Local mathematics in Nunatsiavut: A funds of knowledge approach.

Karli Bergquist

A thesis submitted in partial fulfillment of the requirements for the

Master's degree in Arts (Education)

Faculty of Education

University of Ottawa

Table of Contents

List of Tables

Legend

IBED - Inuit Bachelor of Education

MMKB - Multiple Mathematics Knowledge Base

Abstract

This paper outlines a project with preservice teachers in the Nunatsiavut Inuit Bachelor of Education Program (IBED) who are using culturally responsive teaching methods (Gay, 2013) in mathematics education. A *funds of knowledge* (Moll, Amanti, Neff & Gonzalez, 1992) approach was used as the theoretical framework for understanding how the *multiple mathematics knowledge bases* (Civil, 2016) that underlie individual and household practices can be identified and accessed for mathematics education. The research questions are: 1) *How do Nunatsiavut Inuit pre-service teachers access local knowledge, culture and language when planning for mathematics instruction? ; 2) What are the meaningful interactions, sources and areas of mathematics knowledge they consider for teaching?* Data was collected from 9 participants, all pre-service teachers in the Inuit Bachelor of Education program, who took part in semi-structured interviews. A framework adapted from Aguirre et al. (2012) was used to identify connections between mathematical thinking and local household practices which hold mathematical potential (what participants often referred to as "common sense"). The literature review discusses three themes that emerge in similar projects with Indigenous communities around the world: ethnomathematics, decolonization and community engagement. The themes demonstrate the significant impact of a mathematics education grounded in local knowledge for those it is meant to educate. When grounded in culture, everyday practice and community well being, mathematics education has the potential to be transformative for students and communities. Transcript analysis of the interviews and lesson plans reveal a range of sources of mathematics knowledge, many of which are connected to activities on the land and relationships within the community. Discourse about Inuit identity and education was also revealed in the interviews. I am a non-Indigenous researcher who advocates for culturally responsive

mathematics education and am learning how to do this work *in a good way.*[1] I seek to act as an accomplice of the preservice IBED teachers with the privilege of sharing their insights through my project as they leverage a new way of learning mathematics for Nunatsiavut students.

[1] *In a good way* is a term used to capture the importance of being respectful and building Indigenous partnerships when embarking on Indigenous education.

Acknowledgements

First and foremost, I must acknowledge the patience and openness of my supervisor, Dr. Richard Barwell who took on my wandering ways both literally and philosophically. Without his unwavering support, this journey would have never been completed.

I must also give the utmost gratitude to the participants who shared their heartfelt wisdom and experience with me, and trusting me to use the insight they shared in a good way.

Jodie Lane and Dr. Sylvia Moore, “my people” in Labrador from whom essential connections and guidance was given.

Aalla who allowed me the privilege of joining him on his trip “home”.

The members of MERU who welcomed me into academic dialogue, especially Yasmine and Fatima.

Finally, to my committee members, Dr. Linda Radford, Dr. Ruth Kane and Dr. Christine Suurtamm who have allowed this journey to be my own and provided me with the feedback I needed to speak from the heart.

Chapter 1 – Introduction

I am Karli Bergquist. I am 3/4 second generation Canadian of Swedish, Scottish and Norwegian descent. My mother's mother was born in Guelph, Ontario, and her family can be traced back several generations in Canada to French, Scottish and Metis heritage. I was born in Toronto, Ontario, on the Treaty 13 land of the Mississaugas. I grew up in North Bay, Ontario, the Robinson Huron Treaty land of the Ojibwe. My son's first home was in Behchoko, NWT, the Treaty 11 land of the Tlicho Nation. I now live in Ottawa, Ontario, on the unceded and unsurrendered territory of the Algonquin people. This project takes place in Nunatsiavut, the self-governed, coastal region of Inuit in Labrador.

(https://www.itk.ca/inuit-nunangat-map/)

The Big Picture

This thesis is the description of a qualitative study, a complex and incomplete story, an epic journey to say the least. Continually, I reflect on why I am allowed the privilege of doing this work, reminding myself that I have a responsibility to the participants who made contributions. I come to it as a representative of the settlers, with an identity that inspires skepticism - I am an outsider. Others have struggled with knowing their place, and I have read texts from Indigenous authors such as Mary Battiste (Mi'kmaq, Nova Scotia), Margaret Kovach (Plains Cree, Saskatchewan) and Eve Tuck (Unangax, Alaska) that unsettled my thinking by making me aware that my work in this area as a non-Indigenous person can be dangerous for those seeking self-determination after colonization. Aware that my place is fragile, that my privilege is real, I continually reflect and refine my approach (especially when considering the data and what it means). The metric that I've used to know if I am in the right place is a sense of welcome and approval from the community.

In the beginning, it was difficult to find a partner and initially I thought I might work in the Eastern Arctic. Instead, I was led to Nunatsiavut where I have been welcomed every time. I have found particular inspiration in the work of Lisa Lunney Borden who described grappling with what she describes as an "authority to care" (2011, p. 9). For her, the justification for her research became a question of connection to the community she was working with and the relationships she developed along the way. Throughout my career as an educator I have continually worked to build relationships with students, families and colleagues. I used these skills to have conversations, ask questions and be flexible in my approaches. The result of my conversations and questioning about mathematics education in Nunatsiavut is what follows.

Whether in an urban or rural area, culture, language and life experience are part of mathematics education. For some, this makes home and school a seamless transition. For others, they have to leave themselves (their identity) at the door when coming in to learn and this is damaging. I argue that student success increases when their lived experience is valued by school (Lipka, Hogan, Webster, Yanez, Adams, Clark, & Lacy, 2005). If nothing else, I have become an advocate for those who want more from mathematics education than what our mainstream system tends to offer.

Although I was not able to live in Nunatsiavut, I took time over 4 years and several trips to the North coast to build the relationships that have allowed me to collect data for this project and develop it in a way that is responsive to the community I worked with. Each of my trips involved volunteer service by facilitating Math Camps for youth, working in the classroom with students and teachers, and providing professional development for pre-service teachers about using literature to support math learning. Each of my trips also involved meeting local people and joining them in community activities like going off in the boat to a cabin, for a boil up, and even to play BINGO. These informal opportunities were every bit as important as the data collection and work with the participants. The collection of moments and interactions, sharing of knowledge and space, telling me what I didn't know have all been part of the thinking that goes into this dissertation. The Nunatsiavut government has continued to endorse the project since the initial stages of development in 2015.

In 2017, I developed a workshop we called "Inuit Games with a Mathematical Twist" for youth with an Inuit educator, Aalla, from Ottawa (whose special connection to Nunatsiavut I will describe in more detail). We received a grant from the Nunatsiavut government to take our workshop to three communities: Makkovik, Hopedale and Nain. Having this experience with

Aalla, described below, solidified my sense of purpose in doing this work as I saw him connect with the land and his people.

The timeline shown in Table 1 presents my various visits that shaped the project.

Table 1: Timeline of Trips to Labrador

Visit to Hopedale Science Camp	March Break classroom/school visit	Hopedale Math Camp	Inuit Games with a Mathematical Twist	Goose Bay campus visit	Data Collection, Goose Bay
July 2015	March, 2016	July, 2016	July, 2017	September, 2017	July, 2018

I work from an approach that begins with a willingness to understand mathematics in an unconventional way, from a perspective that begins with lived experience (physical, spiritual, intellectual) and which allows the power of that lived experience and local values to remain while a mathematical conversation is going on. One participant who was an Inuit pre-service teacher said the following:

> I mean we have picked up all other sorts of technology and skills that were brought. It's like how we adapt, we had to adapt to the harsh weather, whatever was given we would figure it out. We are innovative...I don't think it's good that we say oh well we never thought in big numbers, like I think it's good that kids pick up these skills. I think it can be done, putting that framework, that language that we pick up, the tools that we can pick up are going to help us to treasure the land and to live well. (Transcript, p. 20).

The participant is referring to the tension between old and new knowledge, pre and post colonial knowledge and that it is not a return to the past that will allow for better outcomes. Instead, decolonization "requires extensive transformation of education" (Munroe et al., 2013, p.

320) and it occurs when the power of what is valued in the classroom shifts. What follows is the story of how the participants have described mathematics education to me, as well as the other themes that emerged including the critical place of identity and language.

Situating Nunatsiavut

Nunatsiavut, the land claim area of the Labrador Inuit, includes 5 coastal communities: Makkovik, Postville, Hopedale, Nain and Rigolet. Nunatsiavut has a unique history that distinguishes it from other Inuit regions due to its location on the Northern Labrador coast and early settlement by Moravian Missionaries in the 1700s (Natcher, Felt & Procter, 2012). Inuit have experienced cultural and linguistic marginalization in education through a colonizing school system based on Eurocentric values and English as the dominant language. The provincial government of Newfoundland and Labrador continues to regulate education in Nunatsiavut. However, the settlement of the Labrador Inuit Land Claim Agreement[2] in 2005 has given Inuit of Nunatsiavut renewed power to influence policy and programs to promote an Inuit worldview and Inuttut, the local dialect of Inuttut. The Nunatsiavut Constitution states that "every Labrador Inuk has a responsibility to teach Inuttut and Inuit culture and customs to Inuit children and provide them with guidance and a sense of belonging within Labrador Inuit culture and society" (Nunatsiavut Constitution, 1.1.3 (h)). In part to realize this goal, the Nunatsiavut Inuit Bachelor of Education program (IBED) was created in 2014. The preservice teachers, by the nature of their program, are a cohort of teachers who have similar goals and receive support from their instructors to implement practices that are consistent with the needs and interests of students in the Nunatsiavut region.

In Nunatsiavut, not unlike many places, there is a complicated relationship between the community and school, people and political structures. Land based education and culture is

[2] https://www.aadnc-aandc.gc.ca/eng/1293647179208/1293647660333

taught as a “Life Skills” course. A History of Labrador course was recently added to the secondary school curriculum with local content and authorship of course material. Otherwise, the Provincial Newfoundland and Labrador curriculum is the standard and the board office is located in St. John’s one thousand kilometers away. Academic subjects are taught by certified teachers “from away” who generally spend less than 5 years in a community. They are often young, new teachers. Inuttut language is taught as a subject, similar to Core French is in Ontario. There are notable tensions in my view like outside and inside, old and new, ours and theirs, which are backdropped with the history of European imperialism, residential schools and German Moravian missionary settlement.

The Moravian Church is still central to the communities although other congregations are also active. “Going off” on the land or sea is also central to daily life. People continue to hunt and fish, collect eggs, make net and kamutiks, sew and build, cook, ride skidoos, drive boats and raise children with many of the traditional ways all the while adapting to changes in the climate, technology and demography. Not only did Inuit in Nunatsiavut experience relocation and resettlement, from 1953 to 1968 a US radar surveillance base was operated on the hill directly above the community of Hopedale, known today as “Up Base”. It consists of abandoned concrete pillars, platforms and steps. From up there, the views out to the Labrador sea are incredible and the graffiti provides evidence that many people frequent its isolated, eerie and beautiful location. Just like so many other communities in remote locations, an investigation in 2010 led to a report of PCB contamination not only at the site on top of the hill but also directly under a new subdivision that has been built (CBC, 2010).[3] I have smelled the chemicals in the air and I have read the signs banning hunting due to contamination. On my first visit, I had a bath in orange

[3] https://www.cbc.ca/news/canada/newfoundland-labrador/n-l-to-report-on-site-left-polluted-by-u-s-1.957820

water and consumed 8 large bottles that had to be flown in despite the vast natural ponds. Each of the 5 Nunatsiavut communities is unique but connected by their culture, history, language and experience. They are physically connected in small, isolated communities by boat, by plane and by snowmachine. Understanding all of this is just a beginning.

Something else important to understand is that even though there is a compartmentalization and standardization of skills and knowledge in school that is formalized by a Provincial curriculum, the Newfoundland and Labrador elementary mathematics curriculum recognizes the importance of multiple ways of thinking in its curriculum guides: "The learning environment should value and respect the diversity of students' experiences and ways of thinking, so that students feel comfortable taking intellectual risks, asking questions and posing conjectures" (Government of Newfoundland and Labrador, Department of Education, 2014, p. 1). This statement is consistent with other provincial mathematics curricula in Canada and elsewhere to promote equity and inclusion in education, but it is largely left to individual teachers to implement (Fynh et al. 2011, p. 188).

Mathematics is everywhere in Nunatsiavut

The reason my research is focused on mathematics is echoed throughout my data: "math is everywhere" (Group Transcript, pp. 1, 2, 8, 24, 27). Participants expressed how they experienced an *AHA moment* after a professor encouraged them to see mathematics "in a different light" (Transcript, p. 2). Until then, mathematics was something disconnected, something that was hard, "hated", "dreaded" because there was "a lot of memorization" (ibid.). I share this understanding that math is everywhere. I have learned or trained myself to look for "math moments" in my daily life - moments when you wouldn't normally think about using mathematics, which Wheeler (1991) describes as *mathemetizining:* putting a mathematical

structure onto another kind of structure. As a mathematics educator, this way of thinking gives me the freedom to make my own connections and provide students with opportunities to make connections between their understanding of the world around them and mathematical concepts, guiding them to understand mathematics through their experience which has a profound effect on engagement and understanding. The participants in my project overwhelmingly expressed the connections they made between their life and what they know about mathematics: “and that’s math” can be heard numerous times in the interviews. They also made connections between Inuit values and education. One participant told me that “Inuit education is always linked to thinking of [students] as becoming more able people” (Transcript, p. 20). They talked about critical thinking skills and understanding data as being important for competency to influence the world as they will be able to “speak to the reality that is coming to us”, specifically climate change and the impact that it will have for Inuit of Nunatsiavut who have enshrined in their constitution “treasuring the land and the water” (Transcript, p. 20). Mathematics becomes “another tool in their pocket” that can be gained through “reciprocal and respectful sharing of knowledge” (Transcript, p. 20).

Pre-service teachers in the IBED program were chosen as the ideal pool of participants for my project because they are Inuit and thinking about education. My research demonstrates they are in fact thinking about mathematics education in a way that is different from the one they experienced on the North Coast as youngsters. In part to realize the goal of self-determination, IBED was created through a partnership between the Nunatsiavut Government and Memorial University of Newfoundland (Moore et al., 2016). Throughout the program, pre-service teachers “explored ways to create an Inuit-centred curriculum that is founded on Inuit history, culture, and worldview (p. 94).

In 2019, Inuit graduates earned Bachelor of Education degrees from Memorial University of Newfoundland as well as certificates of Inuttut proficiency. This partnership is a significant accomplishment of the Nunatsiavut Government, the regional Inuit government, to begin defining public education locally. Despite the fact that the degree program has the standard course and practicum requirements as any other bachelor of education program, IBED is unique in that all of the participants are Nunatsiavut Inuit, and therefore have the cultural insider perspective I was looking for in my study.

In a New Zealand study of preservice teachers' implementation of culturally responsive mathematics curriculum the team of Averill, Anderson, Easton, Te Maro, Smith and Hynds (2009) found that "preservice students could recognize and describe elements of culturally responsive mathematics teaching, particularly elements with overt links to New Zealand Maori culture, and that those committed to doing so were able to discuss how they transferred some of these elements into their own teaching" (p. 179).

As the pre-service teachers in the IBED program develop their approach for teaching mathematics in Nunatsiavut, they have made similar observations which have transferred to decisions about what mathematics knowledge they will teach. This program is a step toward decolonization because it created space for a Nunatsiavut centric lense for teacher learning. They are preparing themselves to transform the way mathematics is taught in Nunatsiavut schools while continuing to meet Provincial standards. Although the program is still essentially a Southern import, it was modified and delivered in a way that promoted an Inuit-centric world view. Future offerings of teacher education programs may be redesigned with locally developed courses and may even offer an approach to teacher education that is significantly different from

this one. This study is unique to the conditions that existed at the time and is not an evaluation on the IBED program.

This project is about mathematics education. It is also about my own curiosity and desire to understand the way people, Inuit in particular, might have their own way of learning mathematics. The goal of the methodology I developed is to use a *funds of knowledge* (Moll, Amanti, Neff & Gonzalez, 1992) approach to uncover what might entail key *multiple mathematics knowledge bases* (Civil, 2016) for mathematics in Nunatsiavut. *Funds of knowledge* for this project are defined as "the historically accumulated bodies of knowledge and skills essential for household or individual functioning and well-being" (Gonzalez, Andrade, Civil & Moll, 2001, p. 116). The concept of multiple mathematics knowledge bases (MMKB) has evolved from funds of knowledge research and "involves making connections to a range of understandings and experiences that can serve as resources to support children's mathematics learning" (Turner & Drake, 2016, p. 38).

What I have come to know as "common sense" for the participants are the activities that people have figured out through trial and error, through familial relationships, by analyzing their environment, using tools and resources in unique and efficient ways adapted to their environment and lifestyle. Common sense is unarguably based on personal experiences. The Merriam Webster defines common sense as "sound and prudent judgment based on a simple perception of the situation or facts"[4]. After much contemplation, I have decided that what the participants refer to as common sense is not simple at all, but exactly what I was looking for. Participants made reference to common sense being synonymous with concepts and skills, learned by seeing and doing, which is not unlike what many would say when they were asked about how they learned outside of school. Common sense is highly situational, or contextual and is not really *common* at

[4] https://www.merriam-webster.com/dictionary/common%20sense

all. The definition of funds of knowledge and a discussion of the reference to "common sense" will be further explained in a description of the theoretical framework.

The guiding principle of my work is about valuing the mathematics of everyday life for their potential to transform mathematics education. It is also about considering *whose* everyday life is being valued and what new mathematical ideas emerge by thinking about mathematics in this way. In Nunatsiavut, there is reform happening as Inuit influence and inspire education that is grounded in local knowledge, language and values.

Identity is at the core of this ethnomathematical exploration. The participants engaged in ethnographic work through their program as they incorporated Inuit identity and local knowledge throughout their coursework. Practicums took place in the communities. Each of the pre-service teachers is Inuk and has an ongoing connection to Nunatsiavut. Much of their work was reflective, thinking about their own schooling experience and what they wanted for students nowadays. Their training experiences provide a supportive environment that is "specifically designed for the Labrador Inuit educational context"[5].

For my project, the IBED students were ideal participants to provide insight because they were Inuk and thinking about education. The premise of the framework is that "the mathematics opportunities embedded in practices" (Civil, 2002, p. 144) underlying the lived experiences of students. These opportunities can be used to support a more inclusive, participatory, and culturally responsive mathematics program (Civil, 2016; Gay, 2012; Hogg, 2011; Gonzalez et al. 2001; Moll et al. 1992; Turner & Drake, 2016).

My project was designed to respond to the following research questions:

1) *How do Nunatsiavut Inuit pre-service teachers access local knowledge, culture and language when planning for mathematics instruction?*

[5] https://www.mun.ca/educ/labrador/Nunatsiavut.pdf

2) *What are the interactions, sources and areas of mathematics knowledge Nunatsiavut Inuit pre-service teachers consider meaningful for teaching*

To answer these questions, I documented the ways in which preservice teachers in the IBED program are using various areas and sources of knowledge (Hogg, 2011, p. 669) to plan for mathematics education. Areas of knowledge could include: environmental knowledge, health knowledge, practical knowledge, cultural knowledge and linguistic knowledge. Sources of knowledge might include: social interactions within and between households, family, community, popular culture or life experience (p. 671). Through semi-structured interviews prompting a discussion about mathematics education in Nunatsiavut, teachers talked about their own learning process and why they felt that their approach is effective for teaching mathematics. Preservice teachers in the IBED program have relationships and experience in the communities which can be considered ethnographic knowledge (knowledge of daily life they have observed or experienced) they can use for mathematics education. Similar projects in Canada (Lunney Borden, 2011), Scandinavia (Janok Nuti, 2013), Alaska (Lipka, Hogan, Webster, Yanez, Adams, Clark, & Lacy, 2005) and New Zealand (Bishop, Berryman, Wearmouth, & Peter, 2012) with Indigenous communities have shown that teaching mathematics through culture and language can be transformational for students and contributes to the process of decolonizing education.

My data analysis includes a systematic documentation of the sources and areas of local knowledge teachers view as mathematical. This project contributes examples of Inuit mathematics knowledge to the field of ethnomathematics and is a potential starting place for developing local mathematics curriculum in Nunatsiavut. To complete the introduction to this project, I have briefly situated myself which is important for the reader to make sense of the data and analysis, as well as have a frame of reference for my findings.

Situating Myself

As a non-Indigenous researcher, it is important that I am reflective and careful in my role sharing the stories of the participants. I am a visitor in a community that is not my own. I believe in making a valuable contribution to mathematics education that promotes an Indigenous worldview. My interest in exploring the ways local or cultural mathematics knowledge can be used to teach mathematics comes from my experience teaching in linguistically and culturally diverse settings such as an elementary school in Ottawa with a high proportion of newcomers and in a Tlicho (Dene) community in the Northwest Territories. I came to understand through these experiences that pedagogical decision making for students whose culture and lived experience is not valued (ie. not mainstream) leads to educational practices that do not take into consideration the knowledge and skills students have gained outside of school. I have been involved in programming and professional development for teachers over a significant career related to pedagogically responsive curriculum in general. This project is an effort to develop myself as a researcher and as a mathematics educator by investigating local funds of knowledge and contributing to the fields of culturally responsive pedagogy and mathematics.

In the following chapters, the project will be explained in detail. A review of the literature and explanation of the theoretical framework will show how I grounded my thinking in contemporary and foundational research. I will then explain the methodology and data collection activities. The findings and discussion at the end show what was learned with respect to the research questions and what contribution this project makes to the field of culturally responsive mathematics education.

Chapter 2 - Literature Review

In this review, I explore literature which documents research in mathematics education where teacher professional development has taken place to encourage pedagogy that makes connections between mathematics, language and culture. I will focus on three themes: ethnomathematics, decolonization, and community engagement. The language used to describe mathematics is notable in the literature. Terms such as domain, official, cultural, everyday, in-school, out-of-school, daily life, academic, formal, informal, traditional, conventional, contextual, and bicultural have all been used to describe different ways of conceptualizing mathematical practices or understandings with labels. It is important to be aware of these labels because they isolate ideas and imply values and tensions within the body of knowledge. An exploration of these tensions is beyond the scope of the project but an awareness of them is helpful to understanding how knowledge is treated in school and in the literature. In this project as well as those which have been reviewed, there is a view to enhance mathematics education beyond what is conventionally taught in Canadian schools today. From an Indigenous mathematics perspective, this movement is allowing new mathematical ideas to emerge as well.

Ethnomathematics

An ethnomathematical approach to research in mathematics education helps provide a lens for the different ways of mathematically conceptualizing the world depending on our experience and language. Ethnomathematics, as defined by D'Ambrosio (1985), is "the mathematics which is practiced among identifiable cultural groups, such as national-tribal societies, labour groups, children of a certain age-bracket, professional classes and so on" (p. 45). It is often distinguishable from the mathematics we learn in school, although in many ways this is changing as can be seen in curriculum documents which promote the connection to

mathematics in our daily lives. As a means of documenting cultural knowledge *through* mathematics, an ethnomathematical approach to mathematics education leads to greater student and community engagement, increased use of Indigenous languages as well as reveals a tension between cultural and conventional mathematics (Dawson, 2013; Barton, 2008). This tension arises in classrooms where there are significant differences between the culture of students and culture of the school (Meany, 2002, p. 167). An Indigenous worldview is often based on "collectively-oriented knowledge generation, linked to practical and valued ways of social living" (Romm, 2015, p. 4) unlike a Eurocentric worldview that is based on individual achievement. Research shows that there is significant potential for this collective approach for the success of Indigenous students. Three projects will be used to illustrate ethnomathematics in action: Lisa Lunney Borden (2011), Mi'kmaq, Nova Scotia, Canada, Lipka et al., (2005) Yup'ik, Southwest Alaska, USA and Meany, Trinnick and Fairhall (2013), Aotearoa/New Zealand. Each of these projects demonstrates the ways in which mathematics curriculum can be developed where conventional skills and knowledge of concepts can be learned through local cultural and linguistic sources of mathematical knowledge.

Lisa Lunney Borden (2011) describes an approach called "mawikinutimatimk" or "coming together to learn together" that was developed collaboratively within the Mi'kmaq community where she was a mathematics teacher. As she became aware of the linguistic intricacies that were impacting students' understanding of concepts, namely the significance of verbs, she began investigating how she could change her practice so that mathematics became more responsive to her students' needs. Through her work with the community over time, a model emerged that has 4 main themes:

> 1) the need to learn from Mi'kmaw language; 2) the importance of attending to value differences between Mi'kmaw concepts of mathematics and school based mathematics; 3) the importance of attending to ways of learning and knowing; and 4) the significance of making ethnomathematical connections for students (p. 9).

The project was designed to uncover the ways in which the community used language to describe concepts as well as the cultural resources that might be used to teach mathematics, including pedagogical strategies. The Miq'maw language is verb based which was causing a dilemma for students learning in English that uses more nouns and adjectives. Even though students spoke English, the way they understood mathematical concepts was dissonant to the way they were described in English. By observing students exploring geometric figures, the ways that "motion [is] embedded in their conceptual understandings" (p. 12) was revealed.

Jerry Lipka's team working in Southwestern Alaska with Yup'ik communities has also discovered that taking an ethnomathematical approach to mathematics education allows for greater contextual understanding and a reversal of the authoritarian nature of mathematics teaching which most negatively impacts students who are not from the mainstream (Lipka et al., 2005, p. 369). The ongoing collaborative project called Math in a Cultural Context aims to "make the genius of Yup'ik elders' knowledge accessible to elementary school students" (p. 370). Units were developed with Elders which depends on a classroom environment that supports student inquiry and discourse, relinquishing the control that is often present in traditional classrooms (p. 382). This cultural shift in the way teachers interact with students, combined with the availability of meaningful cultural resources to learn from has led to successful experiences for students and teachers.

Meany, Trinnick and Fairhall (2013) have documented how a New Zealand Maori focused school is developing culturally responsive mathematics curriculum. Here the goal is for the mathematics curriculum to be "infused" with the identity of Indigenous students in order to achieve equity for the aspirations of the community (p. 235). The ethnomathematical approach used in this project turns deficit thinking on its head by recognizing and identifying the value of cultural knowledge and lived experience. What they found by looking at a school where mathematics instruction was being developed using the community's funds of knowledge (p. 237) was that Maori students were becoming "not 'other' to the curriculum but integrated into it" (p. 241). Through their interviews and analysis, they also uncovered tension between various influences on education which continued to lead to the reproduction of inequality. Their research asserts that a more holistic approach to the recontextualization of mathematics education is necessary for equity to be achieved. Ethnomathematics in this project describes more than using language and cultural resources to teach mathematics more responsively. Meany, Trinick and Fairhall assert that what is necessary is a "school ethos" which is built upon acceptance of Indigenous knowledge as "official" knowledge that can create the kind of space necessary for equity to be achieved in the mathematics classroom (p. 260). The work is about how mathematics education does not need to exist as "other" but can emerge from multiple ways of knowing that students would draw upon for mathematical inquiry.

The cultural, linguistic and political tension revealed by the project with New Zealand Maori is also apparent in the work of Lipka and Lunney Borden. Language is a key component of how we view the world through our culture and bringing Indigenous languages into the mathematics classroom has had a positive impact (Munroe, Lunney Borden, & Orr, 2013, p. 319). The act of developing mathematics content for school using Indigenous epistemologies is

something that Meany, Fairhall and Trinick (2013) regard as “making the unthinkable thinkable” (p. 260). Similarly to Wheeler (1991), this approach challenges those who make learning possible to include both the skills and conceptual knowledge required for accurate applications (drying fish, surveying land, building a structure), but also a cultural understanding of why concepts are thought about or described a certain way given language and worldview. The shift in thinking that occurs is also a shift in power for Indigenous communities to achieve equity in educational outcomes. As Indigenous knowledge becomes the “official” knowledge in school (Meany et al., 2013, p. 260), decolonization can be further realized. In New Zealand, Maori Elders, community members and researchers have worked together for over 30 years where you can now study from pre-school to a Ph.D. in Te Reo Maori. An Inuit university is being proposed in Nunavut currently and may one day offer a similar experience to Inuit students (ITK, 2011).

Decolonization

Batiste (2004) defines decolonization as: the “deconstruction of colonization and domination, but also about the reconstruction and transformation, operating as a form of liberation from colonial imposition” (p. 2). The research in much of the literature advocates for a transformation of schooling for Indigenous students, where there is a goal of incorporating Indigenous languages, land based learning, and the transmission of cultural knowledge or local practices through Elders or local experts (Lunney Borden, 2010). Parents who want their children to be successful in academics as well as maintain a strong identity with their culture can be faced with difficult choices since schooling does not tend to provide the experiences that learning on the land can provide. Munroe et al. (2013) share the contributions of a parent who “wanted his son to be knowledgeable about Indigenous values and beliefs, but also hoped his son would understand the mainstream science and arguments surrounding issues and to have the

school based qualifications to be hired into any job he desired" (p. 318). The concerns of this parent highlight a tension that exists for people who are trying to maintain traditional practices within the mainstream public education system where these practices may not have a place in, or even be at odds with, classroom practice. Generating a renewed way of thinking is decolonization because it creates the conditions to relieve the tension expressed by the father in the example above. Munroe et al. (2013) advocate for "co-constructing curriculum for language and culture revitalization, and drawing from community contexts to create curriculum" (p. 317) as a means to decolonize education in the 21st century. The content of Nunatsiavut Constitution and programs such as IBED demonstrate the desire of Inuit for a decolonized curriculum in Nunatsiavut.

There is tension between what Mary Battiste (2009/2010) describes as the "unique knowledge and relationships that Indigenous people derive from their place and homeland" (p. 17) and provincial education models that are portable by design. Provincial curriculum tries to catch many students with a wide net in an effort to standardize learning across the population, a goal which has had limited success in some places such as urban schools with high levels of cultural diversity and (often) poverty, as well as for Indigenous students for whom schools have historically been at odds with their culture. Despite a desire for equity and providing a culturally responsive curriculum, teachers require certain knowledge and resources to be able to enact it. The IBED program has been instrumental in helping future Inuit educators make these connections and to create the spaces for this learning. While Battiste very aptly states that Indigenous knowledge must be learned by all, she is careful to also warn that learning does not mean "appropriating their new knowledge and experience for their own [non-Indigenous] expedient ends" (Battiste, 2009/2010, p.17). This phase is complicated by questions of my own

cultural identity as a second generation Canadian of mixed European descent. I have to consciously differentiate between my own connections to the land and a genuine concern for the environment and the spiritual, multi-generational connections Indigenous people have through their own societies, culture and language. Battiste argues that "all Indigenous peoples have, then, a land base and ecology from which they have learned" (Battiste, 2009/2010, p. 14). As a non-Indigenous person, I wonder (and worry) about my place in the process of decolonization as I do not seek to perpetuate my values onto others, but rather gain a greater understanding of how I can make a meaningful impact and also *become* decolonized. As I learn, conscious that I am also colonized but not Indigenous, I endeavour to take careful steps to not appropriate this knowledge as my own despite its impact upon me. These questions are beyond the scope of my project, but they do have implications for the way my work is perceived and accepted by those with whom I wish to work. It creates a sense of uncertainty about my role in a kind of "space" where partnerships are desired but with a sensitivity to the risks.

Decolonizing mathematics education means promoting local expertise when developing lessons so that students not only gain a deeper understanding of mathematics but also have the opportunity to connect with their place and the wisdom of that place (Lipka et al., 2005). As the responsibility for education becomes a community driven enterprise, local expertise is relied upon to promote local language and ways of knowing. Lisa Lunney Borden (2011) describes decolonization of education as the "incorporation [of] indigenous knowledge, culture and values" (p. 8) into pedagogy so that the needs of students can be met. Meany et al. (2013) outline the teaching practices that become possible in New Zealand when a school ethos is developed that links community values and educational outcomes, in particular one which allows teachers the

ability to "recontextualize" (p. 249) lessons to incorporate Maori students' lived experience and need for connections to tradition, culture and language.

As pre-service teachers in the IBED program begin shifting the focus for what is learned and how it is learned to privilege local knowledge resources, they are participating in a decolonization process. Decolonization of mathematics education for my project means focusing on the use of local, Indigenous knowledge, and language to inform mathematics pedagogy. In most research projects, it has been a collaborative effort that involves mathematics educators working with local experts and community members to establish a new mathematics curriculum. Research seeks to uncover, document or apply traditional/local knowledge to improve educational outcomes for Indigenous students and bring authenticity to their education. These projects are inspired by the momentum for self-determination and "the pursuit of self-reliance and prosperity"[6] of Indigenous groups around the world, including Inuit of Nunatsiavut.

Community engagement

Community engagement in research leads to projects which reflect many voices and often evolve from or into ongoing work. Research methods tend to involve ongoing dialogue that continues after the data collection is complete. In education, schools that seek an integrative approach rely on knowledge shared by leaders, experts, Elders, and parents to develop programs but also to provide ongoing support (Bishop et al., 2012, p. 58). In funds of knowledge research, the community plays an essential role. The relationships between teachers and households (parents, students, community members) allow the teacher-researcher to observe, question and discuss mathematical ideas to identify funds of knowledge. A reciprocal relationship between research and community emerges and has led to a shift in how Indigenous research is done. There is now an expectation that the community will be part of the research process and will be

[6] http://www.nunatsiavut.com/department/education-economic-development/

entitled to share any significant artifacts or information collected by projects. Projects that I reviewed from the past 10-15 years involve the community not as subjects being researched but as active participants.

One project conducted in Rigolet, Nunatsiavut which based data collection on "place-based narratives and first-hand observations and experiences" (Willox, Harper & Edge, 2012, p. 131), recruited community members to share stories related to climate change as they were experiencing it. The researchers worked with the local Inuit government to create a space where community members could share their stories. The stories then became the qualitative data for the project. Meaningful dialogue emerged between participants as they shared artifacts of personal significance through a digital storytelling process (p. 132). What developed was a collaborative project which not only gave insight into the impacts of climate change on local well-being but also a sense of ownership over the project itself. Another project described by Swayze (2009) used a participatory pedagogical approach (p. 66-67) in which Elders became "full partners in program development" (p. 66) for an educational initiative involving urban Indigenous youth. Seeking "to challenge prevailing notions of who "experts" are and how teaching and learning occurs" (p. 66) is one of the ways that teaching is challenged in a collaborative environment. A Maori culture based mathematics project shows how collaboration leads to "distributed leadership" (Bishop et al., 2012, p. 58) where teachers, parents and other community members take on active roles in school. It might be challenging to transition from a centralized system with top down leadership, however, the overall positive outcomes seem to be well documented. Kral, Wiebe, Nisbet, Dallas, Okalik, Enuaraq and Cinotta (2009) working with Inuit found that "the process of engaging the community in planning, conducting and interpreting

the research" leads to positive outcomes (p. 301). It is through this "collective agency" (p. 303) and "process as product" (p. 300) that the group gains control of the outcomes.

Beatty and Blair (2015) describe how collaboration involving community members as co-teachers helps to honour the cultural context of knowledge (p. 21). When exploring the mathematics of an Algonquin beading practice, they accessed "third space, merging Algonquin and Western ways of knowing" (p. 19) to create mathematical activities that were "both mathematically rigorous and culturally meaningful" (p. 22). I have participated in an iteration of this research project in my school board and have learned first hand, with community partners, how mathematics can be "done" without talking about it. As a participant, I acted as observer and data collector, the teacher and the beading partner developed the lessons and facilitation plan together. In this particular instance, the two teachers involved both had very different attitudes. One was completely open to allowing mathematics to emerge and saw the connections, the other was preoccupied by the curriculum and how to ensure students were learning mathematics. This experience points to the importance of working collaboratively with open dialogue to push the boundaries of what is known and understood. It highlights the importance of a teacher's learning stance when approaching mathematics education critically. Community partners said things like "just let them bead, talk about the math later". They were clear that the curriculum need not interfere with what students were able to do when given a problem, with manipulatives and tools, with time and opportunity to watch, talk, ask, try, re-try. Students were encouraged to immerse themselves in the beading, and teachers were encouraged to let the mathematics emerge. The teachers in the room took notes of the mathematics they heard emerging from the conversations and observations of students while they were beading to bring up in a later lesson focused on "the math". The authenticity of this approach enabled all students, Indigenous and non-

Indigenous, newcomers to Canada even, to have a meaningful experience through which to connect their inherent mathematical thinking with formal modelling and practices of the "discipline" of mathematics (topics, vocabulary, visual modeling, problem solving applications). Sami educators (in Scandinavia) are looking at the collaborative process of Yup'ik Elders (in Alaska) with mathematics educators used to create Math in a Cultural Context for developing their own mathematics programs for Sami schools (Fyhn et al., 2011, p. 190). This demonstrates collaboration across Indiegenous communities because the pedagogical values (community partners, experiential learning, Indigenous languages, and Indigenous ways of knowing) and desired outcomes are similar. Munroe et al. (2013) describe the way Show Me Your Math, a student led inquiry into Mi'kmaq community mathematics encouraged intergenerational conversations about mathematics whereby students and Elders became co-creators of curriculum (p. 331). Without direct community relationships, culture based mathematics education and research about it would be impossible.

Funds of Knowledge

Studies of funds of knowledge originated in the United States (Moll et al., 1992) from anthropological perspectives of documenting people's behaviour as a means to accessing their multiple knowledge bases. In these studies, teachers were trained to document out-of-school activities of Mexican students involved in a variety of activities like selling goods in local markets. Mathematical practices such as estimating and calculating money amounts, composing and decomposing quantities based on reasoning, problem solving strategies, categorizing and arranging objects (p. 186), and encouraging multiple solutions (p. 184) for different situations emerged from working with students and their families in the community or households. With this as a framework, I can assume someone living in Nunatsiavut has knowledge based on a

lifestyle that is shaped by local geography, climate, culture, language and history. A person living in Nunatsiavut will also have mathematical knowledge, whether they are aware of it or not, based on the definition I accept from Alan Bishop (1988). I use aware, rather than know, intentionally because I have come to understand that we can know mathematics without knowing we know mathematics. The funds of knowledge approach has led researchers to notice the mathematical thinking that emerges from traditionally "out of school" activities and "advance to designing high cognitive demand tasks that connect to these practices and to anticipating students' reasoning about such tasks" (Aguirre et al., 2012, p. 187). Leveraging "multiple mathematical knowledge" bases (Turner & Drake, 2016, p. 38) requires teachers to have a complex understanding of how the bases are integrated if they are to use them successfully as part of a comprehensive mathematics program. This means they need to understand both the cultural practice (in a complex way) and the mathematical thinking (in a complex way). These studies and others have drawn two important conclusions: 1) mathematical thinking is revealed in, and emerges from, human activities and 2) students who learn in a culturally relevant context are more successful in mathematics in school. The literature specifically in the field of funds of knowledge is focused on identifying mathematics and the complexity of understanding that can be leveraged by educators in a traditional school setting. For funds of knowledge to have value in the parameters I have set up, understanding the mathematics or the human activity is inadequate. Instad, there is a complex interaction between ways of knowing that requires thoughtfulness to create a curriculum that reflects a cultural relevance.

Funds of knowledge has the potential to engage students, teachers, parents and the community to become part of a mathematics program. Existing research (Hogg, 2011; Turner & Drake, 2016) has largely focused on examining how teachers, often pre-service teachers, use

mathematical funds of knowledge in the classroom. There are several reasons for using a funds of knowledge approach in mathematics education such as: to promote a culturally responsive curriculum, increase student engagement and motivation, promote meaningful interaction between the community and school, and develop a higher sense of student and parent self-efficacy (Gonzalez et al., 2011). Criteria for meaningful lessons have been identified by Aguirre et al. (2012) and promote students developing mathematical thinking while they are engaged in authentic, collaborative, culturally responsive tasks that often involve connections with the community. The task is much more complex than simply changing the names of people and places to make them more "relevant" which is typically done in standardized mathematics textbooks and programs. Civil's (2016) reflection about funds of knowledge in mathematics education highlights the importance of a focus on practice and "participation structures" (p. 56) of everyday life to better understand how mathematics learning happens in non-academic settings. In this way, knowledge is gained through particular interactions (depending on who, where, what, when and how) with knowledgeable others (animate or inanimate) that then become part of one's fund over time. Aguirre et al. (2012) stated goal is to "explore the practice of making connections to children's multiple mathematical knowledge bases in ways that do not restore the historical separation of children's mathematical thinking and cultural funds of knowledge in the field, but retain the complexity" (p. 188). Similarly, this project, rooted in a context of restoring the significance of cultural and local knowledge by making it accessible in school, will aim to maintain a view of mathematics that is a dialectical and interactive system of knowledge bases which can be used in school to activate children's mathematical thinking. It will document the ways teachers are making connections between knowledges and how they plan to activate them in practice.

Throughout the literature I referred to in this chapter, projects are described that contribute to decolonized approaches in education using ethnographic methods and by facilitating community engagement in research. It strikes me how similar the goals of Indigenous education are globally as well as how much work is underway to make this part of regular schooling. For some, it is just beginning, for others, it has been decades. My reading tells me that this work is necessary for the protection and promotion of Indegenous identities around the world. Ideally, Indigenous people are leading the projects, but if not (yet) the deeper the relationships that develop over years between researchers and Indiegnous communities, the more thorough and authentic the data. Inuit of Nunatisavut have a great deal to contribute to the field of mathematics education and in so doing contribute to the decolonization of mathematical ideas. The positive results of current projects with similar goals, all around the world, make my work worthwhile.

Chapter 3 - Research Questions

I defined the research questions for this project after lengthy contemplation of three influential aspects to my way of relating to the data: my experience as an educator with students who have limited prior schooling and spoke a language other than English, my experience with Indigenous communities including Tlicho and Inuit in Northern Canada, and the literature I selected to review to better understand how collaboration with Indigenous partners is done. Narrowing the scope of the research questions required me to think very carefully about what was important to ask given the parameters of my distance from Nunatsiavut and role as a non-Inuit researcher. Although initially the focus was on documenting something mathematical, what became clear was that my own ability to "see the math" was going to be heavily biased and entering the space where I might be allowed the privilege needed to be done carefully. Ethnomathematics tells us we are limited to what we can understand *as mathematics* by what we understand about the world. This is evident in the multiple ways of knowing and seeing documented by significant research as well as in my fifteen years of experience as an educator. This challenge led me to the pre-service students in the IBED program as potential participants after I heard them speak at the Inuit Studies conference in St. John's in 2016. They have cultural and local insight as Inuit from Nunatsiavut and they have beginning pedagogical content knowledge for teaching mathematics as pre-service teachers. With these potential participants in mind, the first two research questions were developed to reveal what might be considered local funds of mathematics knowledge for Nunatsiavut:

- *How do Nunatsiavut Inuit pre-service teachers access local knowledge, culture and language when planning for mathematics instruction?*

- *What are the interactions, sources and areas of mathematics knowledge Nunatsiavut Inuit pre-service teachers consider meaningful for teaching?*

Over the course of the study, a third question emerged that helped to address not only what people do, but what they say about what they do and that is:

- *Does describing knowledge as "common sense" reflect an indicator of a fund of knowledge?*

The discussion of the theoretical framework in Chapter four further explains the significance of this additional question. In order for these questions and the research approach to make sense, one first has to value human experience (being and doing) as much as human contemplation (knowing). Accessing multiple knowledge bases allows a more comprehensive understanding of a concept or practice. This work requires thinking about the way knowledge has emerged, how it is used and talked about in daily living and innovating. All of these, the areas, the sources and the interactions can be accessed to understand the whole. The findings presented in chapter seven are a beginning.

Chapter 4 - Theoretical Framework

A funds of knowledge approach values the knowledge that comes into play for participation in everyday life (Moll et al., 1992). As a framework, it acknowledges that there is diversity in what people know and how they come to know it. When applied to mathematics, funds of knowledge are distributed across, and tied to social contexts with "an emphasis on practice"; they are what "people actually do and what they say about what they do" (Gonzalez et al. 2001, p. 118). Funds of knowledge are tied to culture, language and history of a particular group of people and as an approach has been used in research projects to demonstrate the value of identifying mathematics in everyday or cultural practices (Aguirre et al., 2012; Civil, 2016; Turner & Drake, 2016). As a perspective, funds of knowledge has helped research evolve from considering culture as "a static grab bag of food, dances, and celebrations" (Gonzalez et al. 2001, p. 118) to instead explicitly valuing the diverse ways people come to know what they know. Funds of knowledge is about accessing multiple knowledge bases, described by Aguirre et al. (2013) as "specifically children's mathematical thinking and children's community/cultural funds of knowledge" (p. 179). For example, in my own daily life in my commute to work, I make decisions about how I navigate and operate my vehicle to get there quickly and safely. I have come to know things about driving through formal education and practice but also through daily experience, knowledge of the community, reasoning, and problem solving about speed, movement and traffic patterns. My cultural knowledge helps me understand how others will react to my decision making and what is expected of me as I navigate. Driving to work has mathematical components although I don't really have to think about it "as mathematics". I can think about it as math, especially if I am talking about measurement (time, distance), transformational geometry, data management, analysis, rates, and I could go on. In effect,

driving to work has become common sense to me, a fund of knowledge that could be a powerful way to teach concepts of mathematics. It is the focus on lived experience that makes this approach meaningful for me and what allows me to consider ALL of the potential aspects of knowledge for teaching and learning of mathematics as a discipline in school.

How people DO mathematics in different ways is not only interesting and curious, but it offers a broadening of what is considered to BE mathematics. It also challenges mainstream notions of how one COMES TO KNOW mathematics. In the project that my research takes up, space is created Inuit ways of knowing, doing and being as described by the participants. The definition of funds of knowledge for this project will be "the historically accumulated bodies of knowledge and skills essential for household or individual functioning and wellbeing" (Gonzalez, 2001, p. 116). This definition will be used to reveal areas and sources of knowledge (Hogg, 2011) pre-service teachers can use to develop mathematics pedagogy which is relevant to the experience of students in Nunatsiavut. Funds of knowledge is not an Indigenous perspective, but it offers an openness and a focus on the powerful element of "the social relationships involved in undertaking the practices, and deep engagement of connection with product, not just a process" (Gonzalez et al., 2001, p. 124), which is an important component of my work. Without spending a great deal of time on it, acknowledging the "hidden curriculum" and what is *not* taught in the classroom and its impact on students is part of what is revealed by this work, and furthers some of the goals of decolonization. Although the work is primarily about improving mathematics education for everyone, the deep thinking about what we do as teachers and why, through an approach like the one I have developed, has the potential to reveal ways to empower students beyond a greater proficiency in mathematical thinking. The funds of knowledge framework encompasses aspects of reasoning, knowing and understanding that

provide a broader perspective on knowledge itself by looking at the ways mathematics is embedded in culture and daily life, through the interactions of individuals with their environment and with each other.

Explaining two elements of the funds of knowledge definition, namely *historically accumulated* and *household or individual functioning* will help clarify what the framework intends to capture. Knowledge that is *historically accumulated* develops over time through human interaction (with each other and their environment). Gonzalez et al. (2001) suggest that there is a dialectical relationship between various knowledges (p. 128) which co-exist within a particular practice (ex. sewing, construction, navigation). They also establish the ways in which knowledge is distributed, based on a Vygotskyan perspective that "human beings and their social worlds are inseparable" (p. 122). Thinking, therefore, "is always mediated, distributed among persons, artifacts, activities, and settings" (p. 122). With a perspective of knowledge as accumulated/mediated over time, through interaction and social activity, the framework reveals variation in understanding between people and adaptations in the way things are done. Inuit come together in community because of what each offers to the collective goals. As new technology, new priorities or challenges, new environments, new information is accessed a practice may change, but it remains rooted in place by a strand of history. For Inuit of Nunatsiavut, the strand extends thousands of years. *Household and individual functioning* means that the approach focuses on those activities which are important for how people live productive lives. Mathematical learning moments occur in daily life when there is an authentic experience of need (for some kind of knowledge) and response (problem solving) that engages people to use mathematical thinking in their everyday lives as individuals and as part of households (Civil, 2016; Moll et al., 1992). In daily life people have opportunities to learn as they observe, inquire,

attempt and be guided to achieve proficiency with certain knowledge or skills (Turner & Drake, 2011, p. 68). A funds of knowledge approach leads us to think about what counts as mathematical knowledge, how the knowledge is transferred between individuals/households and to identify the areas and sources of knowledge available in a particular community (Civil, 2016, p. 53).

Choosing a theoretical framework for this project required consideration of how I situated myself as a researcher, and the way I wanted to treat the data, as I articulated in Chapter One. I have taken inspiration from Indigenous and non-Indigenous methodology to design methods that were open and community oriented. I asked the participants, who had a unique intuition because of their position and experience, to describe their thinking about how mathematics emerges, or could emerge, from everyday practices of Inuit in Nunatsiavut. Using a funds of knowledge approach as a theoretical framework for this project provided a way for me to gain insight of what local mathematics in Nunatsiavut could be.

Funds of knowledge is a suitable framework for my study because it allows me to work with participants who get to speak for themselves. My work as a researcher has been to synthesize their contributions using an adapted framework described in Chapter 4 - Project Design and Methods. The process of noticing and connecting ideas in what people say about what they do is a revealing way to engage in mathematical thinking. In a way, it only reveals what you are prepared to see. This represents a limitation of the approach to identify funds of knowledge, despite having a widely accepted definition (Moll et al., 1992).

For this project, I have limited the theoretical framework to mathematical funds of knowledge. This raises the question about other funds of knowledge that could also be made accessible through the valuing of local and cultural knowledge. One criticism that may arise

from the way I have used the theoretical framework is that by trying to identify a particular kind of knowledge multiple knowledge bases become disconnected. With this caution fully exposed, what I offer is a beginning. From an Inuit perspective, the knowledge would be interconnected. An Inuit worldview would require the curriculum to arise from values such as harmony, order, and becoming an "able human being" while learning by watching, doing and making mistakes (ITK, 2011, p. 72). Curriculum will be grounded in Inuit language, cultural proficiency and "21st century subjects" (ibid., p. 70) with the outcome of being able to "contribute to Inuit, Canadian and global society" (ibid.). It is not my intention to use this framework to pursue further segregation of topics because I acknowledge this is indeed an opposite goal. I am using the framework to identify a particular part (mathematics) of a whole (knowledge system). I recognize that what I have been able to discern using my framework is a small part of what is knowable. It helped me develop my research questions about what Nunatsiavut Inuit think about when they value local and cultural knowledge as a means to learning topics, like mathematics. What I have also intended to demonstrate, in simpler terms, is that despite being able to look at the parts of the whole, parts make more sense when the whole is in view - words make more sense in sentences and paragraphs, mathematics makes more sense with experience and connection.

The funds of knowledge approach helps to show what is important to a community, what is worth doing and knowing as time goes on. Accessing funds of knowledge for mathematics in school allows teachers to "restore" the significance of the multiple knowledge bases so that values, ways of life and functioning are maintained despite the presence of school which has historically done the opposite to privilege Western ways of knowing. Bishop's identification of 6 fundamental activities that are universal and "sufficient for the development of mathematical

knowledge" (1988, p. 182) supports a funds of knowledge approach to identifying what is "mathematically significant" in a much more comprehensive way because of the extensive descriptions of what might allow mathematics to emerge. His work has helped me to consider what might be mathematical and what might not be. It was not shared with the participants prior to data collection but was used for my own reflection about approximating what is math. It is too easy to say "everything is math", although I believe it. At this point, the most useful tool I have found to demonstrate what IS mathematical is to examine what people do and what they say about what they do. I am limited by my own understanding of mathematics and ability to make mental models or apply concepts in new situations. Working with a mathematician to analyze the data would yield results with even more connections. I think this approach to mathematics education has the potential for education to privilege thinking "like Inuit" to be synonymous with thinking like a mathematician.

Chapter 5 - Project Design and Methods

Supported by post-structuralist perspectives on research, this project was designed to "take into account the totality of the activity realized by the actions of an (individual, collective) subject" (Roth, 2012, p. 454). Battiste (2012) describes the "pre-existing and ongoing relationships" (p. 51) that are characteristic and acceptable in Indigenous research. For that reason, substantial time was spent doing field work and building relationships before the design of the project could begin. To develop the kind of thinking necessary to do this academic work requires a non-Indigenous researcher to take particular care, and so many conversations and travels have taken place. Not only was feedback sought from community members, other researchers were consulted at conferences and in personal communication. A substantial section is dedicated to describing the process and nature of relationships that have been built. The data collection tool and data analysis process are also described. By designing a project that was open and flexible, and that sought input from participants through semi-structured interviews, the project aims to identify more than what mathematics concepts can emerge from daily activities. It also captures the context within which the concepts emerge and gives evidence for why this desire for greater understanding is relevant/useful/beneficial.

Building Relationships

Several key relationships were developed over four years to guide the design of the project to have beneficial outcomes. These included initial relationships with various people in the community of Hopedale (*Avertok*[7]) where I spent most of my time while on the North Coast. This was required for me to better understand the context in which I was working and took place before developing my research questions, design and methodology. Each trip I took allowed me to conduct field work to explore the land, meet the people and begin to understand the current

[7] In Inuttut Avertok means: place of whales.

issues or tensions within which to situate my project. On my initial visit I made a connection with the school principal who spent an hour talking with me in his garage about education and my project ideas. I also met children and their parents, taking advantage of any opportunity I could to talk about my ideas. I visited the Legislature and spoke with people who worked there including one of the local representatives. A family offered to take me "off" on the land one Saturday. We went fishing, clam picking, foraging for eggs and had a boil up in a beautiful little bay. I spent the day thinking about math, taking pictures and followed the children around as they explored the land. By immersing myself in the landscape and with as many people as I could, I was gaining a sense of what the community and what was important to people. Without this step, I would have missed the essential and visceral reason for my project. I was able to see for myself how people lived their daily lives. It was a step towards working through bias and assumptions I may have as an "outsider". My trips to Hopedale continued and I was able to facilitate youth camps as a volunteer to continue talking to people about mathematics "outside of school". These youth camps provided me with a way to conduct more detailed field work with a community service element, giving me several opportunities to talk, listen, watch and ask questions as I got to know both Hopedale residents and other visitors over time. Prior to my visit to Amos Comenius School in Hopedale over March Break, I engaged in a pen-pal program with a grade 3 teacher and her class. For several months, my grade 3 and 4 students wrote to students in Hopedale about their families and interests. In return, they received letters describing similar things.

In the summer of 2017, during my third trip to Nunatsiavut, I learned that it is very difficult to talk about the mathematics "outside of school" when my repertoire of experience is largely "in school". On this trip, I was also able to see the impact of doing this work in

collaboration with someone who had cultural knowledge and a historical connection to the Land. I recruited Aalla, an Inuit educator from Ottawa, to help me facilitate workshops for youth in Nunatsiavut. With guidance and financial support of the Nunatsiavut Government, we were able to run the workshop in three communities: Makkovik, Hopedale and Nain. Although the workshops were engaging, the mathematics seemed very contrived as we attempted to have students make connections between various Inuit games and mathematical ideas. Despite being a great deal of fun and a learning experience for me and Aalla, I do not think we were largely successful at helping the youth make mathematical connections. There was too much prompting of conventional mathematics including numbers, shapes and measurements. I had not yet learned to allow students to build, measure, position and problem solve and let it be mathematical without calling it so. This experience signaled to me that bridging between lived experience and mathematical ideas in a way that doesn't undermine the cultural value of the experience is a challenging task. As I continue to explore ways of creating opportunities for mathematics to emerge, working with community members is essential.

It is worth sharing anecdotally, that in a remarkable twist of fate, this collaboration was more than a first trip North for a "life long urban Inuk"[8]. I learned that Aalla's father (now passed away) was Inuit and was born in Nunatsiavut, near Hebron. He had been part of the relocation in the 1940s and again in the 1950s to Nain, one of the communities we would visit. I will never forget the afternoon we landed in Nain and headed out to the grocery store. Aalla was proudly introducing himself to everyone and at some point, when he told a woman who he was, she burst into tears and wrapped her arms around him. She told him she was a cousin and that *her* father had *his* father's pin collection. This was particularly significant, as Aalla recalled to me more than once, that despite being an Inuttut instructor and author of Inuttut dictionaries for

[8] How Aalla situates himself during an introduction.

Memorial University of Newfoundland, his father raised him to be “White” because he wanted him to have a chance of success in life living in the South. Instead, as an adult, Aalla has reclaimed his Inuit identity and is building his own history as an Inuk very involved in the large Ottawa Inuit community. Our trip to Nain made very real for me the importance of being on the land and how deeply connected to place identity can be. I also learned the power of my position as an accomplice to the goals of education in Nunatsiavut. In this case, I was able to play a part and then step back. The difficulty I found with trying to help the mathematics emerge was that I became keenly aware of what I didn’t know: neither enough about mathematics nor how to help it emerge without feeling like I was imposing “outsider” ideas. What we learned together is that the project I was trying to develop required a community voice, and required a researcher stance that reflects awareness of the unknown and possibly unknowable (to me, as non Inuk). On this trip, what Aalla and I learned together is that, at least for now, we needed each other. I was needed to guide learning and look for evidence while he provided the experiences and engagement. I am able to work the system, organize, write, propose and justify. He is able to see and feel the connections, understand the relationships and impart the wisdom of all that he intimately knows as Inuk.

There are several key institutional relationships that also made this project possible. Firstly, I was able to connect with Jodie Lane, the Education Manager for the Nunatsiavut Government (NG) who has provided me with valuable guidance and administrative support. She facilitated an official recognition by the NG to facilitate my ongoing research. Secondly, I was connected with Dr. Sylvia Moore, faculty Administrator for the IBED program. Dr. Moore not only provided necessary information about the components of the Inuit teacher education program but she has also been instrumental in helping me navigate my way to building a

relationship with the participants. In large part, correspondence has largely taken place virtually or over the phone except when I was able to visit Goose Bay on two occasions. Dr. Moore introduced me to instructors, other staff members involved in the program, and invited me to be a guest presenter with the IBED students about using children's literature to teach mathematics. The open/organic nature of my project allowed each new relationship to evolve gradually to establish an ever growing network of connections that precipitated data collection opportunities.

It was reasonable to assume at the beginning of this project that relationships could be established virtually and data collection could also happen this way. This turned out to be a "blind spot" as I learned without face to face connections, the richness of potential data collection would be limited because it was impossible to engage in meaningful dialogue otherwise. I made a trip to the Goose Bay campus in the fall of 2016 on the invitation of Dr. Moore. I spent five days on campus meeting faculty, instructors and most importantly the IBED students. Informal conversations led to me organizing a lunch with them where I could present the research project I was developing, ask for their feedback and get a general sense of their willingness to be participants. The potential pool being only eleven, it was important that I treated this opportunity carefully and with transparency. I also had to ensure that my data collection methods did not create work for them as they were already involved in a heavy workload. The method would be to document what they had already thought about, worked on. It would be reflective, not generative.

Three ethics approvals, one from the Government of Nunatsiavut, help ensure this project conforms to regulations and expectations**.** Trustworthiness of the data relies on the relationships which have been established and continue to evolve, support from the community and that each participant is Inuit from Nunatsiavut. An academic challenge is that there is limited published

educational research literature available for Nunatsiavut at this time. Regional and historical differences among Inuit means that although cultural and linguistic comparisons can be made, the experience of Inuit in Nunatsiavut is quite unique. In order to remain open and flexible in my methods, I have relied on becoming familiar with projects with Indigenous people from various world regions including Canada, the USA, New Zealand and Scandinavia. Based on the reading of these projects, I was able to develop a method that took into account the financial and geographic limitations I was presented with.

Data Collection

The goal of the project being to document what participants say about mathematics led to the use of semi-structured interviews were selected as the ideal data collection tool so that transcript analysis could then take place (Miles & Huberman, 1994) This allowed for a structure with flexibility, more of a guided conversation.

Over the course of three days in July 2018, semi-structured interviews were conducted in Goose Bay, Labrador. The following questions helped guide the discussions:

- What math concepts, skills or processes have you thought about?
- What made you think about them?
- What local skills and knowledge do you have that could help you teach mathematics in Nunatsiavut?
- How is Inuttut important for mathematics learning in Nunatsiavut?

I also planned follow-up questions:

- What challenges might you encounter as you use local knowledge to develop your lesson?

- How will you choose resources (artifacts, manipulatives, experts) to support your lessons?
- What is most important for you when developing mathematics lesson plans?
- Why is this locally relevant approach to teaching mathematics important for you?

The questions above served only as a starting point - participants were welcome to talk about whatever they wanted related to mathematics education in Nunatsiavut and they did. In my proposal, I also stated that I would collect other information from participants such as lesson plans and online postings via Google+. I did collect some lesson plans but they have not been analyzed or included in this thesis because I discovered without the participants voice, the analysis would be overly subject to my own interpretations. The Google+ page failed due to lack of interest in using an unfamiliar platform. In summary, the final data consisted of transcripts from 4 individual and one group interview that had 8 participants. I have learned that Facebook is the media tool of choice on the North Coast and a future project would seek to better align with what participants are already using in order to continue interacting.

Data Analysis Tool

Using a funds of knowledge approach to look for evidence of historically accumulated knowledge for household and individual well-being required a way to systematically analyze data collected. The matrix in *Table 2: Funds of knowledge sorting framework* was used to collect utterances of participants in semi-structured interviews that have been transcribed. Similar to a net for fish, this table does not collect it all and in fact many mathematical funds of knowledge may have been missed. Nonetheless, the sorting framework was useful in identifying what people do and what they say about what they do to uncover the multiple mathematics knowledge

bases in the fund of knowledge. The categories were designed to capture the social interaction with others and the environment that the funds of knowledge approach seeks to uncover. This will be discussed further in Chapter 6 - Findings.

Table 2: Funds of knowledge sorting framework

Interaction (verbs, people)	Who interacted, who else was there? Where did it take place? What circumstances (problem, knowledge sharing, planned or unplanned)?
Area (conventional math)	What mathematical concepts are brought to mind? What skills and knowledge are defined as mathematical?
Source	Who has knowledge to share? What context required the thinking? What dilemma led to the understanding?

(Adapted from Aguirre et al.,2012)

Using the sorting matrix (a completed version is shown in the Findings section), I read and re-read the transcripts copying and pasting what was said that related to areas, sources and interactions. Going through this process I realized another blind spot. A central aspect of what participants shared with me was not captured by the framework, namely identity and common-sense. A new question emerged: How does describing how we know what we know as “common sense” reflect a fund of knowledge? In order to illuminate what they described, I did further transcript analysis and selected more detailed text excerpts that demonstrated the participants reflections. The findings are presented in table format and show the extent to which funds of knowledge are apparent in the participant discourse. I read transcripts five or more times, using the framework as a filter and my reading as the netting. Actual participant utterances were transcribed unchanged from how they were said. This reveals another limitation of the project, that analysis was done in isolation without the participants or guidance from the community.

This is balanced by my experience as a responsive mathematics educator being responsive in culturally diverse classrooms and my time getting to know the land and the people before data collection took place. I have tried to mitigate bias by keeping it simple, remaining consistent to direct transcription, and including far more than I have excluded. With respect to the sorting framework, on one hand, I do not anticipate results would have been much different as the connections seem to me to be fairly direct. On the other hand, the discussion about decision making and the unexpected connections would have added valuable insights to understanding the "totality" of the data. The geographic and financial constraints, coupled with a participant cohort who prefers face-to-face interactions, created this limitation to the project but does not invalidate the results - they are what they are. Participant voice was privileged as intended through direct transcription and limiting researcher interpretation. The findings organize, synthesize and validate the funds of knowledge approach to local mathematical knowledge in Nunatsiavut. What has emerged is a useful starting point for locally relevant, Inuit centred, mathematics curriculum in Nunatsiavut. The findings also reflect a turning point in pedagogical thinking toward fulfilling self-determination for Inuit in Nunatsiavut. These are captured in the section: Culture, Language and Identity, in the next chapter.

Chapter 6 - Findings

By reading through the data and using the framework I created, I worked with the thinking the participants shared with me in order to make my findings. A limitation of this process may be that the participants were not involved with the reading with me and able to offer their own analysis. Despite this limitation, I have been able to show that a funds of knowledge approach can be used to identify examples of daily-life in Nunatsiavut that hold mathematical potential through MMKB (areas, sources and interactions). What has resulted is a way to document what participants, local educators say about local mathematics in Nunatsiavut. Roth (2012) argues that it is impossible for ideology or research to be free of "blind spots" (p. 452) which, if not accounted for, can lead to serious "accidents" (ibid.). Since the beginning, awareness of the existence of blind spots in my research and perspective helped me to be cautious. There are so many unknown unknowns. In retrospect, a more systematic approach to including the participants in the development of data collection methods would likely be beneficial.

This project aims to answer the following research questions:

- *How do Nunatsiavut Inuit pre-service teachers access local knowledge, culture and language when planning for mathematics instruction?*
- *What are the interactions, sources and areas of mathematics knowledge Nunatsiavut Inuit pre-service teachers consider meaningful for teaching*

A third question emerged while analyzing the data:

- *Does describing knowledge as "common sense" reflect an indicator of a fund of knowledge?*

Using a thoughtful, flexible, responsive and relationship centered methodology, the data collected represents what "people actually do and what they say about what they do" (Gonzalez et al. 2001, p. 118). The funds of knowledge theory which guided the creation of the sorting matrix (Table 1) helps to uncover the multiple mathematics knowledge bases (Aguirre et al, 2013) underlying local knowledge and lived experience. In this chapter, I will first respond to the initial research questions by presenting the table which was created by using transcript analysis by sorting utterances into the three catagories: areas, sources, and interactions. I will explain how a funds of knowledge approach allowed multiple mathematical knowledge bases to emerge from discussion about "historically accumulated practices for individual and household well-being" (Moll et al., 2004) using specific examples from the table. I will then explain the findings of the third research question, *does describing knowledge as "common sense" reflect an indicator of a fund of knowledge?,* which emerged after reading the data and attempting to make sense of it. I will argue that, indeed, "common sense" has significance for what people say about what they do and has been described in other projects with Indignous participants (Wagner and Lunney Borden, 2006). Finally, in the section *Culture, Language and Identity* I will present contributions from the participants that reveal and further validate why talking about local knowledge and mathematics education is so significant in Nunatsiavut.

Demonstrating Funds of Knowledge

Table 3 - *Funds of knowledge sorting matrix complete* is the result of simple transcript readings to sort utterances into each category.

Table 3 - Sorting Matrix for Funds of Knowledge

Source: Who interacted, who else was there? Where did it take place? What circumstances (problem, knowledge sharing, planned or unplanned)?	Area: What mathematical concepts are brought to mind? What skills and knowledge are defined as mathematical?	Source: Who has knowledge to share? What context required the thinking? What dilemma led to the understanding?
-older people -siblings -socially learned -parents, grandparents, -peers and self taught -friends -living that kind of lifestyle * -talking to my son in Hopedale (telephone) -learning naturally* -Dad -trial and error process -made a template -people in the community -sister watches -local people* -people had to work -together and had to rely on each other -Elder or an expert, someone who knows more than me -one of my instructors -it was okay to be wrong -an elder -respected community member -well known hunter -the kids out on the land -my family -my dad	-trigonometry -how much he is going to make with this much -weight -patterns -buildings was squares and corners -the angles, the distance -math terminology* -time and distance -East or West, North or South -concepts of direction -makes his own nets -whole net like this big huge pattern -navigation (pilot) -count -understanding wind, the ice freezes the temperature and how these things happen like natural surroundings -direction -the curvature -Inuttut counting system -ratio of how much char did -you catch to salmon to trout -calculating distance -Portioning for meals	-life experiences -fishing (shrimp boat) -everything he learned out there was math -work experience -outside -math is everywhere -hiking -driving the boat* -comparison to a known -trip/prior knowledge: we went from home to the cabin on Sheep Island and he knows automatically how long that takes him to go in the boat* -waves going to certain directions on the boat -common sense - just what you gotta do -a trapper -the land -the trees -berries -the goose’s head -hunting -stories -math instructor -catching fish -things from their own environment -hunting example of how far away is the caribou -hunting and fishing going off on the land -cultural stuff

-people had to work together	-with the guts you can measure the length -draw a goose*	-traditional values -set a snare or hunt for seal -Nunatsiavut Constitution -hunting practices

The table is helpful as a starting point to begin thinking about contributions of the participants from a funds of knowledge perspective. I do not consider each entry as fixed, as entries would be fitting in more than one category. For example, drawing a goose could be a *source* of knowledge that comes as one problem solves to make visual interpretations for an accurate representation. It also involves the *area* of geometric thinking. Drawing a goose might require or lead to *interactions* with others, and the materials. The starred entries (*) are those which posed a particular challenge for me. Each entry in the table does not correspond intentionally across the categories and should be read as three separate lists that represent a sorting of data points into the three categories. I could have used different ways of sorting, I could have corresponded areas, sources and interactions related to one example but without the input of the participants, I felt this would be too influenced with my bias. As a beginning investigation, the sort I chose was adequate to respond to the research questions. I chose to look more deeply into a few examples to show my thinking at the time. I chose examples that had the most detail in the transcript for me to consolidate and elaborate upon.

It came to light in the discussions that the participants and I did not always share the same terminology. This is illustrated by the comment of one participant “we don’t think of it as concepts and skills” (Group Meeting). Hearing this gave me pause about how much interpretation and decontextualization I would engage in as I tried to make sense of the data. With care and awareness of bias, I used my judgement, knowledge of the context and the context of what was said to determine a category. For example, drawing a goose was put into the area

category because the participant talked about “the shape of the head” (Transcript, p. 3) which represented geometric thinking. The category “Area of knowledge” includes excerpts of what participants said that is connected to a topic such as geometry, measurement, designing, or counting what I think of as “concepts and skills”. The interaction category has many examples of interactions between people but also with the land or with a specific material, like rope needed to make a net. Local people are less certain for me in this category because they might also be a source of knowledge and were described this way by participants. Examples in the source section were those that were given as ways others might learn new things. Each entry only occurs once, to keep it simple; however, duplicate and similar ideas came across in multiple stories.

There is another level of analysis that may be worthy of further investigation to look for overarching ideas. Including the participants in the sorting may result in a different collection of data and would likely lead to a greater understanding of how the participants view knowledge. Since I was not able to include the participants, I did not do this.

Two Examples Explained

In order to better illustrate the context of what was shared by the participants, I have expanded on two examples. One that was particularly interesting for me was a participant describing her thinking during a recent boat ride with their family. Boating at sea is a very common and important life skill on the Northcoast of Labrador.

> Even just something so simple, like I was thinking the other day, actually, when we were coming in [on the boat] and it was blowing and the wind was blowing and [the driver] was driving the boat and the way he was coming into the shore it looked like we were going straight for the wharf but like *we never and he never thought of it like oh the angles the distance but really he was*

> *doing it all in his head* and from my point of view I was like oh man we are just going to hit the dock but *by the way the wind was blowing he knew it would bring him up on the shore where he wanted to go something thats math too but you don't actually use math*, you don't think of it in math terminology, but *it's subconscious*. (emphasis added, Transcript, p. 1).

Again, funds of knowledge are distributed across, and tied to social contexts with "an emphasis on practice". They are what "people actually do and what they say about what they do" (Gonzalez et al. 2001, p. 118). In this case, the participant observed a driver of a boat make complicated decisions about forces, navigation, location, movement, and speed. In describing what they knew about their knowledge, they said: "Like for [the driver], like for a lot of people it's like common sense and when I asked a question about it he said 'I don't know how to explain it' and 'that's just what you gotta do'" (Group Meeting). This example shows the connections that were continually made between practical knowledge for daily life and common sense. It brings me back to my own example of driving my car and the complex thinking that has become my common sense.

Another excerpt about driving the boat shows how this kind of mathematical (and other) knowledge is generated from lived experience. The same participant noted about the driver:

> He has that experience and that knowledge and he knows how to do it, so like if I went with him frequently, or you, like who knows in a couple of years you might be able to do that. Or even something so simple of finding my own way down. To know where the shoals are in relation to the land that's along the shore, stuff like that, I wouldn't be able to do that but it is second nature to [the driver]. We go out

> there to Big Apple Island, we will go right in close to shore sometimes because there is a shoal on the other side, and it's like 'how did you know that because you can't see anything?' and he is like 'because I knows it' and he knows how many feet he got in between so he just stays in between that. 'So how are you measuring how many feet you are from the shore right now? How do you know this stuff?' I totally don't have that ability (Transcript, p. 11).

These excerpts could undergo much more unpacking with the input of the participants to make sense of what is really being said and how they might make direct connections to the distributed nature of the knowledge and mathematical thinking. This example also shows how *historically accumulated knowledge for well-being and functioning becomes apparent*. When the participant says "I totally don't have that ability" she is referring to a Northcoast life skill (driving a boat) that is not taught in school that she has not had access to in the same way as the driver. This recognition of skills and abilities, developing common sense based on interactions with others in a similar context, shows evidence of funds of knowledge as well as the limitations to understand without shared experiences or sharing knowledge (multiple knowledges). Historically accumulated knowledge is evident in other examples in the table through several excerpts that have connection to learning through daily life. About one third of the examples in the section *Interactions (Table 3),* involves "elders, parents, grandparents, someone who knows more than me". Others, examples of land based learning (hunting, making a net) or learning by trial and error also point to knowledge being historically accumulated. Based on my experience in Nunatsiavut and what I think I know about Inuit culture, knowledge of Elders and skilled community members is

highly respected and valued. It is precisely the link to the past and the place, the thread that makes Inuit who they are, which is pronounced throughout the literature in Indigenous education, the Nunatsiavut Constitution, and which bridges, for me, to theorizing about funds of knowledge. When I asked participants how they would teach mathematics differently from the way they learned in school, which was described as "degrading" (Transcript, p. 9), a connection to the past emerged in this way: "For Inuit the only way to pass [any] knowledge was oral or visually taught. Another thing is to try to decolonize. That is something that a lot of us are looking at it, even within ourselves. We are so stuck in that mindset and we need to decolonize ourselves to be able to pass on what we want from our culture" (Transcript, p. 18). This example demonstrates how funds of knowledge can be useful for decolonization in order to priviledge what Inuit themselves say counts.

Arguably, the driver of the boat in the example described above accessed multiple knowledge bases in order to complete the practices of driving the boat. These might include: knowledge of the environment, knowledge of navigation using visual landmarks, knowledge of water, knowledge of how to respond in different situations, knowledge of the experience of being in a boat for a lifetime as a passenger than driver, formal knowledge gained through training and schooling. It is possible to document the mathematical thinking, behaviours, and examples that are evident in the experience of the boat driver much like the teacher-researchers of previous funds of knowledge research. The participants were able to describe many connections in what they talked about. They described the A-HA moments various times that came when they took a mathematics education course designed to connect culture, land based learning, and mathematics. It is with training in noticing and naming the mathematics by those who have

expertise in local knowledge that the emergence of mathematics knowledge can occur in a good way. In my experience, when I suggest to people they are doing math when they are driving a boat, they typically hadn't thought of it that way before. Nonetheless, they have done something very mathematical as well as very meaningful to their well-being and values. In this way, a mathematics for Nunatsiavut might emerge, and could be as comprehensive as the creators desire.

Other examples in the table have similar features. One that I am particularly interested in exploring further is the example given of the Nunatsiavut Constitution. In this case, the participant described it as a component of funds of knowledge: "...we can get into demographics, and statistics, and relationships, there is a lot within the Constitution. I mean it is cross-curricular and it's reinforcing identity concepts and place and is enriching" (Transcript, p. 8). I listed the Nunatsiavut Constitution a source of knowledge (Who has knowledge to share? What context required the thinking? What dilemma led to the understanding?) because the participant is suggesting students could learn areas of mathematics such as demographics and statistics while studying its history and content. The interactions involved in this learning through reading, listening, speaking, viewing, modelling, etc. and the "other knowledge", the non-mathematical knowledge that would be gained seems to point to a very powerful fund of knowledge. That it is historically accumulated goes without saying, that it is essential for the well-being of households and individuals is certainly acceptable, and I think that is exactly what the participant is saying is the case. I cannot say that the Nunatsiavut Constitution is common sense among Labrador Inuit, further conversations and investigation would have to be done. The Canadian Constitution, on the other hand, certainly the Charter of Rights and Freedoms, does exist as common sense among many Canadians. Everyday conversations are had about it and it is part of daily-life as we

navigate our public institutions. The participant, in a discussion about mathematics education for Nunatsiavut students, spoke about the Nunatsiavut Constitution as a means to engagement. I never thought of a Constitution to have mathematical potential, but it is a promising notion. This example offers not only suggestions to use the Nunatsiavut Constitution as a text to analyze mathematically, but also use it to inform the way mathematics education is conceptualized for Nunatsiavut, one that reinforces Inuit as innovative, adaptable people whose identity is rooted in "treasuring the land" (Transcript, p. 20).

The table also demonstrates a mixture of traditional and modern land based sources of knowledge such as collecting berries, piloting an aircraft, navigating the waves. The areas of mathematics mentioned include trigonometry, patterning, geometry, directions, measuring, and counting systems represent a wide range of connections. The interactions participants described include many references to older people and Elders, community members working together, and learning naturally by trial and error. The view of knowledge as distributed in a funds of knowledge approach as described by Moll et al. (1992) can be seen in the way social contexts are described in connection with the places, people and experiences they have which are unique to Inuit along the North Labrador coast. Shifting our thinking to value the mathematical reasoning, connecting, problem solving that exist in our daily lives and in historical practices is evident in the way participants talked about their changed thinking about mathematics when it was made meaningful to them.

Common Sense as an Indicator of a Fund of Knowledge

Throughout my research and data collection, common sense stood out, as those interviewed made numerous references to it. Most notably, a participant said "...it's common sense until somebody tells you you are learning math right now. All this stuff that you did before

might seem like nothing but you was actually participating in math concepts and processes and stuff. Like its until you talk to somebody about it who really wants to know then you thinks I did learn math somehow" (Transcript, p. 4). I was puzzled by this idea at first because it creates a kind of tension about how to identify the mathematics they clearly see inherent in a variety of activities or local knowledge as demonstrated in Table 3. If we do call it math, are we changing it? Are we just applying Western mathematics to an Indigenous context? Or, are we opening our minds to different ways of understanding mathematics, those which have existed for longer than Algebra but have previously been ignored in the "mainstream"? Common sense is unarguably based on personal experiences. What I came to accept was that when they were calling something *common sense* they were identifying a fund of knowledge that had been gained through historical accumulation of information and local practices. Common sense is often hidden since it is made of what we take for granted, but for me it has become an interesting place to look for mathematical funds of knowledge that would help inform the goals of a locally developed and culturally responsive pedagogy.

An article by Wagner and Lunney Borden (2006) describes the same situation in their work with Mi'kmaq Elders. For them, common sense was how Elders described "how they know what to do in the situations they describe as mathematical" (p. 522). What is needed is a sense of the situation, a sense of the family's needs and a sense of the work it takes to meet these needs" (ibid). It is in these situations where the response "enough" might be all that is needed to satisfy the question "how much". This article helps me to understand that common sense can only be applied to mathematics education when it is grounded in the experience of the students (ibid.) and in this way can also be directly related to their own concerns rather than those of an outsider. For my project, common sense has become a powerful indicator of funds of knowledge in the

voices of the participants. It differentiates, for now, between that which is typically learned in school and that which is learned outside of school, but the evidence from other research suggests that there is tremendous value to moving in a direction where these distinctions are lessened or eliminated.

The following excerpt from one interview helps to illustrate the way the participants referred to common sense:

> You don't think of it as concepts, skills and processes is just naturally occuring when you are doing something in the boat or you see the temperature change because there is ice on the bike when you come out you don't say that's a process, it's something that naturally occurs if you are used to living that kind of lifestyle. If my dad is talking to my son in Hopedale to refer to time and distance he will say well we went from home to the cabin on Sheep Island and he knows automatically how long that takes him to go in the boat. And my dad was stuck up there because of wind because it was so windy so he had to travel back a certain way, even though he had to go East or West, North or South, he was using concepts of direction but he knew to go a certain way because of the waves going to certain direction on the boat. Like that’s not stuff you call a process with regards to math or a skill it's just automatically learned growing up, like learning naturally. Like for [so-and-so], like for a lot of people it's like common sense and when I ask a question about it he said I don't know how to explain it and that's just what you gotta do (Transcript, p. 2).

This excerpt describes complex skills and knowledge that people use in order to live their life and understand the world. My training as a mathematics educator enables me to identify proportional reasoning, measurement, estimation, direction, intersecting lines, angles, forces, reactions and patterns, planning, problem solving, connecting, etc... I am not sure how the people involved in the activities would describe how they know what they do, but for the pre-service educators it was common sense.

Culture, Language and Identity

When analyzing the transcripts of my interviews using the sorting framework I created based on Aguirre et al. (2012) listing the areas, sources, and interactions, I realized that the questions I asked led the participants to talk about much more than how they approach mathematics instruction. One interview was particularly meaningful. It illustrates the power of changing education and school for the people of Nunatsiavut. It addresses the harm that was caused by decades of colonization, language loss and lack of political power. The participants' words show what this work in education means to individual people who will be directly impacted by it.

> In the documentary I showed you earlier[9], I talk about ice fishing and I always love to talk about ice fishing because there are so many aspects. You take in account the weather, that's science, you take into account the depth of the ice or length of the line you are going to need, that's math, the practice of ice fishing, that's social studies or life skills, we have life skills on the North Coast, you can take any subject within a culture and incorporate or mirror the English curriculum. So for me, I am not taking away, there is no loss to the curriculum or the outcomes or what they learn. It's enhanced, and that is something they will

[9] https://www.youtube.com/watch?v=eNfA7wuRKLE

> appreciate more because that's who they are. And it's ...there is interconnectedness between me and the student, the student and the math, the student and their environment where it is learned (Individual Meeting).

The participant tells us that what we learn is fully impacted by how we learn it. What is expressed is emotional (a longing for connection between school and daily life) and practical for the survival of a culture and the people who need it to live successfully in Nunatsiavut. This participant also described how living without the Inuttut language is debilitating to the sense of self, the sense of efficacy, their sense of knowing who they are. What the participants told me is consistent with how the research in this field unfolds. The collective revitalization and regeneration of knowledge, tied together by culture and language, is something Inuit are advocating for as they determine educational outcomes on their Land.

Students in the IBED program have taken the additional step of taking an Inuttut language proficiency certification throughout their program. Inuttut language loss on the North Coast is significant and many efforts are being made to revitalize its common usage in Nunatsiavut communities. The participants argue for the use of Inuttut in Nunatsiavut classrooms so that students can see themselves in mathematics. Not feeling “Inuk enough” was a sentiment described by participants in the project and was tied directly to proficiency with language (Transcript, p. 26). The participants are telling us that mathematics has the potential to be a force in local education where Inuttut, culture, and sophisticated ways of thinking can be brought together in the meaningful instruction of mathematics.

Summary

What I have learned so far in response to my research questions is that mathematical funds of knowledge can indeed be identified by the participants through dialogue about local

practices. I have learned that they draw upon local ways of knowing and being when I asked them how they think about mathematics. They also talk about a profound shift in the way that they view mathematics as a result of their coursework in the teacher education program. They foresee a mathematics learning environment that is much different from the one they experienced as younger students. They are interested in the ways curriculum of all kinds can emerge from Inuit identity and language. I have also learned that there is some difference in the way we (myself and the participants) think about learning. What the participants said about common sense and how learning happens in their view, deserves more investigation. What I call “learning concepts and skills” they call developing “common sense”. I wonder if this description of knowledge is a place to look for a fund of knowledge, a significant and historically accumulated practice for individual and household wellbeing.

Chapter 7 - Discussion

Funds of knowledge literature continues to grow as more researchers are interested in expanding our Western world view of mathematics for the betterment of students. The research projects that were most influenced by research questions and development of the methodology were those by Lunney Borden (2010, 2011), Lipke et al. (2005) and Aguirre et al. (2012). The former two helped me understand how a non-indigenous researcher goes about becoming part of the work, the latter gave me a structure to connect ways of knowing and multiple knowledges systematically, even if rudimentarily at this point. In developing my thinking and understanding, I became familiar with numerous other projects from all over the world which are revealing similar findings: that Indigenous knowledge holds mathematical potential. Local practices whether traditional or not can provide an opportunity for conversations about mathematical ideas as we know them in the mainstream curriculum. More importantly though, is the opportunity to think about mathematics and mathematics education differently than the mainstream (concepts and skills) whereby local knowledge, values, culture and language provide the context for learning mathematics, whatever that mathematics happens to be.

New Zealand Maori, for example, have made tremendous progress in providing for Maori medium mathematics from elementary to postgraduate education. At one conference[10], a New Zealand Maori participant described the way language is carefully considered as this curriculum develops. Some words are translated, some are transliterated, more are invented in order to preserve the Maori meaning. By first making the mathematics visible and beginning conversations about how mathematics is everywhere, the conversation can begin about how mathematics education might change in a way that promotes local ways of knowing, language and leads to better achievement outcomes.

[10] IndigiMEC, Tromso, Norway, September, 2017

The first research question I investigated *How do Nunatsiavut Inuit pre-service teachers access local knowledge, culture and language when planning for mathematics instruction?* was not timed well. The students were not currently in a mathematics course and the prompt may have achieved better results if they were more focused on mathematics at the time of the interviews. The question may even provoke new responses now that some of the participants have graduated and are teaching. As I have found, the more you think about mathematics in daily practices, the more ideas you have, the more connections you make. This observation is consistent with previous research, including the seminal work of Moll et al. (2004) as well as that of Aguirre et. al (2012) whereby those who were provoked to "see the mathematics" in daily experiences, did.

The second research question, *What are the interactions, sources and areas of mathematics knowledge Nunatsiavut Inuit pre-service teachers consider meaningful for teaching* yielded much better results as the participants were able to speak at length about how they thought about mathematics, and how that thinking had changed through their participation in the IBED program where "the students have not only become familiar with the curriculum guides of the province...but also examined the Inuit-centric curriculum guides and supporting documents from Nunavut" (Moore et al., 2016, p. 96). It was the conversations about all the mathematics they thought about and how they came to know it that led to the third question which got at the root of what I had to wrestle with in my conceptualization of a fund of knowledge. The data left me wondering if "common sense" might be a way to identify funds of knowledge when analysing what people do and what they say about what they do. A method for systematically identifying funds of knowledge is a limitation I highlighted Chapter 4- Theoretical Framework and so this conjecture is an important contribution to the field.

Contemplating discourse comes with inherent bias and doing this work alone is a significant limitation. Although I followed avenues to do this work *in a good way*, any more work would have to be more grounded in the community. The next iteration would involve living and working in a community like Hopedale and engaging local participants in developing the project and interpreting the data in a fulsome way.

A consideration of a funds of knowledge approach is that it allows an outsider "a way in" and this may not be desirable for Indegenous people in a post-colonial context. Meany, Trinnick and Fairhall (2013) found that they could engage in community based research about New Zealand Maori medium mathematics to support a culturally proficient curriculum. Their research shows that it is possible to "make the unthinkable thinkable" (p. 260) and it relied on carefully creating space for these interactions (for example, between mathematics, culture, practice, values). In my study, the various ways I asked for space and made myself available to be known gave me the opportunity to engage in dialogue and learning. I must acknowledge the participants for allowing me the privilege of their time. They also acknowledge how they had been taking space in the mathematics education community by thinking about mathematics in a different way: "All this stuff that you did before might seem like nothing but you was actually participating in math concepts and processes and stuff like its until you talk to somebody about it who really wants to know then you thinks I did learn math somehow." (Transcript, p. 4). In this way, the participant is reflecting on their own mathematical funds of knowledge.

The sense of "other" is palpable when the participants talked about not feeling "Inuk enough" (Transcript, p. 26) as they grew up and became adults. This is changing as they contemplate multiple ways of seeing the world and investing in Inuit knowledge and Inuttut.

> It validates the culture when you look at how math was taught for hundreds of years there was one way, a Eurocentric way of doing things and knowing, if you didn't follow that then you had no value. And there is a cultural way of learning math, we've talked about it here this afternoon. They were living it and they didn't call it math, trial and error, experiential, they went out and they learned it and they didn't write down formulas. I remember we listened to stories, we read a story about an Innu man making his canoe and to make sure all the rungs in the bottom were the same he measured it by his arm. So being resourceful that way, like you've got an arm so use it in the same way for anything else (Transcript, p. 13).

The participants were consistent in their message that they now see mathematics education much differently now than they did as students by learning from an experiential, culture based program. Talking about Inuit mathematics is powerful, empowering, and worthwhile. What I have learned is that there is an opportunity to create space, realign priorities, build something new that does not take away the potential to learn mainstream mathematics but rather enhances it to the level that people leaving the education system feel Inuk enough and have the mathematical skills and abilities.

In doing this work, I am able to understand the need for time to invest in relationships, and that the work is much more than simply doing a project. It is about the lives and livelihood of Inuit in Nunatsiavut, and it is about figuring out how this thing we call mathematics exists within every person's life in particular ways. Having more clarity about these ideas may be powerful to those seeking to develop a local curriculum. The contribution of this project to the body of knowledge that already exists lies in the way it was able to capture the thinking of Inuit educators about mathematics education and not a non-Indeigenous person's anthropological

interpretation. I will say again that a future project would include the participants in the analysis and findings. In the beginning of this project, much focus was placed on how this work was part of decolonization and revitalizing Inuit culture. In the end, I have been thinking much more about how my understanding of mathematics has changed as a result of the project and hearing what people *actually* had to say. Roth (2012) argues that "the [new] theories can disturb conventional understandings of what mathematics is and how it exists in an 'objective' sense" (p. 452). The findings of this project, the words of the participants, have allowed funds of mathematical knowledge for Nunatsiavut to emerge through discussion of local activities and practices. My world view has changed as a result of this work and it has given me tools to use to think about a "math moment". Continuing to develop this framework and use it with educators could also be useful next step.

Chapter 8 - Limitations and Further Research

Using the funds of knowledge approach to gain better insight to local mathematics in Nunatsiavut has revealed a multitude of knowledges and insights into how it can be taught in a rigorous way that emerges from culture, language and local life experience. Further to this, the data demonstrates the significance of this work to promoting Inuit identity and language to the people of Nunatsiavut. Participants shared emotional, practical and optimistic perspectives that were grounded in the goals of their teacher education program to promote Inuit ways of knowing. What was gained through the data collection and analysis was confirmation that using a funds of knowledge approach with pre-service Inuit teachers can help identify local sources of mathematics knowledge and the interactions they depend upon. A potential limiting factor of the research is that the findings and analysis have been done in isolation and without collaboration of the participants. Much more may be revealed if the data could be shared and analyzed together, through dialogue and further documentation of what people do and what they say about what they do. I do not think I understand, yet, what mathematics in Nunatsiavut is or might become. However, there is evidence that local mathematics exists. Further research in the community, by the community, may begin to define what mathematics education can become for Inuit in Nunatsiavut so that culture, identity and language are not sacrificed.

The work undertaken to complete this research project has taken many years and could not be what it has become without all of the experiences (formal and informal), conversations, risks, and leaps of faith. It evolved from a genuine curiosity about mathematical knowledge and learning mathematics in ways that are grounded, rooted, inspired by real life experiences and values. I have learned that by engaging with people who can describe the world in different ways (than I can) and who can talk about the mathematical potential of their own unique lived

experience to create opportunities in education, the conversation about mathematics education shifts from what is useful to what is powerful for learning. Being proficient at computations and having standardized knowledge is important for success in life just as much as literacy is. However, what the participants in this study voiced is that this knowledge need not come at the cost of traditional knowledge and local values. In fact, what they have articulated points to a mathematics curriculum in the future that emerges from local knowledge and empowers students to use their language and experience in mathematical thinking.

Chapter 9 - Conclusion

The findings of my research demonstrate that a funds of knowledge approach can be used to uncover elements of local knowledge for mathematics education. The participants in my study made connections to local ways of life and mathematics in meaningful ways that highlight the funds of knowledge in Nunatsiavut. More than that though, the research uncovered similar findings to other research with Indigenous people, most significantly the critical need for the intense promotion of identity and language in school. Knowing that rigorous mathematics education can be achieved by allowing it to emerge from local context, local skills, local culture and identity, means that the participants have an opportunity to fulfill this aspect of self-determination. In their stories, they identify a turning point when their mathematics education professor helped to shift their thinking. It was a turning point in the way they understood mathematics and saw themselves as mathematicians. Understanding that Inuit, that people from their community who are on the land and sea, who are working to make the community home in everything that they do, have mathematical skills and knowledge to be uncovered might be transformative. Learning mathematics doesn't have to come at a cost to learning locals ways and valuing Inuit culture, and in fact, the statements of the students demonstrate that mathematics can be a window into what is important to them, as a way to come to know mathematics in a way that makes sense and is meaningful. More than that, they talk about how this approach is empowering for students because it allows them to see themselves and the people around them as mathematicians. A revitalized mathematics curriculum that is grounded in Nunatsiavut funds of knowledge may one day lead to to use mathematics in ways that had not previously been imagined.

At this point, I feel confident that this research project achieved the goals I initially set out to achieve. I designed a project that was acceptable and welcomed by the community I wanted to work with. I collected substantial data through semi-structured interviews and dialogue. Analysis of the data confirms the usefulness of a funds of knowledge approach for identifying local funds of mathematical knowledge. Preservice teachers in the Nunatsiavut Inuit Bachelor of Education Program include local knowledge, culture and language when planning for mathematics instruction by identifying local activities, lifestyle features, cultural artifacts and people that they could include or consult. They describe in detail their own experiences and reflections about what mathematics means to them and how they envision land based learning and making connections with their students about local knowledge. Some of the meaningful interactions, sources and areas of mathematics knowledge they consider for teaching were with Elders and family members, on the land or sea and always connected to something useful in their life (navigating, hunting, fishing, communicating and relating). There is much much more to talk about and document, this project shows there is a beginning. In addition, the data confirmed that situating this work within decolonization is appropriate and changes are taking place in the way mathematics is valued by pre-service Nunatsiavut teachers as a product of lived experience. This was talked about explicitly by some of the participants while for others it was just about making mathematics a better experience for their students than it was for themselves.

References

Aguirre, J., Turner, Erin., Bartell, T., Kalinec-Craig, C., Foote, M., McDuffie, A., & Drake, C. (2012). Making connections in practice: How prospective elementary teachers connect to children's mathematical thinking and community funds of knowledge in mathematics Instruction. *Journal of Teacher Education, 64*(2), pp. 178 -192.

Averil, R., Anderson, D., Easton, H., Te Maro, P., Smith, D., & Hynds, A. (2009). Culturally responsive teaching of mathematics: Three models from linked studies. *Journal for Research in Mathematics Education, 40*(2), 157-186.

Barton, B. (1996). Making sense of ethnomathematics: Ethnomathematics is making sense. *Educational Studies in Mathematics, 31*, 201-233.

Barton, B. (2008). *The language of mathematics: Telling mathematical tales*. New York: Springer.

Battiste, M. (2009/2010). Nourishing the learning spirit: Living our way to new thinking. *Education Canada*, *50*(1), pp. 14-18.

Battiste, M. (May, 2004). *Animating sites of postcolonial education: Indigenous knowledge and the humanities*. Plenary address at the Canadian Society for Studies in Education, Manitoba, Canada.

Beatty, R., and Blair, D. (2015). Indigenous pedagogy for early mathematics: Algonquin looming in a grade 2 math classroom. *The International Journal of Holistic Early Learning and Development*, *1*, 1-24.

Bishop, A. J. (1988). *Mathematical enculturation. A cultural perspective on mathematics education*. Dordrecht: Kluwer Academic Publishers.

Bishop, A. (1990). Western mathematics: The secret weapon of cultural imperialism. *Race and Class*, *32*(2), 51-65.

Bishop, A., Berryman, M., Wearmouth, J., and Peter, M. (2012). Developing an effective education reform model for indigenous and other minoritized students. *School Effectiveness and School Improvement*, *23*(1), 49–70.

D'Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics*, *5*, 44–48.

Dawson, S., (2013). Mathematics and culture in Micronesia: The structure and function of a capacity building project. *Mathematics Education Research Journal 25*, 43-56.

Fynh, A., Eira, E., and Sriraman, B. (2011). Perspectives on Sami education. *Interchange*. *42*(2), 185-203.

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

Government of Newfoundland and Labrador Department of Education (2014). Mathematics grade 4: A curriculum guide. Retrieved from: http://www.ed.gov.nl.ca/edu/k12/curriculum/guides/mathematics/elementary/Mathematics_Grade_4_Curriculum_Guide_2014.pdf

Government of Nunatsiavut (2005). *Nunatsiavut Constitution Act*. Retrieved from https://www.nunatsiavut.com/wp-content/uploads/2015/07/CIL-31-12-2012-N-3-Nunatsiavut-Constitiution-Act.pdf

Jannock Nutti, Y. (2013). Indigenous teachers' experiences of the implementation of culture-based mathematics activities in Sámi school. *Mathematics Education Research Journal*, *25*, 57-72.

Kovach, M. (2009). *Indigenous Methodologies*. Toronto: University of Toronto Press.

Kral, M., Wiebe, P., Nisbet, K., Dallas, C., Okalik, L., Enuaraq, N., and Cinottawa, J. (2009). Canadian Inuit community engagement in suicide prevention. *International Journal of Circumpolar Health 68*(3), 292-308.

Lipka, J., Hogan, M., Webster J., Yanez., E., Adams, B., Clark, S., and Lacy D. (2005). Math in a cultural context: Two case studies of a successful culturally based math project. *Anthropology and Education Quarterly*, *36*(4), 376-385.

Lunney Borden, Lisa. (2011). The 'verbification' of mathematics: Using the grammatical structures of Mi'kmaq to support student learning. *For the Learning of Mathematics, 31*(3), 8-13.

Lunney Borden, L. (2010). *Transforming mathematics education for Mi'kmaw students through mawikinutimatimk* (Doctoral dissertation, University of New Brunswick). Retrieved from https://www.collectionscanada.gc.ca/obj/thesescanada/vol2/002/NR82763.PDF

Meany, T. (2002). Symbiosis or cultural clash? Indigenous students learning mathematics. *Journal of Intercultural studies 23*(2), 167-187.

Meany, T., Trinick, T., & Fairhall, U. (2013). One size does NOT fit all: Achieving equity in Maori mathematics classrooms. *Journal for Research in Mathematics Education, 44*(1), 235-263.

Moll, L., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory Into Practice*, *31*(2), 131-141.

Moore, S., Allen, C., Andersen, M., Boase, D., Campbell, J.-R., Doherty, T., Edmunds, A., Edmunds, F., Flowers, J., Lyall, J., Mitsuk, C., Mochasak, R., Pamak, V., Russell, F., &

Voisey, J. (2016). Inuit-centered learning in the Inuit Bachelor of Education Program. *Etudes Inuit Studies*, *40*(2), 93-107.

Munroe, E., Lunney Borden, L. Orr, A., Toney, D., and Meader, J., (2013). Decolonizing aboriginal education in the 21st century. *McGill Journal of Education*, *48*(2), 317-337.

Romm, N., (2015). Conducting focus groups in terms of an appreciation of Indigenous ways of knowing: Some examples from South Africa. *Forum Qualitative Sozialforschung, 16*(1), 1-23.

Roth, W. (2012). Re/writing the subject: a contribution to post-structuralist theory in mathematics education. *Educational Studies in Mathematics*, *80*, 451-471.

Swayze, N., (2009). Engaging indigenous urban youth in environmental learning: The importance of place revisited. *Canadian Journal of Environmental Education, 14*, 59-73.

Wagner, D. and Lunney Borden, L. (2006). Common sense: Necessity and intention in ethnomathematics. *Proceedings of the 28th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, 2*, 521-523.

Wheeler, D. (1983). Mathematization matters. *For the Learning of Mathematics*, *3*(1), 45-47.

Willox, A., Harper, S., and Edge, V., (2012). Storytelling in a digital age: Digital storytelling as an emerging narrative method for preserving and promoting indigenous oral wisdom. *Qualitative Research, 13*(2), 127-147.

Yosso, T. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth *Race Ethnicity and Education, 8*(1), 69–91.