that partners Aboriginal science knowledge with Western science knowledge. This experiential learning style suggests a stewardship model where students and teachers are brought out to a traditional camp along with western scientists.

...future generations learn about their place in the fragile ecosystem they occupy and the responsibility they carry as the stewards of that ecosystem. The instructors of the camp include local elders as well as visiting scientists, who learn from each other while they share their knowledge with the students... The surrounding environment can provide a rich laboratory for students to learn about the many interconnected forces that impact their lives and make a contribution to the well-being of their community, utilizing tools from both the indigenous and western knowledge systems. (Barnhardt & Kawagley 1999, p.135)

Numerous studies and camp experiences have been inspired throughout Canada to address the need for teachers and students to internalize culturally responsive science curriculum and Indigenous knowledge. The Indigenous peoples of Alaska have taken this learning a step further by seeking standards in teachers and education to ensure culturally responsive teaching. The Assembly of Alaskan Native Educators prepared Guidelines (1999) that list the teaching standards necessary for preparing culturally responsive teachers for their Alaskan schools. Within these standards they recommend that new teachers and teachers in training,

should be provided in-depth experiences in working with students whose cultural backgrounds are different from their own... and with a cross-cultural orientation as part of the districts regular in-service program, including where possible, a week-long cultural camp experience and the assignment of an experienced native teacher/aide, an Elder and a student as mentors throughout the first year of teaching... (p.17)

I agree with the Elders that experiential learning, which allows for time out of public school is paramount. One of my first experiences in coming to teach in the north involved one such experience. The Gitksan and Witsuwit'en put on a welcoming for teachers at the band schools. I was working at the Band operated school at Moricetown at the time and all teachers (and their families) were invited to K'san²⁵, for a welcoming ceremony. We were taken through the various longhouses on the property and taught about their functions in the Gitksan and Witsuwit'en social, economical and spiritual order. In the museum we learned of their traditional lifeways and in the evening we were

²⁵ K'san is a replica of a traditional village site built on the confluence of the Bulkley and Skeena Rivers in Giksan and Witsuwit'en territories. It houses contemporary and traditional artifacts, a feast house, totem poles and provides an instructional setting for learning about the culture and history of these peoples.

treated to a traditional feast in their feast house. Food I had never heard of (beaver tongue and ooligan) tempted our pallets while story, song and dance were provided for our enjoyment, but also to serve as teaching tools through the traditional oral histories. It was an experience I have never forgotten. It moved me deeply and firmly routed me in developing empathy and understanding for the Aboriginal people of the north. This tradition of a few years was short lived and discontinued the following year but it is just such an experience all non-Aboriginal peoples, especially teachers new and old can benefit from. I have since returned to K'san with intermediate classes from schools to have them share in a similar experience. I believe that all levels of the education system can take responsibility for creating culturally responsive schools. This is something that could be initiated by schools or the school district by including such experiences into their budgets for Professional Development. One of the teacher participants in an informal interview shared with me a similar experience he had had with his students out on the territories of the Witsuwit'en Nation with Witsuwit'en knowledge holders. He found the stories and the traditional knowledge provided a powerful teaching integrating many aspects of the curriculum including science. However, his frustration was in the lack of funding that is set aside by the school district and Aboriginal education to ensure such experiences can occur. As a teacher and administrator of 44 years he felt that, "we do not honour what Aboriginal peoples learned about this territory. We do not honour or understand their culture" (Participant P).

Teachers clearly identified a lack of materials and resources as a barrier to teaching Aboriginal science in their science programs. The implication was that given the curriculum they would teach it. However evidence suggests that providing curriculum

materials for teachers doesn't always ensure teachers will deliver. There are a number of reasons for this. According to Goddard's (2002) study, one reason is due to the characteristics of northern teachers'. In his study of teachers in northern Saskatchewan and Alberta, he found two common deterrents to teachers teaching about the local Aboriginal culture. Teachers don't tend to challenge the status quo or provide any resistance to "the hegemonic nature of provincial curriculum" and they ignore local needs "in favor of a pan-provincial approach to curriculum" (p.128). Similarly in my study although many teacher respondents indicated using Aboriginal science in their courses high school teachers almost unanimously agreed that the curriculum prevented them from incorporating local Aboriginal science into their programs. Overall seven respondents initially (pre-questionnaire) indicated using a general approach (Pan-Indigenous) while four out of 17 respondents indicated using local Aboriginal materials and/or guests.

Goddard (2002) maintains that,

in their desire to ensure that the children receive the "same" education as those in the south, northern educators, "appear to be ignoring the idiosyncratic contexts of the communities in which they work. The local realities of a small trapping or resource-based economy are ignored in favor of discussions related to increasingly urban and global issues" (p. 128).

UBC scholar Ignas (2004) on the other hand argues, that by facilitating Aboriginal student learning locally, students can construct knowledge that is far reaching and inclusive of a global perspective.

Although teachers in this study indicated an openness and willingness to include Aboriginal science and knowledge in their science programs, many suggested a lack of confidence and certainty in how to proceed. Educators (Ignas, 2004; Thompson, 2003;

McKeen, 2003;) have developed a BC curriculum *Forests For The Future* (2004) which, they believe is meaningful and relevant because it comes from the community and yet is able to inform students globally. They propose that for teachers to be able to teach Aboriginal science they first need to understand Indigenous knowledge. Teachers who are aware of IK can develop a mindset that recognizes the value of Traditional Ecological Knowledge. They will have the ability to work with the local Aboriginal community and be able to practice a teaching approach that demonstrates an awareness of Indigenous Knowledge. Having an understanding of Indigenous Knowledge facilitates the Aboriginal students acquisition of academic skills through constructing meaning from their experiences. In this way Aboriginal students are able to recognize Indigenous Knowledge as a body of knowledge in its own right. The teaching approach they propose is one of facilitation, “it adopts an indirect and facilitative role in the learning process of students” and when using this approach “teachers support the students in their learning endeavors as opposed to orchestrating the learning process” (p. 52). This approach is said to “mirror similar processes of learning involved in hunting, fishing, and gathering” (p.52). In their model community knowledge holders are encouraged to participate in the learning process and the lesson design encourages active student research and inquiry.

The educators responsible for developing this curriculum view it as, ‘culturally responsive curriculum’. The study compiled by Kilman (2006) defines culturally responsive curriculum as curriculum that,

...represents a radical departure from the usual approach to multicultural education. Instead of tacking cultural information onto existing curriculum, it calls for embedding it into everyday lessons, building on students’ experiences and making lessons relevant to what students already know. (p. 2)

According to Kilman (2006) the principal of a Lakota school is hoping to foster change in her staff. "I ask them to include with their lesson plans how they plan to incorporate language and culture," she says, "The problem is most of them don't really know how. We just have to keep showing them that it's possible... Until then smaller gains will have to do" (p. 3).

Teachers in my thesis study were asking for support. They did indicate they were willing to sit down with the Principal for Aboriginal Education and the curriculum developer and work together to develop culturally responsive materials. (It will also be important to include elders at this table). Therein may lay the key. This study indicates teachers are beginning to consider solutions to tackling the IRPs in concert with local Aboriginal educators. There are many many more examples of curriculum including: ANKN, BC Science 6&7, *Luutigm Hoon: Honouring the Salmon (SD# 52)*, *Indigenous plants and trees (SD#68)*; *Plants That We Use Traditional Plants of the Wetsuwet'en People; Forests of the Future* which, teachers, elders and curriculum developers can access as templates to begin this critical work.

Recommendations and Further Study

International, research proposes ways to improve science education for Aboriginal students. These closely resemble the findings in my work and include: changes in teaching strategies, raising student, parent and teacher expectations, changing the beliefs and attitudes of individual teachers, as well as changing the curriculum to include connecting with the learners' culture. (McKinley, 2005, p. 232)

Reviews, reports and agreements from the local school district over the past 5 years express similar conclusions from their studies. As a result of this study I concur with the local school district's agreements, reviews, reports and recommendations. "The district should build upon its progress in Aboriginal education by implementing a language and culture program and developing Board Authorized courses that provide additional credit opportunities towards graduation" (MacRae, & Corman, 2005, p. 8).

Further relevant recommendations from these reports include:

- There is clearly a need to develop [relevant] materials for use in the classroom.
- Several cultural resource teachers indicated that they felt a need for greater knowledge and awareness of Witsuwit'en culture...
- Cross-cultural sensitivity training for all teachers was seen by many to be a need. Part of such training, it is felt, should include increased awareness and understanding of Witsuwit'en culture...(Grieve and Reid, 2000, p.6)

I would also add awareness of Witsuwit'en Traditional Knowledge through the partnering of science teachers, Aboriginal educators, elders, students and community is paramount in securing Aboriginal student success in science. The local school district's

Board of Trustees clearly recognize the importance of this in the recently penned Enhancement Agreement (2006)

Fundamental to this EA is the requirement that schools provide a strong program that rests upon the local Witsuwit'en Nation's culture, on whose territory the schools are located. (p. 12)

What is extremely apparent is that the school district is in agreement on paper on what needs to be done, however there is less visibility of documents that explain the how of it. Battiste (1999, 2000) would argue this is not enough. "Most public schools in Canada today do not have coherent plans about how teachers and students can know Aboriginal thought and apply it in current educational processes" (Battiste, 2000, p. 192). She maintains that there are too few examples of Aboriginal programs in public education that embody an Aboriginal worldview and too few schools for Aboriginal students based on Aboriginal knowledge.

It is painstakingly evident that it is time to turn the research into action. Clearly there is work being done to mitigate the barriers non-Aboriginal teachers face in teaching Aboriginal science in their classrooms. This century is allowing for creative pathways to be drawn around these barriers. It is a time when education must look past the barriers to find creative solutions. "It is a time in education when the heart needs to connect with the mind" (Herb George CBC, 2006) and to afford more space for the heart. It is true, "That education should also help you to find your heart, which is that passionate sense of self that motivates you and moves you along in life" (Cajete, 2000, p.183). For this ideal to be recognized in practice, both time and money need to be found to support Aboriginal students learning in the sciences.

At a time when Aboriginal people are recultivating their own understanding of Indigenous Knowledge for treaty negotiations it bodes well for educators to develop awareness of different ways of knowing and begin to work together to bridge Aboriginal science and Western science learning in the classroom and to encourage Aboriginal students' enrollment in the sciences. For Lorna Williams, the precursor to igniting change is action. Her suggestion is to, "Just Do It!" (CBC, 2006).

Teachers (H and I) indicated I was teaching to the converted in my research methodology meaning they were already "open to appreciating local knowledge". For the most part this group was willing to engage in experiences and learning that could broaden and expand their minds. For me that meant I had to go with the group I had and hope that the others would follow. There was a point where I wanted to pull out of the field trip and limit the study to the pre-questionnaires, but my strong belief in the process made me persevere. I couldn't let the disinterest stop me. I had to go with the group that indicated they were willing because it was their enthusiasm that allowed for exciting things to unfold. I had to 'JUST DO IT'! It is from this philosophy and the philosophy of community based learning that many initiatives have begun to partner teachers, scientists and Aboriginal stakeholders around education: Barnhardt & Kawagley, (1999); Cajete (1999); Youngblood Henderson, (2000); Knickerbocker, (1999); McKinley, (2005); Thompson, (2003); Ignas, (2004) to name a few.

Further Study

The question that comes out of this study is, how to develop and incorporate Witsuwit'en traditional knowledge alongside the science curriculum? (Appendix 7) Further study and research lies in the ability to facilitate the inclusion of local Aboriginal

knowledge in science programs and in doing so informing teachers, community, families and educational systems. By informing teachers, educational systems have the potential to provide a model and a pathway by which more Aboriginal learners can enter the sciences and complete science related courses. Further study has the potential to successfully integrate Environmental science and First Nations ways of knowing into curriculum development. A collaborative effort between Aboriginal knowledge holders and local science educators can partner community and school around important ecological interests and sustainability issues.

Further study can guide participants to attain greater understanding, to develop and acquire curriculum that meets the needs of the First Nations people whose traditional territories we reside on. Through further collaboration with First Nations' to develop a program of study that reflects their values and integrates their traditional knowledge of the environment, we are creating a space in the educational system for other ways of knowing and Aboriginal student achievement. The final dialogue and brainstorm session initiated a collaboration of ideas that can begin to build on a plan of action to promote and encourage the success of Witsuwit'en students in the sciences. There was a general feeling from the teachers who participated in this study that they wanted more. They wanted more time in the bush (B); they wanted to spend more time in Moricetown, Hagwilget and Sam Goosley Lake (H). One teacher suggested that, "It would be even more powerful to have more time between meetings in order to try out lessons and to utilize guest speakers" (Participant G). While another felt it wasn't long enough and thinks small workshops on different aspects of Aboriginal knowledge would be beneficial (Participant K).

Government is currently outsourcing money to universities to develop community based education programs. Some of this money needs to filter down to the school districts within the universities sphere of influence. I am a graduate student working on a small budget of \$1000. A larger multifaceted, longitudinal project, funded to include scientists, teachers, school districts, Aboriginal education councils, local First Nations knowledge holders and the teachers association could implement an Action Research Model that could partner the Aboriginal communities with science education. Universities could connect with school boards, teachers and local First Nations to provide a proactive plan to educate teachers on Aboriginal knowledge, including science knowledge. This could be achieved through Professional Development days, release time and/or as university credit. Together through respectful relations, students, staff and communities can listen deeply to what First Nations people have to say and 'grow these solutions' together.

Finding a methodology for bridging Aboriginal science and Western science in education becomes a delicate task. This process needs to be balanced within, sensitive to, and inclusive of, Aboriginal Ways of knowing on the one hand and not dominated by a Western agenda on the other hand. The catalyst for the immediacy of this bridging according to Colorado, (1988); Kimmerer, (1999); and Simpson, (2002), is the ecological disaster Western science has and is perpetuating on the planet. For Colorado (1988) this process of bridging includes the methods that are recommended by Native Elders who are the "Master Scientists".

Elders recommend that an intercultural team approach be used and that we focus on relations. They will teach educated Native people about traditional ways. In exchange, the Native professionals will be bridges with non-Native professionals. The Elders advocate the use of these teams because the children live in and have internalized the cultural mosaic of today's world. Many are bi-racial. The grandmothers believe

that a unified voice in treating these children will steer them back to themselves, their culture and grandparents. (p. 220)

I believe that "Dialogue" would be an important aspect of this collaborative model.

Dialogue would provide a cross-cultural scientific exchange of consultation, co-operation and collaboration by honoring all the participants and their diverse backgrounds and views.

Through strengthening Indian science and working together, Elders hope that we will once again help out our young to "know what life is" and to steer our families toward the "good life." The key to this approach can be summarized in one word: "NIYE," which is a gentle admonishment of love meaning "my child." It is an honour to be spoken to in this way and it is we, the concerned professional people, to whom the Elders are saying, "NIYE," meaning be good to one another and work together on behalf of the children the Earth and the Good Way of Life. (Colorado, 1988, p. 67)

Recommendations for the Implementation of Aboriginal Knowledge and Wisdom into the Science Curriculum

After a close survey of the literature and after experiencing a model for teachers professional development it appears clear that there is a need to include Witsuwit'en knowledge in science education. Yet it appears equally clear that there is no place in the system to carry out the mandate put forward by the provincial government. Therefore I am including some recommendations.

1. Teachers require ongoing instruction and sensitivity training in understanding Indigenous history, knowledge systems and worldviews.
2. Teachers require ongoing experiential learning of local Witsuwit'en science knowledge.
3. An acknowledgement by the school district that Aboriginal knowledge systems are valid and different from Western science models.
4. Provide educational workshop opportunities for teachers to develop the understanding that Aboriginal knowledge is a living dynamic construct that emerges out of deep rooted spiritual beliefs which are not separate from but an essential part of Aboriginal science knowing.
5. Provide materials defined by the local Aboriginal community as meaningful to Aboriginal student knowledge.
6. Provide a working model that sees local Aboriginal knowledge as the centerpiece out of which an understanding of Western science knowledge can evolve as opposed to the other way around.
7. Create a position for a facilitator to bring together Knowledge Holders, science educators, curriculum developers and other stakeholders (asset workers) to

develop culturally relevant science instruction and assessment, and culturally sensitive science curriculum.

8. Identify teachers within the district who are conducting science instruction based on Aboriginal knowledge and include them in dialogue sessions with Aboriginal knowledge holders from the community and the school district.
9. Provide release time for teachers and asset workers to collaborate with First Nations experts on the land and 'face to face' in collaborative sessions to build relationships.
10. Provide time and money for Aboriginal cultural liaison workers to participate in planning sessions with teachers.
11. Provide whole school professional development in understanding Aboriginal knowledge including science knowledge. All the members of the school community including principals, vice principals, teachers, teaching assistants asset workers, and parents would attend a two or three day workshop.

Teachers need to be open to and accepting of a cross-cultural view of science. A cross-cultural view values the Aboriginal students world view as important and legitimate and teaches it along side the Western Model. Ideally teachers would include the differences and similarities between the Western and Aboriginal views in their teaching practice. Adopting a cross-cultural view of science education would allow teachers to view Aboriginal students as 'advantaged' rather than 'disadvantaged' as in the sense of the deficit model.

Challenges

There are a number of challenges that present themselves as evidenced in this research. I am not prepared at this time to cover all of them however I would like to address three of major importance to curriculum development.

Community

The overall low response rate of teachers in this study is both a concern and a cause for thought. I was very disheartened by the number of teachers who demonstrated a lack of interest in participating. From the verbal responses I received it appeared that many teachers had no personal interest in teacher thinking in the sciences and/or Aboriginal student success. This disinterest could have been for a number of reasons. For instance, I scheduled the field trip for the same day as the District Pro-D day so many teachers were already involved in facilitating the local school district event. Others had made alternative arrangements and still others wanted to attend the Health and Wellness symposium being offered locally.

Another consideration for poor teacher response may well have been that presently within the communities of the Bulkley Valley a dynamic exists similar to that between many small towns throughout BC and Canada, which are neighbouring First Nations reserves. A common factor pervasive throughout these communities is the lack of acknowledgement of Aboriginal peoples. This scenario is typical of Smithers. The welcoming statues to Smithers consist of carvings of a donkey, a bear, loggers and miners as well as a Swiss alpine man blowing a Swiss horn that dominates the Main street entrance. According to a paper penned by UNBC scholars (2006) called, *A Town for All Seasons But Not For All People* they examined the constructed image of the communities

of the Bulkley Valley and found that, "...the Swiss alpine theme creates and solidifies the notion that Smithers has European heritage,...downplaying Indigenous history or roots" (Stockburger, 2006, p.3). The author also defers to a mural in downtown Smithers that, "trivializes and belittles First Nations culture and heritage in the area" (p.6). Her work presents examples of "First Nations as a 'cultural accessory'" (Stockburger, 2006, p.6). This same attitude is pervasive throughout Smithers' society.

The local high school in concert with the principal of Aboriginal education has worked hard to stem the tide of racism (that may mirror the larger community) by contracting local Witsuwit'en artists to work in tandem with students on ongoing projects. One such project includes a totem they have carved that stands before the school (2003) in recognition of peaceful relations between the non-Aboriginal students and Aboriginal students. However, it is evident from teacher responses that the culture of racism still exists within the schools.

One of the teacher participants asked a very poignant question concerning extrications between Aboriginal students and non-Aboriginal students and teachers she witnesses or is subjected to in her elementary school. She wanted to know "How can we address this?" Another teacher drew attention to the fact that although these are all very good ideas she feels they will be lost on Aboriginal students who are suffering from so much hurt! The opposite of the word extricate or disconnect is involvement. Until non-Aboriginal teachers become involved in the education of Aboriginal students in a meaningful way the status quo will prevail. Chief Dan Michell taught us one way to heal and educate is on traditional territories or in camps where the lessons are about survival and the application of that to everyday events. Cajete (1999) talks about the process of

transformation such an experience provides for First Nations people. "Revitalizing ancestral connections with Nature and its inherent meaning is an essential healing and transformational process for Indian people" (p.85). Dan Michell knows this and it is why we tried so hard to find a Witsuwit'en person to drive the van. The responses from this study demonstrate how the same process can similarly affect non-Aboriginal people. It seems abundantly clear that, "There are ways to break out of the mold in which we are oftentimes stuck, though it takes some effort. There are ways to develop linkages that connect different worldviews, at least for a few people under the right conditions" (Barnhardt & Kawagley, 1998, p. 8).

This is an important period in history, it is an important time, because as we come to learn and know about the Aboriginal experience in Canada it is incumbent upon us to renegotiate a fair and equitable response toward a people whose wisdom about these lands far outweigh our own limited understandings.

Erosion in the environment and in culture contributes to a profound erosion in human rights. Perhaps it is surprising to some that the disappearance of species and systems follows the same path as the loss of languages, cultures and knowledge. These erosions of environment and culture could never occur if they were not themselves preceded by an erosion in equity. (P. R. Mooney, in M. Findlay 2002, p. 1)

We have an opportunity to walk beside Aboriginal elders and Aboriginal knowledge holders and listen and learn. We have an opportunity to walk behind them and let them lead. Today feels like a good day to begin to narrow the gulf (Dockstater, 1993) that exists between Aboriginal people and non-Aboriginal people and their worldviews.

Language

The debate (Battiste, 1999,2000; Cajete, 1994,1999; Kawagley, 1995; McKinley, 2005) over the importance of Indigenous language to Indigenous knowledge and traditional knowledge systems in education cannot be over looked. “Where Aboriginal knowledge survives it is transmitted through Aboriginal language” (Battiste, 2000, p. 199). Battiste (2000) suggests that Aboriginal student success; achievement, performance and pride, hinge on valuing students’ Aboriginal languages through respect and support within the education system, as well as within Canada. The Maori scholar McKinley (2005) reports that in New Zealand there has been a successful Maori Immersion program for over 25 years except in science. Their statistics in science mirror BC’s and Canada’s in numbers of Maori students graduating in the sciences. Her paper discusses the debate over the importance of language in teaching science. She acknowledges the importance of teachers who are fluent in their language, have good cultural knowledge and can teach science as critical to the acquisition of Maori science knowledge by students. She notes however that Maori people, with Maori language and knowledge who have the western science background are hard to find. McKinley (2005) identifies that “research in bilingual classes attributes the relative lack of Maori success in science to negative self-esteem and attitudes towards study, yet also points to the effects of inadequate teacher knowledge on classroom practice” (p. 236).

The importance of language to science is seen in the worldview that language constructs. Traditional Aboriginal pedagogy reflects the interconnectedness between all aspects of existence, with the learning seen as a cooperative venture, lifelong and

intergenerational (Hemara, 2000 as cited in McKinley, 2005, p. 236). These are constructs, which do not necessarily transfer to Western thought and science. For many educators (Battiste, 2000; Cajete, 2000; Youngblood Henderson, 2000; McKinley, 2005; Kawagley, 1995) language is inextricably linked to Aboriginal peoples connection to the land, to place. “ Aboriginal languages express an awareness of a local ecology and are directed to understanding both external life forms and the invisible forces beneath them...” (Youngblood Henderson, 2000, p. 262).

For the Witsuwit'en Nation they view speaking the language as “Honouring Our Ancestors.” “The Wet'suwet'en language and culture are critical to our identity – they are linked to one another and to our territory. Our Elders have always advised us that we must learn our language and culture to truly understand what it means to be Wet'suwet'en” (Office of the Wet'suwet'en, 1997, p.6). Youngblood Henderson (2000) further explains this connection between language and identity. “Aboriginal consciousness and language are structured according to Aboriginal people's understanding of the forces of the particular ecosystem in which they live. They derive most of the linguistic notions by reflection on the forces of nature” (p. 263). It is precisely this worldview that informs their language. Consequently, the use of verbs far out ways the use of nouns to capture and express, “ an entire panorama of motion and energy” that is recognized as being in a state of constant ‘flux’, or “eternal transformation and interconnected space” (p. 264). This is in direct contrast to the English language that is built on nouns that name subject and place in a fixed and rigid sense of place.

Literacy in science is recently becoming an important concept to elders and educators for closing the gap between younger and older generations in acquiring

Aboriginal science knowledge. UNBC in partnership with the Tl'azt'en of northern BC have inspired a community based initiative. They have collaborated on a project called, *Strengthening Science Literacy through Traditional Ecological Knowledge*, which they presented at the Aboriginal Education Research Forum in Winnipeg, in June 2005.

Tl'azt'enne have identified a gap in the transfer of their Traditional Ecological Knowledge (TEK) from older to younger generations. Tl'azt'enne also see challenges for their youth in attaining the science and math skills necessary to succeed in high school, as well as in university and college science programs.

For this reason an education team of Tl'azt'en elders and UNBC students are exploring programs based on “ the alliance of Traditional Ecological Knowledge and scientific knowledge” (p.3) to develop curriculum that will inspire the youth, support the transfer of TEK and assist students in developing science skills . The goal of the program includes understanding this Nation’s educational, philosophical values and goals so curriculum can be designed that meets the needs of their youth. The Tl'azt'en are incorporating their language and culture into the program by compiling place names, traditional use sites (Dakelh names and medicine gathering areas), genealogy, and clan territories (p. 3). The Tl'azt'en Nation believe:

Meeting this challenge will help members of Tl'azt'en Nation become professional resource managers, and contribute their skills and knowledge to the management of Tl'azt'en territory. A sustainable future, one which provides healthy communities and effective resource management, requires the use and integration of both scientific knowledge and TEK.
<http://cura.unbc.ca/education.htm>

This example and others like them provide a place to begin. A local place, an Indigenous place within which community and language can be framed (Appendix 7).

Locally language presents a continual challenge. There the debate over which

Witsuwit'en language to use in print (the old orthography or the new)²⁶ has prevented resource materials from going to print and has put a delimiter on developing local curriculum. The express challenge this situation presents became evident to me when trying to determine the focus for my thesis research and again in gifting the teachers. This challenge involved the curriculum *Plants That We Use*. I wanted to give the teachers a traditional plant use curriculum resource authored by Gottesfeld (1991) and published by the Kyah Wiget Education Society but which was presently out of print. I had to make copies to present to the teachers. I knew this was a delicate issue because the curriculum contained the old orthographic spelling and my understanding was that the decision has been to go with the new orthographic spelling. My belief was that it was more important to get the resource out to teachers to guide them in their work and the language would follow. This resource is only one of many local resources that has suffered the same fate and lays in the back rooms awaiting a language makeover or has yet to be written. Significantly the language in the book comes from the elders and identifies plants, plant use and traditional practices.

Further, locally, provincially and federally education puts a high price on learning the French language in school. For Aboriginal students this often means learning a third language.

Instead of requiring Aboriginal students to submit to a third language (French in English-speaking Canada and English in French-speaking Canada), they should have the opportunity to explore their first language in a provincially accredited course in elementary and secondary school, as well as to find appropriate ways to explore their

²⁶ Witsuwit'en (*Revised Hildebrandt*) vs. Wet'suwet'en (*Hildebrandt*): It is important to note orthography (writing system) for the Witsuwit'en translations are written in a revised version of the *Hildebrandt* style now called Distinctly Witsuwit'en. The differences between these two systems are the *Hildebrandt* version does not fully accommodate the entire Witsuwit'en sound system, and Distinctly Witsuwit'en was written to capture all the Witsuwit'en sounds (Enhancement Agreement, sd.54, 2006, p.15)

understanding and expand their knowledge and usage of their second language of English or French. Being required to learn French or English as a third language, without a good handle on their first or second language, imposes yet another major hurdle that impedes Aboriginal students from achieving educational equity. (Battiste, 2000, p. 200)

One school in our district is fairly evenly divided amongst Aboriginal students, Non-Aboriginal students and French Immersion students. There is a French Immersion program that continues to grow and spawn high achieving academics. The reason I am told is that being able to think in two languages produces improved and superior thinking skills. The corollary to this is there is no Aboriginal language program in this school. Aboriginal students are expected to learn French. This dichotomy in learning opportunities appears to disadvantage Aboriginal students while benefiting the French Immersion students. There is no equal playing field for developing literacy skills in this instance. In fact the Aboriginal Literacy teachers, take Aboriginal students out of their classes to teach English literacy skills!

Many educators writing about language believe in the immersion model. “Finally, for Indigenous people, the revitalization of Indigenous knowledge through truly self-determined education provides the most direct route for Indigenous sovereignty” (Cajete, 2000, p. 183).

Spirituality

One teacher in the study explained that they should be prepared for the Spiritual aspects. “You can’t just talk about the person who predicted (Beni, their prophet) because for the Western people it loses all relevance, their eyes glass over. People need to prepare for that or their eyes glass over. Those things are so extremely important because how do

you get to know about people? You have to prepare others for that kind of experience” (Participant A) This begs the question, of whether or not Western scientists can be respectful enough and sensitive enough to Indigenous life ways to practice Indigenous science respectfully in their classrooms? What Western science teachers need to learn and understand is that all knowledge is considered sacred to Indigenous peoples. Spirituality is essentially the corner stone of Aboriginal science. In the wise words of Oscar Kawagley (1999) elder and educator:

The Yupiaq’s careful and acute observational ability taught them many years ago the presence of a Creative Force. They saw birth and death in the human and in nature. This Creative Force flowed through everything-the years, months, days, rivers, lightening and thunder, plants, animals and earth. They were awed by the creative process. They studied, they connected and nature became their metaphysic. (p. 8)

It is apparent that there is a significant discrepancy between Western science and Aboriginal worldviews with respect to spirituality. Kawagley (1995) who was educated both traditionally by his grandmother and in Western education cites the seriousness for educators ignoring this disparity.

My own undergraduate science education was derived from textbooks, laboratory manuals and learning through the scientific method. These teachings and learning processes do not, however, take advantage of the students’ environment, or the environment’s ecological processes. Nor do they prepare the students to recognize a creative force flowing in and around them at all times (p.89). The removal of the mystical force from scientific processes has rendered a society...which no longer honors and reveres nature, but often misuses, abuses, and disrespects it. (Schumacher, 1977 in Kawagley, 1995, p. 89)

Without the ability to integrate the human, natural, and spiritual worlds, science education risks contributing to the decay of the physical environment, with a concomitant diminishment of the resources on which society depends. (p. 89)

The diminishment of resources can refer to the physical environment as well as to the diminishment of Aboriginal students as a resource. Cajete (2000) speaks passionately about his role as teacher in dancing between worlds and how difficult that is for himself as teacher, but especially for the students. He speaks about the duality Aboriginal people experience daily in their educational life as one of a "split mind". "It is our way of saying that you're not thinking, that you're not doing something with a whole mind... As a result of colonization... We lead lives of paradoxical conflict and contrast" (p.187).

Although I am a non-Native teacher I internalize the daily struggle of Aboriginal students within this system and like Cajete I can't help but feel that, "Today I do not consider myself successful in the teaching process unless I can at least begin a process of healing this split."(p.187) And knowing that, "The split head, of course, leads to ... things that we have talked about before: suicide; self-hate; the disintegration of our cultures; the lack of knowing where we are, where we are going and where we are coming from" (p. 187). "mainstream science education has failed miserably at attracting and retaining Aboriginal students" (Cajete, 1999). This knowing informs me there is need for change in science education not only in a global context in recognizing the dis-ease of mother nature but at a local level where this dis-ease is manifesting itself in the distress of many Aboriginal students. Recognizing the neediness of our world and the youth of that world underscores the poignant need for sensitivity training for non-Aboriginal teachers. Sweats, ceremony, teachings and stories (as teachers become ready) can develop an awareness of Aboriginal worldview that can inform science education. Not in an attitude of misappropriation or for personal gain but for building mutual respect, validation and an acceptance for diversity within society.

It was recently brought to my attention by a friend working in the government arm of the Ministry of Children and Family Services that her whole team was sent for a weekend long sensitivity training retreat with local Aboriginal people. They came together for talks led by the Aboriginal people, stories were told, a sweat lodge ceremony was held to help the non-Aboriginal workers appreciate the Aboriginal worldview. This too could happen in education with positive results for non-Aboriginal teachers and Aboriginal students.

Anyone who has taught classes including Aboriginal students knows not only the challenges that those students face but also the remarkable contributions that they can make if they think that the learning environment recognizes them as a resource rather than a liability. (Findlay, 2000, as cited in Battiste, 2000, p. xii)

Reflections

This journey I began last year has given me pause to reflect on my teaching practice and my career, to find the best way I can to support Aboriginal youth. This journey has involved a great deal of listening, sharing and learning. What I've learned is at the heart of Aboriginal student success in the sciences is communication. This communication needs to come in the way of conversations, collaboration and opportunities to meet and network as teachers, the teaching community and the outside community. There is a sense that Aboriginal educators, non-Aboriginal educators and community want to work together. We need to come together on a continual basis to learn how to move forward and to recognize the unique contributions we each have to give. To be able to make fundamental change in education and develop truly culturally responsive science curriculum we need to experience it, advocate for it and to model it. This initiative needs to be lead by the Aboriginal knowledge holders working together with non-Aboriginal teachers in good relationship maintaining the attributes of responsibility, reciprocity and respect. The lesson I have learned on this journey is that to make meaningful change you need to be able to look at the landscape from your own point of view but also listen to the view from another perspective to deepen your understanding. Teachers who have come on this journey with me in some instances have gained a new perspective on Aboriginal science. This new perspective came as a result of teachers' asking questions rather than giving the answers, from listening instead of speaking and by following instead of leading.

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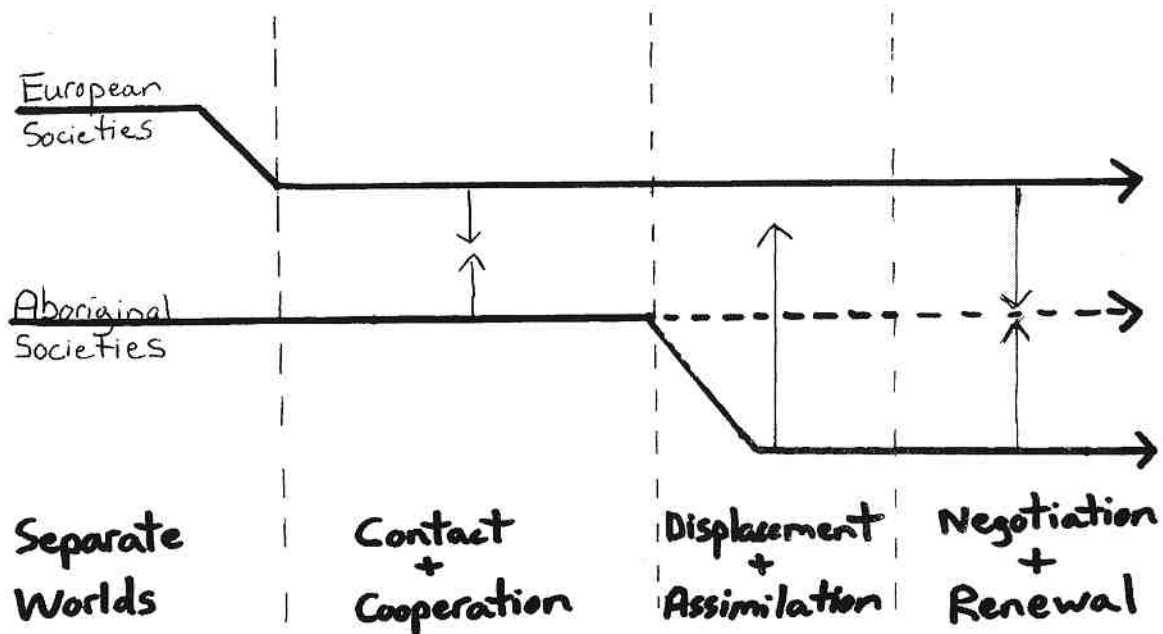
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Appendix 1

Historical Stages in the Relationship
Between
Aboriginal and non-Aboriginal Peoples



RCAP (1996)- Adapted from Mark Dockstator-(1993)

Appendix 2

A cultural hearing aid

Cartoonist Don Monet spent many hours listening to the powerful explanation of what Gitksan and Wet'suwet'en culture is as stated by four hereditary chiefs. One of his most effective interpretations of Chief Justice Alan McEachern's cultural hearing problems (*The Interior News*, June 24, 1987, page A2) cannot be fully appreciated unless people know what actually happened in court.

When lawyer Peter Grant asked Chief Mary Johnson to sing a Gitksan song as an essential part of her evidence on the "Ayook," the ancient but still effective Gitksan law, Judge McEachern objected. He said he did not want any "performance" in his court of law. "I can't hear your Indian song, Mrs. Johnson. I've got a tin ear." In the cartoon, Mrs. Johnson says, "That's okay, your highness, I've got a can opener."...The whole courtroom, including Chief Justice McEachern, broke out in friendly laughter. The cartoon shows Chief Johnson using her "can opener" to overcome the cross-cultural deafness caused by the judicial "tin ear." (Taylor, W. as quoted in Monet and Skanu'u, 1987)

Appendix 3

Pre-Questionnaire

Key Research Questions for science teacher participants to be used in a written anonymous questionnaire to uncover teacher thinking (ideas and beliefs) about science.

1. How long have you been teaching?
2. What subject/subjects do you teach?
3. Do you have Aboriginal students in your science classroom? If so how many?
4. If you have Aboriginal students in your science classroom, what Nations are they from?
5. Evidence suggests that Aboriginal students are underachieving in the sciences. Why do you think this is the case?
6. Do you think science is important? If so please explain why and how?
7. Please write down your definition of science.
8. Are you familiar with the term Aboriginal science? If so what do you know about it? Please explain.
9. Have you included Aboriginal knowledge in your science program and if so can you give some examples.
10. Do you think that Aboriginal knowledge is science? Please explain.
11. Are there any other comments you would like to make?

Appendix 4

Post - Questionnaire

The overall question I would like to answer is, "Why Haven't We Done More?"

1. After the field trip and dialogue what stands out for you about your experience?
What concept or idea spoke to you the loudest? Please explain.
2. Have the workshops changed your thinking? If so, in what way?
3. Do you think Aboriginal knowledge is important? If so how and why?
4. Do you think you could use Aboriginal knowledge in your science classroom?
Why or why not?
5. If you think Aboriginal knowledge could be used in your science classroom,
describe and give some examples.
6. What do you think might be some barriers to teaching Aboriginal science in the
classroom?
7. What do you think some benefits might be of teaching Aboriginal science in your
classroom?
8. How effective was this format of a one and a half day workshop on teacher
thinking?
9. Are there any other comments you would like to make?

Appendix 5

Dialogue Questions

Dialogue Questions

1. What was your experience of science education when you went to school?
2. How can what you've learned from your field experience(s) be applied to science teaching? How could Aboriginal science be used in the classroom? What would that look like?
3. How could including Indigenous knowledge in science benefit Aboriginal and non-Aboriginal students?

Brainstorming & Discussion

4. What action needs to be taken to meet the needs of the Witsuwit'en students and to ensure success for Witsuwit'en students in the sciences?
5. How can the new Ministry science PLO's (Prescribed Learning Outcomes) work locally and meet Aboriginal students' needs to ensure their success?

Appendix 6

Dialogue Guidelines

- 1) **Participate as an individual:** To foster openness and creativity and to minimize the constraints associated with representing a particular organization or interest, we will ask people to speak only for themselves, drawing upon their full range of experiences and concerns
- 2) **Confidentiality:** We will ask the group to agree to convey the ideas and experiences of the meeting to others outside the room only in a very general manner and without attributing specific ideas or statements to any identifiable individual. We see this as an essential element in creating a safe environment for dialogue.
- 3) **Respectful Communication:** We will propose that participants agree to:
 - speak clearly and to the point
 - refrain from interrupting
 - listen to the tone and intent of your comments
 - set aside the urge to persuade; instead, focus on being understood and understanding other people
 - ask each other questions about values, commitments, beliefs, etc., rather than making assumptions, and
 - in the interest of making the meeting respectful refrain from making negative comments about those not present
- 4) **The Pass Rule:** We will ask participants to agree to “pass” or “pass for now” if asked a question that they do not feel ready or willing to answer - no explanation required. This rule insures that all participation is voluntary. It also frees people to ask questions without trying to mind-read another person’s level of comfort or readiness for the question.

Appendix 7

Communication, Collaboration and Science Curriculum

The process of partnering Indigenous elders with Western scientists for Aboriginal and non-Aboriginal student success in the sciences has begun in many regions. Forests for the Future developed by Ignas and Thompson, (2003) has significantly contributed to relevant science curriculum materials for Aboriginal high school students in northern BC. Introductory units cover the important subject of Indigenous Knowledge, Traditional Ecological Knowledge and Scientific Knowledge. The remaining units cover a diverse set of case studies including a Plant Classification and Nomenclature, a case study on Reconceptualizing Ecological Knowledge using the Pine Mushroom Industry in NWBC as well as a case study on The Smallpox Epidemic of 1862 on the North Coast of BC and finally a case study of AIDS and its impact on Canada's Indigenous populations. They have generously granted teachers permission to download the units and make copies for themselves.

Similarly Barnhardt & Kawagley (1999) have been working closely with educators, elders and scientists in Alaska to post a growing number of units on TEK on the ANKN web site. They too have made these units available to teachers for use as templates for including their own local traditional knowledge. Cajete (1999) has course outlines available at the end of his book for college or university which could be adapted to high school and lower grades. These are taken from curriculum he put together for his dissertation in 1986. These initiatives are examples of the growing availability of Traditional Ecological Knowledge and Indigenous Knowledge contributions being made available to educators. Thanks to CURA the Tl'azt'en Nation in Northern BC is working

with UNBC scholars in a forest co-management project that is also providing a foundation for building a catalogue of TEK principles and teachings and Tl'azt'en language.

Figure 2

A Working Model for Professional Development

