

**ISSUES AND UNDERLYING FACTORS RELATING TO THE
GRADUATION RATES OF ABORIGINAL STUDENTS FROM
MATHEMATICS PROGRAMS**

by

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A Thesis

Submitted in partial fulfilment of the requirements

For the degree of

Master of Education

**FACULTY OF EDUCATION
LAKEHEAD UNIVERSITY
THUNDER BAY, ONTARIO**

February 2012

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Dedication:

To Rita

Acknowledgements

I would like to acknowledge the time and energies of my supervisor Dr. Wayne Melville for providing strong support that is on-going and has provided me with the direction I have required throughout the writing of my literature reviews and this proposal. Dr. Melville has read through my materials with meticulous eyes many times and has provided countless numbers of valuable comments and questions. Additionally, I would like to acknowledge Dr. Melville's capacity for understanding how students learn and what that has meant for the writing of this thesis. Most importantly, I would like to thank Dr. Melville for his integrity without which, I would have battled unnecessary and unreasonable extents of stress.

Additionally, I would like to thank both Dr. John Hodson and Dr. Seth Agbo for sharing their rich awareness of the range and scope of oppression and for the foresight they exhibited in First Nation community struggles. They both guided me when I needed it most.

I would also like to acknowledge the efforts of Dr. Ann Kajander and Dr. Alex Lawson who started me on my way and directed me to many of the mathematics materials that have been critical to the literature in this thesis. Dr. Kajander's CRYSTAL grant partially assisted me in the financing of my first study.

Essential to the writing of any thesis proposal are the efforts that take place behind the scenes by administrators, assistants to administrators and supporting faculty. This proposal would not be at this stage of submission had it not been for the efforts of these people.

Lastly, I would be remiss if I did not acknowledge the time and dedication of my husband Dennis McPherson, who reads what I write, making sure I "walk carefully" with my words and remain firmly grounded in a position of *support* with the Aboriginal people of Gull Bay First Nations Community.

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Introduction

The intent of my research was to shed light on the factors that impede Aboriginal students from finding success in their formal mathematical instruction within the Ontario provincial education system. The goal of my research was to provide a direction with which to proceed into the future. Specifically, my research was an attempt to explore the issues surrounding the high dropout rate of Aboriginal students. This research project is critically important because recent data is indicating that Aboriginals continue to struggle in school with dropout rates far above the national average (Auditor General of Canada, 2010; Banff International Research Station for Mathematical Innovation and Discovery, 2009). The aligning of my ontology, my understanding of epistemology and my methodology was critical in this process. My ontology encompasses a Euro-western perspective but has been swayed by the Aboriginal perspectives of my husband and family. My epistemology includes a mathematical framework combined with an attempt to understand situations through narrative. This aligning process has required incorporation of a unique ethno-epistemology, as I am also working with First Nations people.

The study involved First Nations participants who had completed their elementary education in their community. Participants who had completed a partial elementary program in their community, with the remainder in provincial schools were also included in the study. All students had transferred their elementary mathematics education to provincial Lakehead Public Schools Board secondary schools. None of the participants had completed post-secondary education. Therefore, the participants were asked questions pertaining to their early mathematical experiences through to their secondary mathematics education encounters, in an attempt to discover why they dropped out of their high school mathematics program. I felt that it

would be beneficial to interview students who had been away from school for a number of years because their subsequent potential for reflection on their experiences.

In the next section I will be delineating the purpose of this study to provide the details and motivations that support the basis for its body. Definitions of terminologies will be included to add clarity to the writing of this thesis. I will then be outlining my methodology and methods, which will include the framework of my study design, the participants that I worked with, the general research questions they were asked and the potential limitations of the study. The literature reviews will consider the vision for mathematics education in the provinces, prior to the examination of three fundamental issues that arise from this vision. These are an examination as to whether mathematics classrooms are setting the stage for the success of all of their students, and whether teacher-directed methods of teaching mathematics contribute to the oppression that is felt by some students. The literature reviews will also explore whether First Nations communities should be developing and delivering their own mathematics programs.

In the data and analysis section, I will begin with a short biography of each participant to set the stage for the data analysis and subsequent discussion. Data analysis was a two-step process involving data collection of interviews of the participants' early educational experiences, particularly as they applied to mathematics, and the observations and artifacts which were generated by their involvement in the GED program. Coding revealed a much heavier emphasis on issues of identity in both areas of data collection than I had considered when I first initiated this body of work. This will be examined further in the discussion section.

The discussion section will set out the implications of my study, and my reflection on my changing perception on issues around Aboriginal education. It will infer directions for future

studies and for the GED program in First Nations communities. Additionally, I will outline implications for research skills and their ability to be strengthened through the pursuit of mathematics.

Purpose

Recent data indicates that Aboriginal students are dropping out of school in high numbers (Auditor-General of Canada, 2010; Banff International Research Station for Mathematical Innovation and Discovery, 2009). This research aims to pursue the question of why this is happening, with a particular focus on mathematics. The purpose of this research is to explore the issues and underlying factors relating to the graduation rates of Aboriginal students from mathematics programs. This research is important because Aboriginal people “falling through the cracks” in their mathematics education may not be consistent with all of the guidelines set for the standards of mathematics pedagogy adopted by the Province since 1989 (NCTM, 2000). The research will be looking at the participants’ perceived importance of the incorporation of their traditional values in mathematics, potential language barriers, location of First Nations Communities and social factors stemming from 500 years of oppression (McPherson & Rabb, 2010). This research will also explore the potential for conceptually-based learning of mathematics to minimize trust issues that may otherwise impede participant learning. This research is important because it is the adult Aboriginal participants themselves who will be given voice, while they are receiving upgrading toward the writing of their General Education Development (GED) exams.

Depending on the findings revealed by this research into the underlying issues and factors relating to the graduation rates of Aboriginals, more research may be necessary.

Specifically, a need for more research will be indicated if it is found that the current provincial educational systems are not fully supporting or able to fully support the most fundamental reason(s) for Aboriginal student attrition in mathematics.

Definitions

In an attempt to diffuse any notion of problematic terminologies in this paper, I will provide a provincially accepted definition of the word success for the purposes of this paper. The release of three important National Council of Teachers of Mathematics (NCTM) documents beginning in 1989 set the standard for mathematics teachers and policymakers in the United States and Canada. These three documents are the Curriculum and Evaluation Standards, Professional Standards for Teaching Mathematics and Assessment Standards for School Mathematics. All three documents and their visions are available on-line and on CD ROM and portray the possibility of success in mathematics for all students within Canada. NCTM is an international professional organization dedicated to the on-going improvement of mathematics pedagogy and assessment. Their documents outline the definition of success in mathematics for all students within Canada.

Contained within the NCTM documents is the Equity Principle which recommends “access to an excellent and equitable mathematics program that provides solid support for their learning and is responsive to their prior knowledge, intellectual strengths, and personal interests” (NCTM, 2000, p. 12) for all students. The meeting of the Equity Principle is essential, for the purposes of this study, for the success of Aboriginal students in mathematics. In other words, the definition of success, although implied when a student graduates from secondary school is given a broader responsibility in the context of this paper. I will be adopting a definition of success, as defined

by the Equity Principle, which I feel is sufficient enough to encourage Aboriginal students to choose mathematics related areas of study beyond that of secondary school. In other words, even though the students in my study have not graduated from high school, I will be working with them using the Equity Principle at every step, in the hopes that they will consider choosing mathematics beyond the passing grade allotted by the GED mathematics examinations. So simply, success in this study will be defined by students who make choices to continue enjoying the pursuit and/or application of mathematics in their endeavours, beyond the scope of this study.

Methodology and Method

In this section I provide a methodological context for the study, which includes my personal and cultural introduction; the research design and procedures I used to gather data for the study; and, the strategies I used to analyse the data. My personal and cultural introduction is relevant to this study because I am not Aboriginal by birth. While this study is cross-cultural research I am married to a status Indian who champions for Indian causes, have two status Indian children, three status Indian step-children, 10 status Indian grandchildren and 3 status Indian great-grandchildren. From teaching students in the Jane Finch “corridor” of the city of Toronto for ten years and attempting to help smooth the way for positive changes in my students’ lives, to my concentrated efforts in the Guy Paul Morin case in the mid ’80s to mid ’90s, social justice has always defined me. I retired from my teaching position in Toronto to move to this area to support my husband’s work. I have watched his struggle to debunk the stereotypical imagery of what it is to be an Indian, while at the same time empowering individuals to come to grips with their own identity. I have provided this support for the past 14 years. I feel that it is now time that I more directly support the voices of a people who are suffering from the effects of 500 years

of oppression, and I want to support them specifically in the area of giving voice to their mathematics experiences. I have read many articles about “Aboriginal ways of knowing” as a means of teaching mathematics that seem inconsistent with mathematics as a pure subject to which many cultures have contributed to over thousands of years (Rowlands & Carson, 2004).

My comprehension of First Nations issues has been developing for 15 years as I have become more aware of the suicides and abuses among a people who are not granted choices, or even the privilege under The Constitution of Canada, of being considered “persons” beyond that of a fiduciary agreement with the Federal Government. I have read articles written by Dr. Seth Agbo, a professor in the Education Faculty at Lakehead University, who, having gained deep and reflective knowledge in the history of colonialism in Africa, somehow managed to walk into First Nations communities and understand what has been happening to these people. How was this man able to pinpoint the real issues so quickly when the majority of his peers who have been studying Aboriginal issues for years in the north, cite “aboriginal ways of knowing” as the deep-seated areas of concern in Aboriginal education? I suspect from my discussions with him that what he sees in terms of colonial self-interest and interference in First Nations communities is a close match to what he had observed during the formative years of his life in Ghana. It is from this position that I go forward with my research.

In this thesis, I have researched the issues and underlying factors relating to the graduation rates of Aboriginal students from mathematics programs. Recent curriculum changes incorporating more Aboriginal content indicates that the provinces are acknowledging that there are problems and are acting on the recommendations of their studies into improving Aboriginal education outcomes (Ontario First Nations, Metis, and Inuit Education Policy Framework, 2007).

This research project took place with a group of people in a First Nations community. The research project commenced while the participants were struggling to overcome some of the same obstacles that resulted in their failure to graduate high school mathematics with their classmates. It was my hope that this setting would provide clear reminders as to the main impediments to their initial success which I, in turn, would be able to capture.

I was working with the participants of this study in a teaching/tutoring capacity for a period of time before the interview process would begin. I forged a rapport with every student in the General Educational Development (GED) program for pedagogical reasons and to provide an avenue for thoughtful reflections to take place. This delivered a prolonged period of engagement which was necessary to increase the credibility of the study. Forging this rapport built the trust that was necessary for the students to learn from me, and generated confidence in my graduate work. I strived to remain objective, although I gave all students as many opportunities for success as I was physically able. I picked them up from their homes and repeatedly offered to work with them when they came to Thunder Bay from my home in order to maximize their chances for success in the GED program.

Study Design

This study essentially took an ethnological case study approach incorporating interviews, observations and artifacts. In the process of considering my approach, I closely examined and considered both Grounded Theory and Hermeneutic phenomenology.

Hermeneutic phenomenology includes interpretation and understandings which are intertwined and represent evolving processes. This method was especially appealing to me because the lived experience is crucial for understanding the underlying factors of the

experiences of my participants toward mathematics. I saw my research as an attempt to understand the meaning of the lived experience of the participants in their particular phenomenon, and knew that I would need to address context specific questions that arose as the inquiry proceeded. Knowing that hermeneutic phenomenology assumes that human behaviour occurs within interactions to people, events, things and situations, and that the essence of the experience of the participants' relationship with mathematics is of utmost importance, I began to settle in my selection of a method (Crusius, 1991). I felt that it was essential to describe the participants' experiences as neutrally and as clearly as possible. In essence, the hermeneutic phenomenology "fit" to my research was tailored in all relevant aspects. Difficulties arose, however, when I realized that there were still characteristics, such as culture and emerging theories that needed to be addressed outside of this method. I directed my attention to the method of grounded theory to measure its applicability.

Grounded theory does not utilize a hypothesis to guide the study, so was different to the other methods I had considered (Morse & Richards, 2010). It emphasizes the generation of a theory derived from the data as its starting point. Grounded theory initially appealed to me because I was looking for a theory to emerge from my research. Employment of this method would require of me to put aside any budding hypothesis and concentrate on data collection from numerous sources. I knew that my key points would need to be coded, sorted into concepts from which categories would be formed and theories developed. It seemed to me that my question was "What is going on here?", hence grounded theory appeared applicable to my overall quest for underlying issues. Additionally, a typical grounded theory question of "What is the main problem of the participants and how are they trying to solve it?" seemed to embody the scope of

my research. I saw it as necessary to understand the subsequent process from these questions (Morse & Richards, 2010).

Given that “reality is negotiated between people, always changing and constantly evolving (Richards and Morse, 2010)”, I knew that I would need strong data to support comparison, reflection and probing and felt that I could provide it through artifacts, interviews and observations. I felt that it would be possible to construct theory grounded through the detailed and intimate exploration of this data. All that was missing was a cultural component and as much as the other methods held their attraction for my overall objectives, the cultural component could not be set aside for the sake of their appeal. I looked to ethnography in the hopes that it would satisfy all of my research’s critical requirements.

As culture accounts for many perceptions and the ways in which people view their worlds, ethnography is touted as best conducted by researchers who are not a part of either culture being compared, the etic (Richards & Morse, 2010). Viewing myself as ‘having one foot in both cultures,’ created a problem for me from the outset. Am I approaching my research from an emic (inside) perspective or that of an etic, or outside, perspective? As a non-aboriginal there is no doubt that I am outside of First Nation communities. However, being married to a status Indian and having children and grandchildren who are status Indians served to muddy the question of perspective. If I had married my husband before 1985, I would be a status Indian myself and belong to a First Nations community. Given that we married after 1985, Bill C31 revision of *The Indian Act* (1985) designated that I have no standing in the First Nations community of my husband and children. The issue was further complicated when I factored in the fact that my husband, a champion of Indian causes, reviews the essence of my work before it

is considered for submission. Did this place me in a position of an emic perspective? After much consideration I realized that whether my work emerged from an Aboriginal perspective was irrelevant in light of the fact that the First Nations community I was studying was different from that of my husband's and children's. I would be providing an etic perspective. I see it as important to provide this outside perspective because the education system of another culture is involved in the research. Richards and Morse (2010) discuss the importance of maintaining an etic position in all ethnography research but I do wonder if there are situations where ethnography would necessitate an inside perspective. According to McPherson and Rabb (2010), it is essential that Aboriginal peoples begin to research in their own communities to uncover disengaged philosophies among their own people. The authors discuss this research as necessary to bind together fragmentations of knowledge bases devastated by the dominant culture over the past 500 years. They contend that these missing links hold the key to the overall loss of identity among Aboriginal people.

Ethnography would require that I first access the community and then build trust with the participants. I would also need to elicit their cooperation and a degree of acceptance in the process. I was comfortable with these requirements and knew that I could follow through with the withdrawal stage (Isaac & Michael, 1995; Neuman, 2006; Richards & Morse, 2010) necessary as I neared the end of my project. As discussed by Richards and Morse (2010), ethnography would allow me to conduct interviews in a semi-structured manner, which appealed to me as did the pre-defined questions I felt were needed to define my data. I was also looking forward to using observation and artifacts to complete my data collection techniques (Neuman, 2006). Using ethnography, my research would be conducted in the natural setting of my

participants' learning environments. As such I would need to analyse my data based on cultural values, beliefs and behaviours of the participants (Richards and Morse, 2010). I decided I could live with a "thick description" as a result and that any emerging theories could be dealt with in a delineating study.

Focus

In an attempt to explore the reasons why Aboriginal students in Ontario are not succeeding in the area of mathematics, a small, purposeful homogeneous sample was chosen through a selection process largely determined by the community's Chief and Council (Neuman, 2006). The data collected in the early experiences of the participants' portion of the study was the responses to several semi-structured interviews, which addressed open-ended, pre-defined questions. Determining the focus for these interviews was important because it established the boundaries for the inquiry (Lincon & Guba, 1985).

Investigation of the reasons why the participants felt they did not succeed in their prior mathematics experiences was the focus and intent of the questions asked. The focus of the interview questions was also to invoke the participants' judgment on how they best learn their mathematics. The data focused on the commonalities of the first order interpretation of the developing, emerging and unfolding of data as outlined by Neuman (2006). Each interview lasted approximately 30 minutes and the location was mutually determined. The questions and the order in which the questions were asked were tailored to each participant (Neuman, 2006). Elaboration was encouraged in a conversational exchange with interview questions. Open-ended questions occurred with frequent probes. Both the participant and the interviewer controlled the actual length of the interview with the interviewer adjusting to the participant's use of language

and other norms. The social context of the interview was noted and documented and considered for interpretation of the data.

The participants' involvement in the GED program was examined and followed through observations and analysis of initial mathematics assessments that were given to provide a framework for the focus of the tutoring sessions and the subsequent emerging data. Attendance was tracked and varying aspects of mathematics development were noted over time. I prepared audio tapes following each one-and-a-half hour tutoring session to substitute for notes that I could not make while the sessions were underway. These audio-tapes were transcribed and coded using index cards.

Establishing Integrity

As Richards and Morse (2010) highlight, "any study is only as good as the researcher" (p. 190). Establishing reliability in qualitative research is critical for ensuring quality, credibility and rigor. Credibility is a major component for trust and confidence as is dependability and conformability. Isaac and Michael (1995) encapsulate Lincon and Guba's (1985) five techniques to ensure the credibility of a research project. The first is integrity of the researcher's observations, which is made up of three elements which can be found in "prolonged engagement, persistent observation, and triangulation" (Lincon & Guba, 1985, p. 301). Prolonged engagement must allow for the investment of adequate amounts of time for the building of trust and understanding of the culture involved. As I had established a strong rapport with all of the participants through their intense tutoring and teaching sessions, and have had many years to gain a comprehensive understanding of their lived culture, prolonged engagement is established.

Similarly, I had many hours of opportunity for persistent observation due to the time involved in the teaching and tutoring sessions.

Qualitative research is augmented through the use of observing different viewpoints through the process of triangulation for validity (Isaac & Michael, 1997; Lincon & Guba 1985, Neuman, 2006; Richards & Morse, 2007). For this research project, triangulation took place with analysis of the same artifacts between the primary and secondary study. Lincon and Guba (1985) also acknowledge that triangulation can take place through providing member checks; opportunities for verification of the interviews of transcripts and through opportunities to review the full draft of the paper.

Through triangulation, specific information that emerges as the study develops can be validated against at least one additional source. The source in the case of this study will be the participants themselves due to the self-reporting nature of the interview questions and artifacts. This will meet the criteria for the third integrity component for this research project.

Peer debriefing is the second technique delineated for credibility. It will, as outlined by Isaac and Michael (1997) commence with a small selection of graduate students after the initial interviews. Peer debriefing involved a disinterested colleague who, in playing devil's advocate, had the opportunity to explore my approach to identify its strengths and weaknesses.

The third credibility technique was met by negative case analysis. Negative case analysis is the process of "revisiting the hypothesis with hindsight" (Lincon & Guba, 1985, p. 309) to continuously revisit a hypothesis until all known cases are accounted for without exception. Negative case analysis was considered after the data was collected so that the opportunity for any contradictions to emerging patterns could be explored. Five of the interviews were audio taped

thus ensuring referential adequacy in the process. Carrying out referential adequacy will ensure the fourth criteria for credibility. It is my feeling that trust issues between past research and the community prevented the participants who opted out of audio-taping from feeling comfortable with being audio taped. For these six interviews, I took careful notes throughout the interview process. Neuman (2006) describes member validation, or member checks, as occurring when the interviewer takes the results back to the participants who are in turn, able to judge them for accuracy. Member checks validate the accuracy of the interviews to that of the results emerging from the interviews. Isaac and Michael (1997), refer to member checks as the most crucial technique for establishing credibility because it is the agreement of the participants on the validity of their data that is the basis for the entire study. I relied on my supervisor and thesis committee, in part, for dependability aspects of this research project to examine both the process and the emerging results repeatedly for any discrepancies and to audit and enhance the project's credibility. I also relied on my husband, an educator in Indigenous issues to scrutinize my analysis. Transferability or external validity criterion as outlined in Issac and Michael (1997) took place when the literature was compared to the study's findings.

Coding

When the interviews had been transcribed and member checks had taken place, data analysis using coding for themes or coding data commenced. I coded the data using index cards to search for common themes. Consistency was adhered to throughout the collection process and two categories emerged (Richards & Morse, 2007). Two categories also developed through the coding of the GED observations and assessment of the participants' initial evaluations. Data

analysis was shaped by my experiences of working with the students as well as the reading of the literature.

My coding of the data revealed themes from the lived experiences of the participants prior to their registration in the GED program, as well as themes that emerged from my observations of their successes and challenges while enrolled in the program. Four themes predominated: home-life, identity, trust and teaching and oppression. At the outset of my study, and after reading the literature, I predicted that home-life would emerge as a theme. After working with the participants for 3 ½ months, I also believed that teaching and oppression as a result of not being taught beyond grade 5 in mathematics would stand out as the major theme. Both of these themes proved to play a substantial role in the underlying factors that led up to the participants needing my tutoring services. The merging of the theme of home life into the larger theme of identity links to the literature. Struggles with identity also emerged as the major theme from participant interviews about their past experiences and from the on-going observations, communications and artifacts from the GED program itself. Identity issues dominated my study, while issues of trust linked the themes of both the interviews and the GED program. Home life predominated as a symptom of a disconnected identity throughout my study, including that of the GED program. Trust was the glue that bonded identity to academic achievement.

Participants

This research used a purposeful homogeneous sampling method as defined by Neuman (2006) where the cases are selected with a specific purpose for the study and are often used “to select members of a difficult-to-reach, specialized population (p. 222).” Isaac and Michael (1997) purport that homogeneous sampling can illuminate “major program evaluation

issues” (p. 224) by describing a category of individuals through an in-depth description of a particular subgroup. I investigated the interactions between myself and the participants as an “opportunity to be explored” (Lincoln & Guba, 1985, p. 101). This opportunity moves the inquiry beyond the constraints of objectivity into an area of objective subjectivity to help facilitate my ability as a researcher to see the forest along with the trees (Lincon & Guba, 1985).

The primary participant selection criteria was based on students who had been selected by the community Chief and Council, based on their requirement for mathematics education. All potential participants from the primary selection criterion had not graduated from secondary school. All participants were over the age of 21, are all are status Indians as defined by *The Indian Act* (1985). All primary participants reside in a First Nations community. As such, the participants were in a position to provide information on the research topic. It was my goal for the selection criterion of this research to facilitate rich information data that is the underpinning of excellent qualitative research.

During the interview process, I was working with the primary potential participants in a support capacity for the development of their mathematical understanding toward their General Education Development (GED) exam. I asked these students for their involvement in this research. The primary criterion for selection of the participants is that they all had requested upgrading in their mathematics from their current level.

It is these adult Aboriginal students themselves who were in the best position to determine what went wrong in their mathematics education and who are best able to work with educators to find solutions to facilitate change in the mathematics education of their children situated on a large lake 200 km north of a neighbouring city, the 1,189 residents of this First

Nations community reside on 3,940 hectares of lands held in reserve for Indians. Of this population, 400 are on-reserve residents (Aboriginal Affairs and Northern Development Canada, 2011). Band Council is made up of eleven councillors plus the Chief. In this community there are eighteen (18) community members working in programs supported by Health Canada, the Ministry of Community Services and the Union of Ontario Indians. The particular positions are one health representative, a referral clerk, two security guards, two transportation drivers, a Brighter Futures Programmer, a solvent abuse worker, an addictions councillor, a family support worker, a community wellness worker, a Building Healthy Communities worker, a community care nurse, four homemakers and one health director. The Band staff is funded by the Department of Aboriginal Affairs and Northern Development which includes a Band manager, a receptionist, an Operations Maintenance worker, an Education Councillor, a housing coordinator, a water plant operator, an Executive Assistant, two sanitary engineers, one principal, three teachers, one secretary at the school, a social assistance administrator, two cleaning staff, an economic development officer, two finance officers, and three police officers who are supervised by the Ontario Provincial Police (Band Councillor, 2011).

General Interview Questions

Upon review of the literature, and in conjunction with the issues and underlying factors relating to the graduation rates of Aboriginal students from mathematics programs, seven major themes were identified for my interview questions. I explored these through the answers to the following general guidelines.

1. Which schools were attended?
2. What were the experiences as related to mathematics in those schools?
3. What home and school supports were experienced?
4. What were the participants' relationship toward the math they were taught?
5. What are the participants' preferred methods of learning mathematics?
6. How will the passing of the GED mathematics examinations change the lives of the participants?
7. How does cultural/traditional relevance fit with the participants' learning of mathematics?

Having considered the general research questions and their connotations, specific questions were developed (see Appendix A) for the semi-structured interviews. These questions are intended to search the recollections and feelings of the participants' toward the prior learning of their mathematics.

Potential Limitations

It is expected that the size of the data set will be small due to the small number of participants. Consequently, generalizing the results beyond this group will not be possible although similar results may apply to similar groups of Aboriginal students seeking GED accreditation.

It is with the utmost caution that I approached trust issues as a lack of trust potentially limited the scope of the participants' answers to the interview questions and may well have impacted their learning. I considered that the building of trust was my major challenge for this project

because of the centuries of mistrust by First Nations people toward the dominant culture I felt that it was important that each participant was able to come to some understanding that I cared deeply about their learning and about their individual worlds. I had faith in my ability to convey this because I do care deeply and felt that this was detectable in my biography, teaching style and through individual conversations.

Background Information

The deliberations of the National Council of Teachers of Mathematics (NCTM), a North American professional organization dedicated to the on-going improvement of mathematics pedagogy and assessment, guides the development of standards for mathematics teachers and policymakers in the United States and Canada (see NCTM, 2000). In Ontario, these standards are reflected in the most recent iteration of the mathematics curriculum, *The Ontario Curriculum Grades 1-8: Mathematics* (Ministry of Education, Ontario, 2005). The Ontario document incorporates the NCTM vision of all students having the opportunity to learn mathematics regardless of their particular skill sets at any given time. The NCTM embraces six principles for school mathematics including the equity principle which offers all students “access to an excellent and equitable mathematics program that provides solid support for their learning and is responsive to their prior knowledge, intellectual strengths, and personal interests” (Principles and Standards for School Mathematics, 2000, p. 12). This research project explored whether the principles set down by the NCTM are being experienced by the students of one First Nations community in their elementary and secondary schools.

The GED program involved a Coordinator who stayed with the students between the hours of 9:00 a.m. to 4:00 p.m. She worked under the guidance of the Director, who supplied the

classroom with all materials necessary for the students to meet with success. The Coordinator tracked attendance, communicated the students' needs to the Director, made photocopies and sent and received faxes.

Literature Review

The first literature review is an exploration into present knowledge available on how provincial schools are setting the stage for success of all students including those of Aboriginal descent who transfer from First Nations schools to provincial schools at different stages of mathematical understanding. As it may be the case that many at-risk students contend with oppression issues outside of the school environment to varying degrees, and therefore may be particularly sensitive to oppressive teaching pedagogies the second literature review will examine the effects of teacher-directed learning that is predominant in public schools across Canada. Do students experience a degree of oppression when subjected to large amounts of teacher-directed learning? Are students who are experiencing extensive oppression outside of school being “pushed out” of the system because of their inability to be subjected to oppressive styles of pedagogy inside of the school environment? Finally, in order to provide direction with which to proceed in the future, the third literature review will attempt to investigate whether Aboriginals should be considering developing and delivering their own mathematics programs in order to address the drop-out rates examined above (Auditor-General of Canada, 2010; Banff International Research Station for Mathematical Innovation and Discovery, 2009). These inter-related issues form the basis of the three literature reviews that follow.

Are Mathematics Classrooms Setting the Stage for Success of all of their Students?

The 1989 release of the standards documents for curriculum, teaching, and assessment, *Principles and Standards for School Mathematics* focused strategies for success in mathematics for all students in the United States, approaches which had been adopted by the Ontario mathematics curriculum. The NCTM vision includes all students having the opportunity to learn mathematics regardless of their particular skill sets at any given time. As mentioned above, NCTM embraces the equity principle which delivers all students with “access to an excellent and equitable mathematics program that provides solid support for their learning and is responsive to their prior knowledge, intellectual strengths, and personal interests” (Principles and Standards for School Mathematics, 2000, p. 12).

Using this NCTM principle, I will attempt to explore what the literature has to say about whether mathematics classrooms in Ontario are setting the stage for the success of all of their students. The following sections summarize the literature that speaks to early education, culture, hidden curriculum, classroom practices, at-risk students and suggests areas that might be in need of systemic growth including greater numbers of educational assistants and increased support for teacher training and teacher professional learning in the area of reform mathematics.

Students who master the fundamentals of mathematics in the early grades are most likely to meet with success in secondary school (Education Quality and Accountability Office, 2010; Expert Panel on Student Success in Ontario, 2004). The Expert Panel revealed that students who struggle in later grades typically have not met provincial curriculum guidelines early in their math education. According to the Expert Panel, identifying and providing timely support is a crucial cornerstone for success in mathematics.

The Expert Panel asserts that identifying at-risk students early, and providing on-going support, is key to students' mathematics success (Expert Panel on Student Success in Ontario, 2004). The Expert Panel defines at-risk students as being "at risk of leaving high school without the mathematics skills and understanding they need to reach their full potential in the twenty-first century" (p. 9). According to Kajander, Zuke and Walton (2008), at-risk students, in particular, need to understand basic mathematical concepts before they are able to put them into practice (p. 1042). Understanding basic concepts is a complicated requirement, for both students and teachers. Conceptually-based mathematics requires deeper understanding than procedure-based mathematics; raising the province's expectations for teachers' comprehension of the mathematics they are teaching (Expert Panel on Student Success in Ontario, 2004). If teachers do not understand their mathematics well enough to teach conceptually-based mathematics it may be the students who experience a difference between the culture they are living in their homes and the culture they are experiencing at school that end up dropping out.

There is an increasing recognition of the significance of culture in understanding the preponderance of students who are "at risk of leaving high school without the mathematics skills and understanding they need to reach their full potential" (McPherson & Rabb, 2011; Principles and Standards for School Mathematics, 2000, p. 12; Rushowy & Brown, 2010).

The Canadian Auditor-General highlights concerns for Aboriginal students who are often at-risk in their studies. In her 2010 report she describes that Aboriginal students are lagging 28 years behind mainstream society (Auditor General of Canada, 2010). According to the report, this education gap refers to the proportion of Aboriginal people living on reserves with at least a high school diploma, compared with the proportion in the overall Canadian population.

The Auditor-General's report is supported by the Banff International Research Station for Mathematical Innovation and Discovery web report that notes that by grade four, Aboriginal students lag behind mainstream students by about 20 percent on their numeracy performances (Banff International Research Station for Mathematical Innovation and Discovery, 2009). The Banff study reports that by grade ten the gap is larger, with 47 percent of Aboriginal students performing at grade level in numeracy compared to 77 percent of mainstream students (Banff International Research Station for Mathematical Innovation and Discovery, 2009). In the same period, it was found that only 38 percent of Aboriginal students graduated from grade 12 as compared to their non-Aboriginal counterparts (Banff International Research Station for Mathematical Innovation and Discovery, 2009). In Ontario, this number is higher with 42 percent of Aboriginals failing to complete high school (Mendelson, 2006, p. 23).

Echoing the Auditor-General, Deyhle and Swisher (2007) found that the dropout rate of Aboriginals from schools in the United States is two times the national average (Deyhle & Swisher, 2007). Deyhle and Swisher found that a further forty percent of Aboriginal dropouts from United States publicly-funded schools complained that their image of their school experience was cold and unrewarding (p. 130). McPherson and Rabb (2011) argue that as long as students view themselves as the predominant culture sees them, not as who they really are, an optimum learning environment cannot exist in any subject. Similarly, Dei argues that "the current (dominant culture) school system looks at the world through European eyes. We're talking about looking at the world through the eyes of African peoples – their experiences, their cultural knowledge and their history" (University of Toronto Magazine, 2010).

John Dewey (1897), long influential in educational reform policies, maintained that the environment of the classroom should closely match that of the home. Dei (2003), one of Canada's top researchers on black school achievement, questions how that match can take place while teachers and schools are not acknowledging ethnic differences in classrooms. Dei maintains that unless schools are inclusive in their approach to the teaching of all students, many such students will continue to be “pushed” out of the system. He expresses concern that educators often place blame on the support systems of homes and families without ever attempting to understand how the cultural differences between families and schools play out in their classrooms.

According to Dei (2003), the population of racialized students including Afrocentric, Chinese, Indo-Pakistanis, West Asians, Arabs, Latin Americans, other Asians, Filipinos, and Pacific Islanders grew by 58 percent between 1986 and 1991 across Canada, where the rest of the population grew only 9 percent. Further, Dei (2003) found that forty-nine percent of this group lives in Ontario. He estimates that over 40 percent of all high school students in Toronto have a first language that is not English and that these students were born in approximately 174 countries outside of Canada (Dei, 2003). Within Ontario, students speak over 70 different languages at home. Dei examines how teachers, fearing vilification for racism, avoid all mention of the ethnic backgrounds in their classrooms rather than celebrate the obvious diversities that exist (Dei, 2003). As reported in the University of Toronto Magazine, “A 1993 report on the old Toronto school board found that the graduation rates for black students was 44 percent and the dropout rate 42 percent. Comparable figures for white students were 59 percent and 31 percent respectively. This appalling situation is no different today” (University of Toronto Magazine,

2009). The magazine went on to report that the drop-out rate of Black teens became so alarming for educators that, on January 30, 2008, Canada's largest school board voted 11-9 to open an alternative Afrocentric school to help combat the dropout rate of Black teens. Dei (2003) calls the idea of an experimental black-focused school in Toronto long overdue. The statistics alone are indicating that the "solid support" aspect of the Equity Principle of the NTCM document is not being provided with Blacks and Aboriginals within Ontario. How might the system position itself to better support all of its students?

Agbo (2001) points to the hidden curriculum that must be addressed if educators hope to improve the system for all students. He argues that students of ethnic minorities are crucially impacted by the culture of the learning process, often attempting to assimilate them by superseding their languages and cultures. McLaren (2002) defines the hidden curriculum as "the unintended outcomes of the schooling process" (p. 212) which more often than not, stands in the way of success for racial minorities and the poor. McLaren sees the hidden curriculum as referring to the kinds of learning students derive from the very atmosphere and organizational design of the school and classrooms, as well as from the attitudes and behaviours of teachers and administrators. According to Agbo (2001), Western education has been responsible for promoting 'hidden' behaviours and values that harm Aboriginal students. He implies that the hidden curriculum sets up Aboriginal students to be viewed as failures and argues that students fail when they are viewed as failures. Agbo (2002) suggests that the self-centred worldview of Western education is damaging to the epistemology of Aboriginal students.

Deyhle and Swisher (1997) contend that narrow-minded attitudes, lack of awareness and prejudiced views have revealed that teachers share in the problem of "Indian (Aboriginal) ... at-

risk educational failure” (p. 115). They had two findings relevant to this literature review. First, they found that almost 40 percent of Indian students who dropped out of school stated their teachers did not care about them and did not assist them enough with their assignments. Indian students in the study complained that they were learning the same things over and over. Second, students perceived that being Indian meant that teachers did not expect anything from them, hence slotting them into a general education with no encouragement for post-secondary bound classes. Deyhle and Swisher report that many of the students in the study dropped out of high school. Similarly Kajander, Zuke and Walton (2008) found in Northwestern Ontario that all students in their study were reluctant to ask questions, that teachers were not making homework checks and procedural work was not being accompanied by conceptual understanding (p. 1051). The Ontario literature on classroom practices suggests that not all students have “access to an excellent and equitable mathematics program that provides solid support for their learning and is responsive to their prior knowledge, intellectual strengths, and personal interests” as outlined in the NTCM documents (NTCM, 2000). A result of this lack of access is that many students are at-risk.

According to Kajander and Zuke (2007), at-risk students are unmotivated and often lack meaningful levels of participation in the classroom. They say that students are still floundering in conceptually-based mathematics classrooms despite the focus on curriculum reform guidelines set out in *The Ontario Curriculum Grades 1-8: Mathematics* (2005). Further, Kajander, Zuke and Walton (2008) determined that teachers were abandoning conceptually-based mathematics because of the perceived challenges involved in implementing it in the classroom. They found that substantially more professional development to support conceptually-based learning is

needed to reflect the mathematics standard-based curriculum changes in classrooms across Ontario. Stigler and Hiebert (1999) support this contention and comment on the difficulties of attempting to teach conceptually based mathematics where our cultural “scripts” (p. 101) are ignored. The authors contend that we have been attempting to implement changes to the way we teach mathematics as if mathematics were a “non-cultural activity” (p. 101) by enhancing teachers’ manuals, demonstrating more effective teaching pedagogies and providing recommendations. They argue that improvement to our “cultural scripts” (p. 101) for our teaching is what we need to focus on to improve teaching for the long term. Similarly, they recognize that improvements to teaching by altering the cultures within schools must occur in small increments because cultures cannot be changed hurriedly or radically.

Deyhle and Swisher (1997) suggest that teachers need to engage in meaningful professional development that includes the experiences they are living in their classrooms such as mentoring, observation and content instruction. They go on to say that teachers need time to do this as well as to prepare for their classes. Stigler and Hiebert (1999) agree and argue that professional development should focus on collaborating with other teachers to develop high quality, well-tested lesson plans for all teachers to provide input into and to access. They stress that for the teaching culture to change on a national level, the lesson plans that are developed need to be shared with other schools and districts and must be improved slowly, over time.

The literature reveals implications for concern in regards to accessing quality mathematics education for all students as outlined in the guidelines set down by NCTM (Agbo, 2002; Agbo, 2001; Auditor General of Canada 2010; Dei, 2003; Deyhle & Swisher, 2007; Education Quality and Accountability Office, 2010; Kajander, Zuke & Walton, 2008; McLaren, 2002; Stigler &

Hiebert, 1999). The Auditor General of Canada's 2010 study underscores concerns about the proportion of Aboriginals living on reserves, who have not met the requirements for a high school diploma as compared to the rest of the country. Dei's (2003) findings revealed that even though the percentage increase of the racialized population as compared to the rest of the population has experienced substantial growth, schools within Ontario are not adjusting to accommodate these increases. Agbo (2001, 2002) and McClaren (2002) place responsibility for such failures to accommodate racial minority students on the shoulders of the hidden curriculum. The Expert Panel on Student Success (2004) and the Education Quality and Accountability Office (2010) reports reveal that students who struggle in later grades have not met provincial guidelines early in their mathematics education. Kajander, Zuke and Walton (2008) further found that at-risk students in particular need to understand basic mathematics concepts. These findings may indicate that many teachers at the elementary level may not be adhering to the 2005 Ontario Curriculum changes that address the importance of teaching to these concepts.

The literature in this review implies that the NCTM Equity Principle of "access to an excellent and equitable mathematics program that provides solid support for their (student) learning and is responsive to their (student) prior knowledge, intellectual strengths, and personal interests" (NCTM, 2000, p.12), may not be fully implemented at the present time in Ontario for all students.

Are teacher-directed methods of teaching mathematics contributing to the oppression that affects the learning of some students?

Many discussions have taken place among educators over the last decade and a half examining the effectiveness of elementary education within Canada, particularly in the areas of

literacy and numeracy. My goal for this literature review is to explore whether the teacher-directed approach to teaching mathematics which continues to predominate in our classrooms, despite major provincial curriculum over-hauls, oppresses the students it is meant to educate. This goal includes examination of cultural links within the system which may be playing out inside of our classrooms. It is anticipated that close scrutiny of these cultural factors will reveal issues and underlying factors that influence the graduation rates of Aboriginal students from mathematics programs.

Freire's (2003) definition of oppressed people includes "persons who have been ... deprived of their voice ... not able to transcend himself or herself, if one were not able to perceive reality and understand it in order to transform it" (p. 35). Freire (2003) raised a red flag about teacher-directed education and has long written about our responsibility to do more than to 'fill' (p. 55) students with the contents of lectures. He talked about teacher-directed education in terms of the 'banking' (p. 55) concept of education, which describes student responsibilities in regards to the storing, receiving and filing of deposits but that in the process, it is the students themselves that are being filed away (Freire, 2003). Freire professes that oppression results from traditional teacher-directed 'banking' forms of education.

I explored what the literature has to say about whether teacher-directed methods of teaching mathematics are contributing to the oppression that affects the learning of some students, and investigated the potential oppressive tendencies of teacher-directed teaching. The literature includes ideas on praxes that influence schools, classrooms, practices, cultural disconnects and addressing of oppression directly.

Intrigued by the outcome of several studies emerging in the late 1970s out of England and France that were revealing inconsistent educational experiences for different social class backgrounds, Anyon (1980) decided to conduct her own study in the United States. Her study took place in New Jersey in the late 1970s and compared the teaching styles and the overall pedagogical practices of several schools serving “working class”, “middle class”, “affluent” and “executive elite” neighbourhoods (pp. 211-212). In the working class model, the students were taught steeped in mechanical, rote procedure with very little decision making or choice (Anyon, 1980). Anyon found that the teachers rarely explained why the work was being assigned, how it might connect to other assignments, or what the ideas are that lie behind the procedure. She discovered that the work was easy, everything in the class belonged to the teacher, and the children were told to “shut up” or “shut your mouth” (Anyon, 1980, p. 215). In the middle class schools, Anyon found that the work was about getting the right answer, math involved some choice and children were encouraged to explain how they did the problem. She explained that quiz and test questions were set up to check whether homework was done and that the work lacked creativity and was largely text-book based (Anyon, 1980). Anyon (1980) documented that students were encouraged to work hard to get into a good college or to get a good job. She argued that in affluent schools, principals instructed teachers to “be creative” (p. 219). Anyon (1980) claimed that work was carried out independently, good design was deemed important and connections to reality were important. She found that there was more creativity and more breaking up of routine with almost daily presentations by students. In executive elite schools, Anyon (1980) found that children derived formulas for mathematics, there was far less right and wrong but instead students agreed or disagreed. Anyon (1980) explains that questions asking for

concepts were encouraged and students were told that they were the drivers of their cars, that they must decide and regulate their own speed. Were students from executive neighbourhoods being taught to be in control of their own realities? Teachers were polite to students. Students themselves prepared and taught lessons, with controlling class behaviour being part of their assignments (Anyon, 1980). The results of the Anyon study seem to indicate that it was more important in the 1970s in New Jersey for students of affluent neighbourhoods to ‘find their voice’ and be the drivers of their experiences than it was for the students of working class neighbourhoods. The study implies that the latter group was being taught to accept being ‘deprived of their voice’ through larger proportions of teacher-directed learning and they were being done so deliberately.

Despite the fact that the Anyon study was conducted forty years ago and the Ontario curriculum has since been overhauled to de-emphasize teacher-directed learning in mathematics, Kajander and Zuke (2007) argue that teaching in some regions remains “highly traditional, procedural, and teacher-directed” (p. 92). Indeed Anyon’s working class students were provided with the most teacher-directed pedagogies of her groupings.

In Freire’s (2009) analysis, education is either an instrument that is used to provide the assimilation of generations into the present system and bring about conformity to it, or it is the “practice of freedom”, the means by which people think critically about their reality and actively engage in the transformation of their world (Freire, 2003, cover). Freire’s thoughts on pedagogies of oppression suggest that teacher-directed learning on its own is an instrument of assimilation and the more conceptually-based teaching, as outlined in the Ontario Curriculum Grades 1-8: Mathematics (Ministry of Education, Ontario, 2005) is the practice of freedom.

Freire would perceive an education void of conceptual understanding and student engagement as a “banking system of education” (p. 55) and therefore a tool of oppression affecting all students in its wake including at-risk students.

Kajander and Zuke conclude in their 2007 Northern Ontario Education Leaders (NOEL) Lakehead Education Research Report that teacher-directed mathematics classrooms do not meet the needs of at-risk students. According to Kajander and Zuke, at-risk students, who are often unable to focus for long periods of time, require more assistance from the teacher. This may result in teachers providing even more teacher-directed instruction. Boredom and frustration may manifest itself in negative or disruptive classroom behaviour as a result. Kajander (2007) reports that long-term procedural practice void of comprehension is not effective. Stigler and Hiebert (2004) support this, clearly demonstrating that those elementary schools in six countries that emphasized conceptual understanding in the classroom had higher achievements in mathematics. Further, Kajander maintains that when tests emphasizing procedural fluency take priority in assessment procedures, students are not provided with adequate opportunities to show what they know about the given topic area (Kajander, 2007). Again, Freire would deem these forms of evaluations to be oppressive citing that the students are being “depraved of their voice” (Freire, 2003 p. 35) in their assessments. Dei, (2003) further argues that we need to give merit to the contrasting knowledge and perspectives that every student from all corners of the globe brings to the classroom.

Dei recognizes that acknowledging histories, knowledge and experiences sets students up for engagement and permits them to develop an identity within the school, a sense of entitlement to their learning and a feeling of belonging. Freire (2003) argues that such inclusion promotes the

freedom of thought necessary to transcend realities. Dei (2003) maintains that classrooms without engagement result in students who have a physical presence but whose minds and souls remain elsewhere, eventually dropping out of school altogether. McClaren (2002) sums up his experiences of teaching in the Jane/Finch corridor in Toronto as; “the full horror of the situation struck me only when I realized that my students were essentially spitting in the eye of a ruling ideology, and in many ways I represented that eye” (p.xxxiii).

Lunney (2010) who lived among, and taught mathematics to the Mi’Kmaq people while writing her dissertation, states that mathematics is steeped in cultural values. She says that Eurocentric values continue to be perpetuated in classrooms through the current provincial curriculum itself. Lunney began to use verbs to replace nouns to represent the motion she felt helps to define mathematics. She documented a positive relationship between her use of verbs and the success of her math students. Lunney admits, however that despite her best efforts to encourage and support the students with whom she worked to pursue post-secondary mathematics and sciences studies, they did not make those choices and that many of her students continued to struggle with the higher levels of mathematics. If teachers in Ontario are emphasizing more conceptually-based engaging teaching as outlined in the provincial curriculum and initiated in the standards set forth by the National Council of Teachers of Mathematics (2000), could the issues raised by Lunney and Dei be resolved?

Perhaps not, suggests Kajander when analysing her 2003 case study of a First Nations student. Kajander (2003) suggests that given the specific cultural differences between mainstream Canadian society and First Nations, math reform as outlined in the curriculum might be culturally inappropriate. Further, the study underscores that the learning of conceptually-

based mathematics for some students requires the examination of their relationship with their cultures. For example, the First Nations student in the study was asked to explain and defend her ideas and thinking as well as question the thinking of others. Kajander found that this appeared to create a problem for the student given that an oral defence is expected in a conceptually-based classroom and defending one's position was inappropriate, according to the student, in her cultural upbringing. This raises a question of how strongly this student's upbringing and culture have been influenced by the church run residential schools.

Carson and Rowlands (2004) argue that it is problematic that mathematics has historically been used as a tool of oppression with First Nations people in Canada. They suggest that it is difficult for oppressed peoples to separate their memories of lived oppression from the tools which oppress them. Carson and Rowlands (2004) further suggest that formalized mathematics might be viewed much more favourably by First Nations people if initial European political, cultural and economic contact had been steeped in mutual sharing and respect. This dilemma may place a responsibility on mathematics educators in Canada to avoid engaging in pedagogies which would continue the oppressive measures to which Aboriginals have historically been subjected (Jenkins, 2004). Jenkins (2004) argues that these oppressive measures include stereotypical imagery such as dream catchers or medicine wheels used to represent mathematical concepts. Gustin (2008) argues that his teaching methods can actually ameliorate such oppressive measures.

Studies that examine the teaching of at-risk students over a short period of time may be limited in their ability to expose some of the less obvious drivers of the oppressive characteristics of teacher-directed learning, as discussed above. For a multidimensional look at comparative

mathematical teaching methods, it is useful to examine how seasoned educators are reaching out to meet the needs of students who experience oppression outside of their school environments. Gustein (2008) finds little use for teacher-directed learning in the classrooms of his predominantly at-risk student population. He uses mathematics lessons that utilize value driven problems to reach at-risk students who are often confronting, what are to them, all-consuming social problems in their daily lives (Gustein, 2008). For Gutstein, who has taught at-risk students for 14 years, the development of solid cultural and social identities is essential in order for at-risk students to cultivate the freedom to be who they are. Gustein (2008) contends that value-driven mathematics should be used to fight injustice and improve society. He routinely has his students investigate social issues such as using mathematics to look at statistics involving police operations within the community through the collection and analysis of data (Gustein, 2008). Perhaps when adolescent students who have long been oppressed outside of the school who either remove their cooperation inside of the classroom or drop out of school altogether are sending their educators a message that they are not able to realize any more oppression in their lives. Educators may also be noticing that this agitation plays out in the shutdown of the student's ability to continue learning under such conditions.

Overall, the literature indicates a variety of potential issues needing to be addressed when considering the impact of teacher-directed learning as a prime oppressor in the classroom. By all accounts however, the literature does reveal that classrooms that are focused on procedural learning with minimal conceptual connections, fall into Freire's (2003) "banking system" (p. 55) of education, a system that is held up as central to Freire's very definition of oppression. Teacher-directed learning, on its own, may fall into that definition. Stigler and Hiebert (2004)

suggest that teacher-directed learning in combination with conceptually-based connections involving student engagement, however, might meet the level of conceptual comprehension necessary to raise student achievement to optimum levels. Crusius (1991) argues that the deeper comprehension of mathematical concepts emerging from these connections, in combination, may strengthen students' relationship with their own learning, ordinarily experienced through philosophical hermeneutics. Kajander and Zuke (2007) and Kajander (2007) both indicate that long term procedural-based learning void of deep comprehension often leads to monotony. They suggest that such teaching methodologies were ineffective as a result. Similarly, Gustein found that in some cases, procedural methods caused students to act-out, indicating a demand for another form of instruction. Gustein (2008) found that students, who tended to act out due to the various aspects involved in being at-risk students in the first place, were further engaged when more creative teaching styles were implemented. Gustein's approach addresses Carson and Rowland's concern that mathematics has been historically used as an oppressive weapon to colonize the New World by applying mathematics in a way which deliberately attempts to improve the lived experiences of its students. However, it may not fall on the backs of educators to take on the responsibility for moving students out of the oppression they experience outside of their school environment, regardless of how those effects play out in the classroom. As Freire (2003) points out, the oppressed must engage in their own struggle for empowerment.

In going forward I will explore what the literature has to say in regard to whether Aboriginal peoples should be developing their own mathematics programs while taking the question of identity into consideration.

Should Aboriginals be developing and delivering their own mathematics programs?

John Dewey's (1897) vision of a close cultural match between home and school has resulted in a match between the schools and the hegemonic cultures of western society, not those deprived of socio-cultural benefits (At-Risk Students, N.D). As a result, racialized groups generally realize the least value from the predominant provincial educational systems in Canada (Auditor General of Canada, 2010; Banff International Research Station for Mathematical Innovation and Discovery, 2009). In this literature review, I will explore what the literature suggests about Canadian Aboriginals developing their own mathematics programs. I will look to the literature to define what the problem(s) are, whether provincial schools are in a position to acknowledge and address those problem(s), and whether First Nations communities are capable of delivering mathematics programs which are likely to facilitate student success. The National Council of Teachers of Mathematics (NCTM), an international professional organization dedicated to on-going improvement of mathematics pedagogy and assessment, establishes the standards for mathematics teachers and policymakers in the United States and Canada (NCTM, 2000). NCTM embraces six principles for school mathematics including the Equity Principle which recommends all students should have "access to an excellent and equitable mathematics program that provides solid support for their learning and is responsive to their prior knowledge, intellectual strengths, and personal interests" (NCTM, 2000, p. 12). I have reflected deeply on the question of equity throughout my years of teaching and wondered if it is a key to the success of all educational endeavours by all students. I have explored the cultural aspects of this question of educational equity through my teaching experiences, and wonder if perhaps there are answers to some of the issues of Aboriginal education by pursuing this line of thought. Aboriginal

student needs include reducing the gap in student achievement for numeracy and literacy skills (Ontario First Nations, Métis, and Inuit Education Policy Framework, 2007, p. 14). If we imagine for a moment that all of the Aboriginal student needs that the provinces are presently attempting to address were miraculously met by a provincial system, would the provinces be setting the stage for success for Aboriginal students in mathematics?

McPherson and Rabb (2010) say no, when they express concern that the main difficulty with Aboriginal learning is a question of identity or lack thereof. They argue that within provincial schools, Aboriginal students are subjected to an ‘outside view predicate’ where they see themselves as the predominant culture sees them, not as who they really are. Without a solid sense of personal identity, McPherson and Rabb (2010) argue, this is a recipe for cultural disaster. They suggest that First Nations communities need to engage in much more community-based research to tie together the missing links that colonial interests have severed through governmental “divide and conquer” policies such as assimilation, experiences in residential schooling and the removal of thousands of Aboriginal children from their communities during the “sixties scoop” (McPherson & Rabb, 2010; Alston-O’Connor, 2010). As a result, Aboriginals are people whose minds have been deliberately rendered dysfunctional (Chrisjohn, 1997). McPherson and Rabb (2010) and Adams (2010) argue that at the present time, Aboriginals are people without an identity of their own, and that this contributes to difficulties with learning.

In going forward I will explore what the literature has to say in regard to whether Aboriginal peoples should be developing their own mathematics programs while taking the question of identity into consideration.

Why are Aboriginal students avoiding the pursuit of mathematics-related university and college programs (Eggertson, 2004)? A study at the University of Alberta indicates that the research is clear in its conclusion that schools that work well for every student also should work well for those students who are labelled at-risk (At Risk Students, N.D.). This report found that direct one-on-one teaching is an effective method for the teaching of mathematics to at-risk students in provincial schools but that it is not known whether the relationship with the student or helping the student with content is important to success (At Risk Students, N.D.). The report acknowledges that both factors are at play.

In their recent book, Widdowson and Howard (2008) cite examples of improvements in a First Nations run school, noting that “these improvements were not made by instituting ‘culturally sensitive’ programs, but through a focus on ... academics, and objective assignments” (Widdowson & Howard, 2008, p. 259). They found that prior to these improvements the students had no demands placed on them and were “out of control.” As a consequence, they found that the students expressed feelings of failure, rather than developing a strong sense of self-esteem. It was also reported that the principal and her staff largely used careful implementation of Euro-centric educational methods to dramatically improve the educational achievement within the school. Despite success stories such as that outlined by Widdowson and Howard, perhaps modes of thought influenced by culture need to be considered.

Educators that are debating with one another for and against the support of ethno-mathematics are working to find appropriate solutions for Aboriginal learners of mathematics (Rowlands & Carson, 2004). These authors describe ethno-mathematics as mathematics that “engages the teacher in a side of the mathematical conversation that opens up a route of access to

the child's own unique modes of thought, both personal and cultural" (p. 336). They express concerns about throwing the 'baby out with the bath water' when considering that cultures have contributed to the rich library of developed mathematics over thousands of years. They go on to say that formalized mathematics in its own right is "one of the greatest achievements of the human mind" (p. 331) and a critical key to both happiness and material wealth. Further, they emphasize the intellectual aspect of mathematics as fundamental for all civilizations because it draws students into its beauty. Rowlands and Carson (2004) argue that conceptually-based mathematics opens doors and lets more students in on this appreciation potentially guiding student interest toward pursuit of math related subjects in the process.

Gustein (2008) disagrees with Widdowson and Howard (2008) when he suggests that students need to see themselves as capable of changing the world. At the same time, Gustein also argues that development of the social and political underpinnings of society requires a deep understanding of mathematics and its practical applications. He suggests this is especially true for at-risk students who are often dealing with what they view as all-consuming social issues. As a teacher of at-risk students for many years, Gustein suggests that developing solid cultural and social identities is essential in order for at-risk students to develop the freedom to be who they are. Further, he goes on to say that value driven mathematics should be used to fight injustice and improve society. He routinely uses mathematics in the classroom to reveal social inequalities such as those that occurred in the aftermath of Hurricane Katrina. To illustrate this Gustein says that mathematics was used to discover who suffered most in the tragedy and why. He had his students look at pictures of all the racialized people who had nowhere to stay but the "Superdome." The students were then asked if that meant that only African Americans lived in

New Orleans, and other similar questions. He goes on to argue that the mathematics required interpretation of a complicated graph. Rather than the current standard math problem approaches, Gutstein (2008) would like to see 85% to 90% of mathematics programs dominated by social justice where students examine their social realities. The Gustein study may be in disagreement with Rowlands and Carson's argument for teaching to an appreciation of formalized mathematics. Nelson-Barber and Estrin (2001) argue that although the NCTM standards documents give significance to the linking of students' concepts to that of their existing knowledge and experience, what is missing is a philosophical, historical and cultural framework that might put these standards documents into perspective. Perhaps the promotion of mathematics for Aboriginal people is not entirely prescribed in the current curricular documents.

Lunney (2010) argues that language matters when teaching mathematics to Mi'Kmaq students. Lunney explains that mathematics should be taught in a verb centred context. She contends that educators should approach the teaching of mathematics with language that encourages fluid and dynamic learning because so much of mathematics happens in the doing. Lunney further sees Mi'Kmaq students as "English Immersion" students. She argues that language disconnects create barriers and result in confusion for Aboriginal students. For example, she cites that the words "flat and middle" are non-existent in Mi'Kmaq and that words are conjugated depending on their usage. Gee (2004) supports Lunney's argument for concentrating on language when he advocates that "words and phrases in any social language ... have not only relatively general meanings (which basically define their meaning potential), but situated meanings as well" (p. 24). Lunney continues by arguing that educators should be concentrating on the process of mathematics rather than the product. Lunney reports success in

graduating students with strong mathematical skills but admits that a full transfer of education to Aboriginal people would affect each band differently.

Rodriguez and Kitchen (2005) argue that implementation of Lunney's (2010) and/or Gustin's (2010) visions of mathematics would be problematic for many teachers. Central to the overall effective mathematics education of students is the reluctance of teachers to engage in teaching that is different from their own learning. Further, Rodriguez and Kitchen (2005) argue that despite the fact that teachers advocate for the goals of education, they often tend to resist comprehensive learning which makes use of pedagogies that are socially relevant. Rodriguez and Kitchen (2005) support teachers' use of authentic activities, dialogic conversations, metacognition and reflexivity as a means of putting theory into practice. They argue that teachers should be engaging in activities that facilitate deep reflection of their practices, beliefs and social norms. They further discuss the personal assumptions they view as needing to be examined through dialogue and metacognition - metacognition that should be used to inspect teaching practices through culturally appropriate positions. This appears to counter Rowlands and Carson's position of teaching to the appreciation of formal mathematics. Rodriguez and Kitchen (2005) continue when they argue for teacher reflexivity, which examines how our cultural beliefs and experiences impact on how and what we think we need to teach. They claim that reflexivity in the professional development of teachers is necessary to increase the self-efficacy needed to embrace a new path for their pedagogies.

Kajander, et al. (2010) argue that Aboriginals have reason to be suspicious of what they are being taught and this plays out in their learning of mathematics. The authors further suggest that if Aboriginal students are experiencing difficulties inside or outside of the school environment,

these trust issues will play out in their ability to learn. Conceptually-based mathematics as currently embraced by the provincial curriculum may not only let students in on the ‘beauty of mathematics’, it might also offer solutions that accelerate their ability to absorb math content by offering “proof” for each concept with which the student is presented. In offering this proof, conceptually-based mathematics may be in a position to address underlying trust issues that might otherwise prevent students from being able to work with particular concepts. The authors support teaching of teachers to concentrate on experiences and understandings rather than the content that students need to receive. Further, Turner and Lapin (2002) contend that the role of parents is intertwined with the role of educators and that educators need to recognize that both play support roles in the guiding and instruction of students. Widdowson and Howard (2008) argue that students who are not stimulated outside of their classrooms are less able to engage in learning experiences in general.

Widdowson and Howard (2008) claim that many Aboriginal students come to the classroom less prepared than their mainstream counterparts because they are under-stimulated in their home environments. Further, they argue that lack of stimulation does not prepare them for the educational demands that are made on them at school. Alston-O’Connor (2010) would caution Widdowson and Howard citing that their arguments are similar to those which were the impetus for residential schools and the “Sixties Scoop.” Widdowson and Howard counter by expressing concerns that educators are lowering the assessment standards for Aboriginal students resulting in a web of lower educational expectations among First Nations communities in general (Widdowson and Howard, 2008). For this reason, Widdowson and Howard express concerns

about mathematics programs that are developed by Aboriginals. Perhaps it is important to examine the educational quality of First Nations schools currently operational in Canada.

The literature on First Nations schools in general is scant. Few articles address scholastic achievement in First Nations schools. In one participatory study of a Mohawk community, Agbo (2001) found that his participants felt it crucial for teachers, because they hold a position of trust, to have an understanding of their culture. He argues that all students will find success if teachers connect with them culturally and that modern forms of technology can complement such undertakings. Further, the study found that people in many First Nations communities do not have the proficiency to gauge the overall accomplishments of their schools. He contends that in 1996, the highest grade of any of the education Coordinators in First Nations communities was grade eight. He further argues that “everybody and nobody seem to be in charge of schooling for children in some band-operated schools” (p. 297). Agbo (2002) concludes that schools for Aboriginal students will remain “mediocre” (p. 297) until the Federal Government commits fully to the funding, resources and support needed for a full jurisdictional transfer. McPherson (1997) argues that, at present, the Federal Government’s contemplated transfer of jurisdiction of education is nothing more than the government’s attempt at cost cutting. Downing’s (2002) report validated Agbo’s concerns when he found that the drop-out rate of First Nations students living on reserves is higher than those living in urban areas with many on-reserve students performing well below grade level, particularly in reading, science and mathematics. Without adequate data, there is a need for more research on the mathematical educational outcomes of First Nations students. For example, what are the mathematical outcomes for students graduating from Dennis Franklin Cromarty High School which is a private secondary school

operating since 2000 in Thunder Bay, Ontario, and funded by individual First Nations remote communities (Lakehead University, 2000).

Widdowson and Howard (2008), along with the at-risk students study out of the University of Alberta, (N.D) which suggests that schools that work well for all students should work well with at-risk students both propose that Euro-centric teaching methods are sufficient for Aboriginal students' learning of mathematics. McPherson and Rabb (2010) contradict the arguments of Widdowson and Howard and the At Risk Students, Literature Review (N.D) when they suggest that support issues of identity are a major impediment to learning among many Aboriginals. Lunney's (2009) work with the Mi'Kmaq shows that students learned mathematics through verb-based language. Yet, her findings revealed that although students learned mathematics under her tutelage, they did not choose mathematics related programs in post-secondary education.

Rodriguez and Kitchen (2005) argue for deep reflection of teacher beliefs, practices and social norms that would enhance the quality of education programs and help to address the cultural diversity in this province, supporting the arguments that identity plays a part in the learning of mathematics. The recent mathematical curriculum guidelines have put conceptually-based learning in the forefront of student learning, particularly for at-risk students (The Ontario Curriculum Grades 1-8: Mathematics, 2005). Kajander et al (2010) have recognized through their studies that students that are experiencing problems outside of the walls of their school, have fundamental trust issues that are addressed through effective conceptually-based mathematics programs.

The literature may be suggesting that too few Aboriginals are making strong connections with mathematics within the provincial system. Does that indicate that the provinces may have become part of the problem? There is not enough literature to determine the role that provincial policies and mathematics teaching strategies may play for Aboriginal learners. This finding underscores the importance of this research. Aboriginals at the present time are a people without an authentic identity (McPherson & Rabb, 2010). McPherson and Rabb (2010) and Agbo (2002) agree that in the absence of a genuine body of knowledge of Native philosophy, Aboriginal participation in education will not mature beyond its current state. Freire (2003) understood that it is oppressed people themselves who need to engage in their own struggles to rise above their oppression.

Burke, Chairman of the Indigenous Australian Higher Education Association and an Australian Aborigine asks the question “How can you expect your culture and identity to survive if you give all the responsibility for education to another group of people” (Maslen, 1995, p. 47). If the success of the new Afrocentric school in Toronto, Ontario that opened in 2008 to help combat the dropout rate of Black teens is any indication of what might be possible for Aboriginal groups, there is reason for hope (University of Toronto, 2009). Recent standardized test scores place the school’s performance at 81% of Grade 3 students meeting provincial standards in writing and math compared to about 71% across Ontario (Rushowy & Brown, 2010). Rushowy (2011) reports that an Afrocentric secondary school in Toronto is proposed to open in the fall of 2011.

The scheduled opening of a First Nations Post- Secondary Institution delivering First Nations programming to students in Quebec and Newfoundland and Labrador will be the second

post-secondary school within Canada to be established to meet the needs of First Nations students (Picard, 2010). Perhaps “access to an excellent and equitable mathematics program that provides solid support for their (student) learning and is responsive to their (students) prior knowledge, intellectual strengths, and personal interests” as outlined in the Equity Principal of the NTCM document (NCTM, 2000, p. 12) by itself is not enough; the words of Burke, and the opening of First Nations post-secondary institutions by Aboriginal peoples, suggest there also must be opportunity for access in order to achieve the goals set out by the NTCM. At this time more research is needed to address whether First Nations communities are likely to deliver mathematics programs which are likely to meet with success.

Findings

The intent of my study is to investigate the issues and underlying factors that have influenced the mathematics experiences of the participants. This study uses an ethnological case study approach through interviews, observations and artifacts. Interviews, which offered voice to the past mathematical experiences of the participants, provided one segment of this study. These interviews gave insight into prior educational experiences that the participants had an opportunity to reflect on over several years. Having chosen ethnography for my method, it was important for the interviews to be conducted in the participants’ natural learning environments. I gathered the stories of the participants as they looked back into their past experiences to share their narratives with me. To gain a wider perspective, I have also investigated community influences. The ethnological method required an in-depth description of mathematical experiences which were examined not only through interviews of early experiences but also of on-going educational encounters. I have documented many of the observations and

communications of various aspects of the community, particularly those that took place while the study was in progress. Although the intent of my study is to look at their mathematical experiences, some participants felt it necessary to go beyond the scope of mathematics to explain why they were pursuing their GED at this point in their lives. I came away from our interviews with a great deal of respect for every single participant's struggle.

Parallel to the participants' past mathematical experiences are their present experiences of going through the GED mathematics program itself. I have assessed artifacts that have been ethically cleared to assess such as mathematics evaluations that served as indicators of the preliminary grade levels of the participants. I have assessed these evaluations using provincial curriculum documents as a reference. I recorded our encounters daily, including the struggles and frustrations that served as impediments to the success of some participants.

I have included attendance data in Appendix B (Band Councilor, 2011), of the elementary students, to provide a framework for comparison of the interview data of the participants regarding their attendance in their early education, to that of their children, all who are currently attending the community school.

Each participant contributed unique early experiences and more current involvements in the GED program. A brief appreciation of each participant through my perception and their own self-description is found in the next section.

Biographies of the Participants

The interviews were the primary source of data for the following biographies. I have also included my own observations, drawn from my field notes, to augment their descriptions.

Pseudonyms have been used.

Anne is the mother of several children who live with her in the community. She attended the community school for JK and SK only. She attended four elementary schools and two secondary schools in total. She has a robust personality and a keen sense of humour. She likes to swear when given the opportunity. No swearing was a rule in the GED program and that likely did not sit well with Anne. Throughout the program she repeatedly made no apologies for any behaviour that others might consider to be inappropriate such as arranging for rides to and from the community then not showing up, and embellishing her credentials. She spoke freely in class, asking questions to forward her learning. Anne was always looking for an opportunity to laugh, both at others and at herself. One participant admitted to being bullied by Anne when they were both young.

Tanya is a quiet young woman who liked to work alone. She expressed independence in her studies and likely would have passed the mathematics portion of her GED exam had she not lost her baby near the end of the program. She attended JK to grade 6 in a school in the city, followed by grade 7 and 2 months into grade 8 in the community school but it was, she claimed, too easy, so she quit. Tanya attended grade 9, 10 and 11 in a high school in the city where she attended a 'Back on Track' program.

Tanya displayed a great deal of concern for her family members during the program and appears to be a role model to younger people with the community. Her humour was quieter than that of Anne's hearty expressions but just as prevalent in her own quiet way.

David is a proud young man with a young family whom he looks after. He was the third strongest participant in the mathematics portion of the program. David switched schools four times in his elementary education and attended the community school from JK to grade 3 then

again for grades 5 and 6. He displays himself as a little 'rough around the edges' but consistently reached out to make himself available to help his peers when he could. He asked questions in class and was the first to volunteer to show his thinking to the rest of the class. He told me during his interview that he was suspended from high school for punching the principal in the face. When I asked him why he did that, he replied "He was in my face and wouldn't back off." David passed the mathematics portion of the GED exam but continues to struggle with English.

Elizabeth is a lovely, quiet woman who displayed a great deal of frustration and anger throughout the program. Elizabeth attended the community school from JK to grade 8. Never confrontational, Elizabeth would consistently choose to walk away rather than speak her mind. She did not ask questions in class and was very conscious about how others perceived her math skills. Her tumultuous upbringing was fraught with issues of violence and substance abuse. Many indicators, both during the GED program, and in the interview have led me to believe that this upbringing continues to define her as a person and as a learner of mathematics. Confidence issues were overwhelming for Elizabeth and although I watched her begin to develop into a competent learner of mathematics, she did not study for the exam and did not write it.

Kaylee was the most proactive student in the GED program which was interesting because she entered the program with a solid grade 5 level of mathematics. She attended a school in the city between SK and grade four and returned to her community for grades five to eight where she claimed to learn nothing, in any subject. She was looking forward to going to high school in the city but ended up quitting after three months to return home because she felt that her siblings needed protection. She said she was sad to return home because she was getting straight A's. She asked the most questions of all the participants, not caring how they might be perceived by

the other members of the group. She experienced all of her elementary education at the community school. She was pushy with her learning, demanding attention when she needed it. During interviews I advised more than one student to watch Kaylee's behaviour closely because she had all the makings of becoming an excellent student. Kaylee's mathematics skills increased, along with Tina's more than any of the other participants. Kaylee's learning broke down when she began to immerse her emotions into that of the problems that various members of her family were experiencing, including a death in the family, and with her increasing vocal frustrations with the Coordinator of the program.

Tina was quiet in class initially, but became more vocal proportional to the strength of her mathematics learning. Of all of the students who tested at a grade 5 level or below, Tina had the greatest chance of achieving a passing mark. She attended the community school between JK and grade 8. She attended a 'Bridges' program in grade nine but did not want to ask any questions and eventually quit. She learned quickly and worked hard. She was well attended and began to exume confidence when she challenged the strongest student, Sarah, in the lead up to the exam. She wrote the exam but did not obtain a passing mark. She later admitted that she was ill the day of the math exam and had not done her best. Tina found it difficult to study for the supplementary exam when she was hired by the band and because she has children and nowhere to study in her home.

Michael was also hired away by the band as he was beginning preparations for studying for his supplemental exam. He attended all of his elementary years in the community school. Someone sat with him in grade nine when it became evident that he did not understand any of the mathematics taught at his high school. Michael was a personable young man whose attendance

was more of an issue than it was for any of the other participants. He took time off to go hunting early in the program and gave the Coordinator a gift of a roast when he shot a moose. He expressed to me that he did not like mathematics. In response, I asked him if he enjoyed solving problems in his own life and in that of others thinking I could draw in parallels. He indicated that he preferred to walk away from all of his problems. He worked closely with another participant in the program who tried to help him with the various concepts. He was part of the group that travelled to the city to have me teach them. He stayed with the program long enough to write the exam despite his frustrations with the Coordinator, but he displayed a lack of the solid dedication that was necessary for him to fill in his large conceptual and procedural gaps in mathematics.

Maureen and Sarah(not their real names) were the strongest participants in the program. Maureen was quiet but resolute. A residential school survivor, Maureen displayed confidence, dedication and a genuine love of math in her gentle demeanour. She attended a residential school from JK to grade five but skipped grade three, six and eight to live in the bush. She claims to have not learned in the residential school. She attended a city school for grade seven, then attended grades nine, 10 and 11 in a city school.

Maureen helped other students in the class with the concepts and procedures and was well attended throughout the entire program. She passed the exam easily. Having spent years in the bush hunting and trapping as a young girl, she was deeply affected by her traditions. Maureen did not appear to be hindered by identity issues along the way although she expressed difficulty with day to day issues which she overcame while the program was underway.

Sarah also felt that her traditions were very important to her. She carried a positive outlook, careful never to engage in any issue that might interfere with her studies. Sarah switched schools four times in her elementary years. She attended the community school from JK to grade two but her parents were concerned with the level of education and moved to the city. She returned to the city school for grades seven and eight but claimed she learned nothing in those two years. Sarah felt as though she did not really belong in her high school and quit at the end of grade 10. Identity issues did not appear to be an impediment to Sarah. In fact, it appeared to me throughout her interview and through observations within the classroom, that she was the owner of a strong, solid identity, perhaps the strongest of the group. Sarah made a point of giving me a moose roast in a display of generosity which defined her nature. She helped other participants throughout the program. Sarah exhibited wisdom beyond her years in many of our discussions as we travelled to and from the city together.

Cara was a lovely young woman who appeared happy-go-lucky but in reality, carried the world on her shoulders. Mostly brought up by her father, Cara was open, prided herself in her honesty and her ability to connect with her educators. She attended a city school for JK and SK but failed grade one because she did not attend. She returned to the community school for grade four and was transferred to the high school at the end of grade seven because of her age. She attended a transitions program in her high school from grades nine to eleven.

Cara arrived into the program late and missed critical hours because of her late enrolment. It seemed important to her that I know that she felt she had been diagnosed as a “slow learner” a few weeks into the program and that I understood that she needed me to sit with her to learn. Although I found Cara to be bright, capable of learning quickly and retaining concepts, her

attendance became an issue when she decided to work at home. Shortly before the exam she had assured me that she had worked her way through all of the mock exams and had done well. She kept track of her marks with each exam. I sat with her at her kitchen table on my last visit before the exam and noted that she was not as strong as she was having me believe. When the participants wrote the exam, she was finished first. She later admitted to guessing at all of the multiple choice questions on the exam, not because she could not do the work, but instead because she considered herself good at guessing. Cara, after long discussions, agreed to work with me one-on-one on her supplemental exam. She spent four full days struggling through the procedures as she put pencil to paper for the first time in the program. Had she not consumed large amounts of alcohol the night before her second last session, she may have passed her supplemental. As it was, she did and she did not pass on her second attempt. She became frustrated and despite setting a date for a third attempt, disengaged from her learning process.

Suzie was a young woman who came into the program after 14 hours of instruction. As we covered a lot of territory in the first few sessions and spent time setting up a culture inductive to learning mathematics, this late introduction proved untenable. Additionally, Suzie attended the community school for her entire elementary education and was evaluated with grade 5 math skills at best. She attended grade nine briefly but dropped out when she realized that she did not understand any of the mathematics. She stayed with the program until we began to study to the exams but had difficulty focusing on her work, particularly as she struggled with feelings of not being able to catch up to the other students.

Interviews: Giving Students a Voice-Identity

The interview data speaks clearly as to the challenges that the students have faced in pursuing their education, and to their resilience in the face of adversity. In particular, the students spoke of issues around their home and community lives: issues that were intensified by the challenges of not being taught beyond grade five. In this section, my aim is to give the students a voice in describing the challenges that they have faced, and how they perceive identity issues as a major underlying cause of those challenges. To achieve this aim for the theme of identity, I will focus on the three key identity issues that were raised by the students: early life experiences, cultural and traditional components and experiences which contributed to moving forward with their learning. Additionally, I will be giving voice to students who claimed not to have been taught beyond grade five in their elementary school. Identity and teaching and oppression are the two themes for the interview portion of my study.

Early Life Experiences

Early life experiences played a critical role in shaping the students' attitudes to, and potential success in, their education. At the extreme end, issues of domestic violence prevented Elizabeth from learning: "I was beaten at home so much that I think it did something to my head. I didn't learn very much at school. The elementary school was fine but it was the beatings that kept me from learning." Absenteeism also played a role in truncating educational opportunities. Cara failed grade one because she did not attend, and without proper remediation, this deficiency appears to have stifled her future learning. She remembers returning from the provincial system to her community school in grade four:

"I was looking forward to math in elementary school. But they kept giving us the same work over and over again. They would give us the same worksheets. I felt smart at first

until I finally figured out why they were handing us the same sheet. I felt like I was being laughed at, being played with . . . like with my emotions, making me think I can do this at the blink of an eye but meanwhile it was the same paper.”

Another experience that impacted negatively on some students was the transfer to high school, and the feelings of insecurity and inadequacy that this involved. In Cara’s case, she came to accept a doctors’ diagnosis of her learning that was based on testing that to her was common sense.

At the age of 15, Cara was in grade seven and then transferred directly to high school without grade eight. “I was sent for the transitional program. I passed grade 9 and went there until grade 11. I did not feel comfortable there.” Cara continued with memories from her high school:

“In grade 9 there is a doctor that goes to all the schools and checks the Aboriginals because that a lot of Aboriginals have problems when they come from their communities to TB. He gave me a test with blocks and ducks and you had to see how fast you could do it. I felt like a Chimpanzee. The questions were common sense. The test was ½ hour long. I was told that it takes me a long time to comprehend things and that I understand better when people show me, not tell me how to do things. Maybe it is hard for me when people talk too fast.”

During the interview process I asked Cara if she agreed with the doctor’s diagnosis. She replied “Yes, I think he is right.”

Michael had a similar experience of transferring schools:

“I was transferred into high school because of my height and age. I was 13. The boarding out was alright but it would have been better if I had my mother there to get me up and stuff like that. Coming from a reserve into a big city was basically culture shock. I didn’t catch on right away in high school. I thought I was doing good but then when they tested me I was at a grade 6 level. It was messed up.”

The early life experiences of students’ were also heavily influenced by role models. These were upheld as influences on the participants’ mathematical education in three of the interviews. Sarah talked about her parents extensively in her interview. “My mom was director of education, then principal and even my teacher for a while. I got a lot of support from my mom in

math.” Sarah sees “my big strength has been the solidarity of my parents. They “found” one another and have enjoyed a very happy marriage. My mother is the strong personality with a strong focus on education. The Chief and Council does not like her very much because she asks too many questions and is too smart.”

Anne spoke of her mother as her role model and tutor. “My mom was able to help me with my math tests but my dad wasn’t around very much.” She continued, “I would like to become a nurse because my mother always wanted me to . . . because I would do anything for her.”

Cara remembered “My dad helped me (with mathematics) but he was always so busy. My uncle helped me.”

Tina was one of two participants who discussed bullying inside the classroom as a major influence on her school experience.

“I was picked on so bad at school. There were a group of bullies and they picked on a lot of kids. I didn’t want to go to school because of it so I missed a lot of time. My mom tried to teach me at home but she had trouble herself so it didn’t work. That bullying is why I am here today. Now my children are experiencing the same thing in the school.”

Cara experienced similar difficulties with bullying.

“When I came down here (to go to school in her community), I was the smartest one and not bragging or anything but I knew more than what they knew and the kids didn’t like that. They dragged me down. They called me smart ass, teacher’s pet. They picked on me, picked on me. The kids came after me for help. I got bullied and I didn’t want to go to school so I didn’t for a while. I took a year off. I knew more because I came from town.”

As a researcher, I found Cara’s mathematical experiences to be poignant because she had clearly gone from a bright capable student to one with diagnosed learning issues within five years. Her experiences in this regard adversely affected the way she learned mathematics.

Homesickness was an issue for many of the participants because most had to leave home as a young teenager to board out in a nearby city in order to attend secondary school.

Elizabeth discussed homesickness directly. “I was homesick when I went to high school and that was strange because life at home was so bad. But I was so homesick that I quit school and returned home.”

Cara talked indirectly about the cultural differences she experienced. “When you come from a reserve and go to town, you are a little behind with the trends and stuff . . . the girls had purses and I never had a purse. They were doing their hair and makeup in class and I felt like an oddball.” “The people I lived with were very organic. There was no pop. I wasn’t used to it. My uncle brought me a big bag of chips and pop.”

Residential school syndrome affected student learning through moves to escape school and abuse within the home and community as a result of parents’ and community members having attended a residential school (Chrisjohn, 1997).

Only one participant herself attended a residential school although most parents or grandparents were affected directly by them. Maureen talked of moving around a lot and taking years off to live in the bush to escape the residential school. She was attending residential school hearings while she was working on the GED program. Cara informed me during her interview that most of my participants were fighting drug and alcohol addictions due to the generational effects of these schools. For her, she said, drinking was a problem. Visible signs of substance abuse only occurred once with Kaylee when she showed up after drinking all night. Kaylee informed me during her interview that in her opinion, “If you bring up children on this reserve there is a 100% chance of them being sexually abused.” Elizabeth complained that “My parents didn’t care at all about school. It didn’t matter to them if I learned or not.” Michael talked about not being taught enough in the schools. “I can remember teachers teaching me who were from

(this community). Maybe that is all the math they were taught in residential schools so that is all they taught us.”

The interviews revealed that early life experiences dramatically affected the participants’ relationship with mathematics. These experiences altered their identity, and simultaneously, their view of themselves as students capable of being successful in mathematics. They formed and deepened issues of trust which had to be overcome to move forward with their learning. Trust issues became the link between their experiences and their learning curve. Positive role models seemed to help motivate students while bullying resulted in attrition and struggles with self-images that influenced learning in general. Diagnosis of learning difficulties that seemed to arise from bullying and being given the same work “over and over again” likely further interfered with student identity and issues of trust. Homesickness and cultural differences away from home meant that student emotional health needs were compromised. Residential school syndrome further complicated identity issues and deepened divisions of trust.

The participants were asked about their perceptions of traditional and cultural associations with mathematics. I noted throughout the interviews that for the most part, the participants’ lived cultures were vastly different from that of their traditional values that had been passed down by their ancestors. When interviewing the participants, I distinguished “culture” from “traditions” and gave each participant the opportunity to voice whether they thought either or both held a place in the learning of mathematics for them. I defined culture as the values and interactions that defined their communities, as they were being experienced by them, in their present lives. I defined traditions as beliefs and values that had been passed down for generations by their forbearers.

Traditions and Culture

All of the participants were asked how important they felt it was to incorporate traditions and culture inside of the teaching of mathematics, particularly as examples for problem sets. Five participants felt that teaching of traditions and culture would enhance student learning of mathematics to varying degrees and six participants felt there was no place for traditions and culture in mathematics teaching.

Michael pondered, “I guess traditional/cultural would help a little but in a way it wouldn’t matter. The government wouldn’t approve of it. It might be good. I don’t even know my own language. A lot of old people talk in Indian and do their math in their language. I would still struggle with math.”

Suzie and Kaylee saw no place for Aboriginal ways of knowing or cultural components for learning mathematics but both indicated that they like to learn traditions in their education. David admits that some people might like to see traditions in math but he doesn’t want them. Maureen, however indicated that traditions “are not relevant for math but they are for language. They should be taught in language.”

Tina spoke of traditions, “I think it is important to see it in math problems. It would make it easier to relate to the problems.”

Elizabeth was confused by the question. I asked her if she would rather use examples of aspects of her traditional upbringing or life on the reserve as she has lived it for math questions rather than the examples that are often seen in math books. She continued to be confused. “Math is math. There is no Native math. There is just math.” Cara agreed, “It doesn’t really

matter if a problem says two little white people or two little Indians. It doesn't really matter to learn."

Tanya liked the idea of traditions in mathematics because "I didn't get any traditional teachings while I was growing up."

Anne had strong views about culture and tradition in mathematics. "It doesn't really matter about cultural things. I don't really know about any culture. I don't think they used any math back then. It doesn't really matter. Math is math right? It doesn't really matter about having the problems be relevant to day-to-day life or connected to what I know." Anne continued expressing frustration with the accuracy of what she is learning in her traditions.

"Sometimes people learn and then they get upset because that really isn't the way it was. It is better to learn it in my own community because it is more accurate. If it is taught at school I get frustrated because it isn't taught right and then I refuse to do the work. It gets us mad when a white person tries to teach that stuff because what the hell do they know? It should be like a Native. But then they get offered money and that isn't really what it is all about you know?"

Anne felt that bringing elders into the schools won't work because there are too many rules and regulations. "Dilico used to come into the schools to teach traditional stuff but there would be maybe one Indian and the rest were white. I don't understand Indian. I used to pretend I did, but I didn't. I like it when Indians teach traditions."

Sarah reflected on traditional teachings and cultural inclusion in mathematics, "It's really important to understand when you can relate to math. I would use teepees with wood stoves. I find it is easier to learn, easier to understand. When we are interested, we are having fun and it isn't really work . . . we can relate more." She indicated that helping someone in your family to solve a problem is more interesting than helping someone you don't know. "Cultural

components are important because they help you learn better and they help you be a better all-round person.”

Although the participants seemed divided on whether traditions and/or culture would likely help them relate to mathematics in a meaningful way, most had strong opinions to voice. It is interesting to note that five out of the six participants who wanted to see more traditions/culture in mathematics, were well attended (with the exception of Tanya) until the end of the GED program.

Moving Forward

Some students claimed to require one-on-one assistance in order to move forward. These, along with students who worked well independently, were able to cite their relationship with mathematics outside of the classroom in their everyday lives. Establishing this relationship was important because it provided a pathway for students to dream of their future aspirations.

Three participants indicated that they do better in mathematics when they are given one-on-one assistance. One day, when teaching to the GED program, Suzie came into class and put her head on her desk. I had been trying to get some one-on-one time with Suzie since her late arrival into the program and as students were working independently, I was hoping to be able to sit with her. She looked very down and started to scribble with her head down. I told her that I wanted to work with her one on one, all day. She said she just wanted to be left alone. I went to the Coordinator who told me just to leave her alone and if she left she would dock her pay. Having taught older adults in manpower programs at Seneca College for ten years, I understood that teaching older adults required a completely different approach to that of younger adults. These students needed their autonomy respected to the utmost. All had had experiences that were

incongruous with their learning needs and with their culture and many had negative, pre-established relationships with mathematics. That, however, did not mean that Suzie would turn away an offer of assistance more than once. I had worked with many students from the Jane/Finch 'corridor' who had exhibited similar precursors to abandoning their studies and I believed that Suzie wanted to connect. It was up to me to come up with initiatives to negotiate the direction of our day together. I went to my car and brought in my cappuccino maker, a package of Skittles and a ratios worksheet. I put the worksheet and the skittles in front of her and showed her what needed to be done on the worksheet, completely ignoring her request to be left alone. She was sufficiently intrigued and began to work. When she finished it, she ate the skittles and I put an algebra question in front of her and we walked through it slowly. After a couple of questions, I got up and made her a cappuccino. We spent the entire day together and she met with success. She told me during her interview that she came in to quit, despite the fact that she knew her son would quit high school if she did. She said "I told myself that this teacher is trying to help me. That day I felt that my world completely turned around. I really just need someone to sit with me and that really happened for me that day." That was the last time that Suzie worked inside of the classroom. She feigned being tired and having to go to town instead of attending class. She did not write the exam.

Cara indicated in her interview that "I need someone to sit with me. I can't learn any other way. If I could change anything, it would be to introduce math earlier and to spend one-on-one with students."

Elizabeth felt that she needed someone to sit with her because she has never really learned before. "I don't know how to learn" she stated. "I like to work with other people when I need

them but by myself at other times.” Michael commented, “If someone shows me how to do the problems I am fine.”

In order to help establish the participants relationship with mathematics in their everyday lives, and to establish how much of their identity was intertwined with mathematics, I asked them to talk about where they used math on a day-to-day basis.

The participants were all able to cite at least some use for mathematics in their everyday world. Michael needed prompting to provide his reasons. Most participants cited doing their finances as their main use for mathematics in their lives. Some use mathematics in cooking. Cara responded “I use math for cooking and measuring, making a garden, measuring when you are building something like 2 by 4s or for a birdhouse.” She adds, “my life is going to be hard without high school. I will have to work like a man . . . outside work bush work and stuff . . . that is what they say here. If you go to town you can get high paying jobs.”

Sarah spoke of a general use of mathematics. “I use my math when I cook, when I am at work . . . with everything. I never really noticed before how much we use math for everything.”

Many of the students had goals for their future that motivated them later in the GED program that helped to set an optimal learning environment for them. Nine of the eleven participants talked about their future aspirations as being different from what they were doing upon entrance into the GED program. Elizabeth and Suzie were the only participants who indicated that they did not know what she wanted to do with their lives. Tina, Tanya and Sarah indicated that they want to go into nursing and indeed, Tina plans to register into nursing at her university in 2012. Tanya is also interested in becoming a teacher. Although Anne indicated that she would like to become a nurse for her mother’s sake, she expressed different interests herself. She answered “I

want to go back to school: General Arts and Science to get the feeling of going back to school then go back to be a paramedic, a parole officer or a conservation officer.” Kaylee and David both want to continue with higher education, Cara wants to start up her own restaurant specializing in “Native food.” Maureen discussed, “I want to go into bookkeeping. I have wanted this for a long time. Next year I am going to leave my husband, go to (named city) and become a bookkeeper.” Michael dreams of hotel management in his future.

Dreams of future aspirations provided motivation for the participants to continue working in the face of adversity. Having goals may have contributed to the building of student identity as would use of their learning outside of the classroom. The participants were able to identify and measure their rapport with mathematics in their daily lives. For some, trust issues linking their identity to their learning may have been enhanced through learning one-on-one. For Cara, one-on-one learning may have been a need, partially brought on by the fact that she was raised without her mother and somewhat driven by a doctor’s diagnosis.

Identity issues seemed to establish the framework for the participants’ descriptions of the aspects of their lives that brought them to the point of being a part of the GED program. It would be impossible to determine exactly how their educational experience might have been different, however, if they had been taught beyond grade five in mathematics, in their elementary school. Not being taught beyond grade five resulted in a necessity for transition programs at best. This fundamental lack in their mathematics education leading up to high school undoubtedly further, and adversely, affected their identity and their level of trust.

Teaching and Oppression

Many of the participants complained that they were not taught beyond grade five at the community school. Several students indicated that Sylvan Learning came to their community and did assessments on the mathematics level of the adults. No one admitted higher than a grade five testing by Sylvan and both Michael and Cara indicated that they tested at a grade four mathematics level.

Maureen spent grade seven in a provincial school and grade 8 in the bush being taught to hunt and trap by her family.

Michael noted, “The books at (the school) were old. People’s names were in the books and I knew the people. I had trouble at school and other parents came and helped out. They didn’t know very much though. My mother helped me at home. She is good at math. She regrets it now that she didn’t move to Thunder Bay. I had younger siblings. My younger siblings got new books. When I was there, it was the old curriculum. I only had 5 credits from high school. They have triple what I had but they dropped out too.”

Cara remembers, “(The community) hired teachers from all over but they didn’t last. There was no discipline, no manners whatsoever.” “One teacher taught me how to play chess and he signed a book and gave it to me.” She remembers some teachers sitting with her. “One teacher went to Cuba and brought back something for everyone.” Cara’s favourite teacher took the class to Outward Bound. “I feel like (the community) didn’t teach us nothing . . . like they didn’t prepare us. I didn’t know how to do it. I knew how to add and subtract and blah blah blah.”

Kaylee cited the Chief , Council and corruption found within as the main reason why kids are not being taught properly although she does say that teaching in the school has improved a lot.

Kaylee drove with me to visit the school which she explained was “two portables stuck together.” “It has been that way for many years since the school burned down.”

David, who spent grades five and six at the community school remembered that the school “was not a good school. I didn’t learn much there.”

Sarah claims that she was put into a grade 8/9 program while attending grades 7/8 at the community school. Having attended a provincial school up to grade six, she observed “they were not teaching any math beyond grade six in (the community school).”

Suzie indicated that she did not recognize any of the mathematics at the provincial high school that she briefly attended. Tanya attended grade seven and two months into grade eight at the community school but found it too easy and quit.

Those participants who were not taught beyond grade five in mathematics have suffered a great deal because of it. Their lives have been severely altered. Dreams were shattered and hope was taken out of their reach. How could these people have had the strong sense of self necessary to learn well? How could these people possibly know who they are, and how they fit into the world around them? Against all odds, these participants, along with their counterparts, enrolled in the GED program years after the graduation of their peers.

GED Observations, Conversations and Artifacts

Coding for the recent educational experiences of the participants was problematic. Three themes emerged but were, once again, very closely tied to the predominant theme of identity. Through my observations, I was aware that attendance and social issues were only symptoms of a much broader problem with student performance in mathematics. They were both predominant

within themselves and played a vital role in influencing the success of the participants in the program. In the end, I decided on two themes for my GED observations, conversations and artifacts: a question of identity and social problems.

As a tutor/teacher with experience working with older students, I decided from the outset that it was up to me to set up a learning environment based on mutual trust. On the first day I took some time to offer up a synopsis of my own journey through life, which included its struggles and solutions that I found worked for my family in our educational endeavours. I believe that this first day allowed us to connect in a way that opened the doors for trust issues to be set aside to some degree, if only for their learning of mathematics. I also understood that these connections would require constant maintenance so in that vein, I brought food with me every time I visited the community. Sometimes I brought my popcorn maker or my cappuccino maker or baked muffins, buns or cookies. I picked up and dropped off students that lived a long distance away and worked with one student in her home. When students began to leave at lunch and not come back, I began offering them lunches to entice them to stay. They knew that I cared about them and took advantage of that which became a mutually suitable arrangement.

The results of the initial mathematics evaluation of the GED program which tested addition, subtraction, multiplication and division of two digit numbers, mathematics symbols used up to the end of grade 8, properties of simple geometric figures and basic understanding of algebra were evaluated. Most participants did well on the addition and subtraction of two digit numbers with multiplication constituting a close second. Many students did not know the various symbols for division such as “/”. I found it necessary to address the class as a whole to make certain that everyone understood that 4 over 5 means 4 divided by 5 after working one-on-one

with several students. Many did not understand the purpose of “x” in an equation. Most were not able to find the perimeter or area of a rectangle and only one participant was able to draw a right-angled triangle. These students were scheduled to write their GED exams in 3 ½ months. I was given assurance by the director of the program that all students would be given opportunities to re-write if they were not successful but that many of the supports would not be able to continue beyond the 3 1/2 month period.

Setting Students Up For Success

With the guidance of the Coordinator and the thoroughness of the director of the program, all students were provided with GED workbooks and texts, calculators, pencils, and paper. The director of the program provided the classroom with two whiteboards and markers. He provided the Coordinator with a fax machine, internet, telephone, long distance minutes and extra supplies. The Coordinator began each morning with a talking circle. The participants later rejected this time, expressing that they needed all of the time to concentrate on their studies. The Coordinator, an optimistic woman with an outward positive outlook toward the students, sent sweet grass around the room for anyone who chose to take part. She also held “cultural awareness” classes on one of the days I was not there that were meant to initiate traditional awareness. Throughout the program, the director provided us with everything we asked for in order to fully support the learning of the students. He avoided formulative decisions where he could and his support augmented student learning. He paid for babysitting where needed. The participants were paid for each session they attended. He provided the students with lunch when they came to Thunder Bay for extra tutoring. The class quickly became a unit which was strong and tight and motivating for everyone.

Our first session began at 9 am and ended at 4 pm with a one hour lunch break. The nine participants in attendance wanted to take frequent cigarette breaks but they found that I wasn't supportive of any more than one in the morning and one in the afternoon. I began by taking up the initial evaluation which required discussions on number-lines, the x, y axis and what they are for. We talked about symbols.

I asked the participants if they could tell me what a dot means when it is placed between two numbers. Despite class interactions being lively to this point, no one volunteered an answer.

Then,

Me: Can someone tell me what a star (*) means when it is placed between two numbers?

David: I think it means multiply

Me: Thumbs up for anyone who agrees with David.

Class: Sarah raised her thumb.

Me: For those of you who agree, you are correct. * and dot both mean multiply. David,

Can you show me an example on the white board?

David: (Writes $5 \cdot 6 = 30$, $5 * 6 = 30$ on the whiteboard)

Me: Thank you David. Can anyone tell me what no notation or symbol means when it is

written like $(3 + 2)(1 + 4)$ as no notation between the brackets? For example, you do not

see an addition, or a subtraction sign between the two sets of brackets so how do you

know what to do?

Class: Silent

I went on to explain that in such a case, we are being asked to multiply but to beware because

having no notation between the 2 and the $\frac{1}{3}$ in a fraction form $2\frac{1}{3}$ would mean addition.

The Coordinator, who held a master's degree, and who had paused for a few minutes to listen in, told the group that she had not previously understood many of the symbols and had very little understanding of mathematics. I told her that she was welcome to stay but she headed back to her office. Tanya, Kaylee, Sarah, Anne, David and Michael were all vocal asking good questions as we proceeded. On the initial evaluation, most of the participants knew "greater than" but not "greater than or equal to" or "not equal." None of the participants knew the infinity symbol or beta, omega, alpha uses or symbols. None knew milli, micro, mega or kilo. We ploughed into the symbols, defining each term and giving examples. Our discussion for π involved paper cups, and a piece of paper towel that I asked them to cut to the length of the diameter of the cup.

Me: Now wrap the piece of paper towel around the cup, marking the cup where you begin. How many times does the paper towel, the length *across* the cup, fit *around* the cup?

Michael: About 3.

Tanya: Three and a bit.

Anne: A little more than 3.

David: 3.14!!

Me: Yes, you are all right. Can anyone tell us what this number means?

David: It is π . Cool!

Interestingly, when the participants were given the initial evaluation a second time, half the students answered $d\pi$ instead of 2π when asked for the circumference of a circle, indicating that they were falling back on their conceptual understanding in order to answer the question.

I showed them what a right-angled triangle was and asked them if anyone knew the total of the other two angles together. No one answered. I showed them how beta, alpha and omega can be used to name the angles. I talked to them about perpendicular and parallel. We distinguished between diameter and radius.

Me: David was telling us this morning about the donut he wants which we all agreed he should share with us when he gets it. If David were to measure from the outside to the centre of the hole after before he shared it, what measurement would he be taking?

Kaylee: The radius

Me: The radius. Good, and if David measured all the way across instead?

Sarah: The diameter.

Me: Good. Those are two measurements you need to be able to distinguish between. If there is ever any doubt perhaps you can think of David's donut and how good it was when he shared it.

Class: Laughter

Me: Now, please take out your rulers and measure all the way around your table, recording each measurement. Work with a partner. When you measure all the way around you will have found the perimeter of your table.

Class: Measures tables, recording the results.

Michael: What do we do with the numbers once we get them?

Me: Well, you are measuring the perimeter which is the distance all the way around the table. What do you think you need to do with the four measurements you have?

Tina: Add them.

Me: Thumbs up if you agree with Tina.

David: Add them.

Me: Ok, add them. Now let us say that instead of finding the distance all the way around, we needed to know all of this (rubbing my hands over the surface of the table).

Does anyone know what all this is called?

Class: Silence

This began a discussion of area from a conceptual framework, working toward an understanding of the procedure. I asked them to cut up 7, 1 cm sections for height of 7 cm. Each section was 12 cm long so we talked about the fact that we were making a 12 cm length, 7 times (hence 12×7). When I was satisfied that all students understood the concept of area, I held up a piece of square paper and asked them to imagine that this was their table. I then folded it in half to make 2 triangles.

Me: What shape is this?

Anne: A triangle.

Me: But isn't it half of a rectangle?

Anne: Yes, but it is also a triangle.

Me: So what is the area then?

Anne: Half of the rectangle.

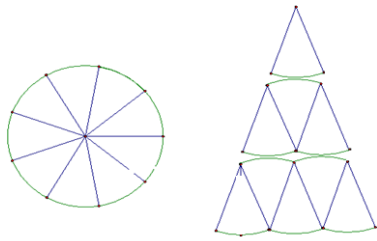
Me: What is the area of a rectangle?

Tanya: base x height.

Me: So what is the area of a triangle?

Tanya: $\frac{1}{2}$ base x height.

In another lesson we addressed area of a circle. I had made them 9 plastic manipulative circle sections each which made up a circle when put together. I then asked them if they could make the shape of a triangle out of them working in pairs. Several participants came up with the following shape:



Me: What is the circumference of a circle? I forget.

David: $2\pi r$

Me: So if the circle is divided into 9 pieces, how much of the circumference does each segment have?

Sarah: $1/9^{\text{th}}$.

Me: Can you write that out? If the entire circumference = $2\pi r$, what is $1/9$ of the circumference?

Sarah: $2\pi r/9$?

Me: Ok, so remind me again what the distance between the outside and the middle is? Can you work with what you know to help me figure out what the area of this new shape is?

After a period of struggle, we worked through as a class that the triangle was $3r$ in height and that the base of the triangle was made up of $3/9 (2\pi r)$ because 3 sections made up the shape of the base of the triangle. From there, we worked through the numbers substituting into $\frac{1}{2} (\text{Base} \times \text{Height})$. This lesson was far more prompted than I had anticipated and I decided that this was due to how new even the concept of substitution was to them. Concepts were being developed quickly with very little time for reflection.

At another point in the lesson to address the fact that many students drew a cone on the initial evaluation when asked for a cylinder.

Me: Now, going back to David's donut once more. Let's imagine that he manages to get a dozen donuts and we stack those donuts on top of each other like this (on whiteboard).

What would we have?

David: Lunch!

Class: Laughter.

Me: Well we have a bunch of donuts or circles that give the shape a new measurement that wasn't there when there was only one circle.

Kaylee: height

Me: How many agree? Thumbs up (several agree).

Me: So our new shape is called a cylinder and if we imagined a bottom to this shape and if we imagined that all the donuts were bound together, how many people would agree that we could pour water into this new shape?

Class: Many nods.

Me: So if you look around the class can you see a similar shape?

David: Coffee cup.

Me: Good. So if the distance around the original circle is $2\pi r$, and the area of the bottom of the cup is πr^2 , what would be the area all the way around the cup?

Kaylee: Wouldn't you need to know how many circles there were?

David: You get what you need by the height I think.

Me: Ok, let just say I told you that the height is 10 cm. Work with a partner and see if you can come up with it.

The students responded positively to their growing conceptual comprehension and refused to work with any procedure that they did not fully understand. They expressed that they liked the you-tube videos that I downloaded for them as they provided them with different perspectives for their learning.

I talked to them about $-2(-4)$ and what that meant and how to work with it. This was a challenge for the majority of the class who had never worked with negative numbers. We used the number-line with a figure with her nose pointing toward the future, always to begin with. They did a few in class. I taught them $+- = -$ and used the symbols throughout the lesson. They asked questions, teaching me what they didn't know. Teaching conceptually built trust between us but it also gave them an idea of how much work was going to be necessary for the mathematics component of their exam. Both Kaylee and David approached me at the end of the second day expressing amazement at how far they now knew they had to go. Kaylee asked if I could commit more than 2 full days a week. I could not. She then asked if I would teach them if they agreed to come to the city. I said that I would. I left the class with homework each day,

complete with answers, to be worked on over the next two days. Several participants discussed with me in class how they had never been taught like this before. I told them that the reasons that brought them to this point were not their fault, but that now, they needed to do what was necessary to move forward. No one else would do it for them but that there was a lot of support available to them to maximize their chances of success. I told them that there was not one person in the room who was not capable of doing well on the GED exam or of continuing on and that I suspected I was going to see them at the university or college after the end of the program. I knew that math phobia plagued most of them and wondered if it would be one of the largest identity hurdles that they would need to overcome.

At the end of the first week the students informed me that they had approached the Coordinator about coming to the city the following Sunday so that I could teach them. They planned to take two vans and to travel back on the same day. Eight of the participants did just that. Their motivation was extraordinary. They expressed that they appreciated feeling as though they had control over their own learning. They began to trust their environment, trust the non-oppressive pedagogies within it, and trust in their own ability to learn. They did homework and came to me with problems they were having difficulty with. Tina, Tanya, Kaylee, Sarah, Anne, David and Maureen all showed signs of believing in their ability to succeed. Michael and Elizabeth lagged behind in this regard but once I identified this, I was able to plan our time more efficiently.

Struggles: Identity

Student learning in the program did not come without its struggles. Collectively, we faced each issue as it was raised to minimize its effects if at all possible. There were times when it was not.

Errors in judgment were made along the way in the GED program and for some, they proved fatal to maintaining motivation over the long term. Cara and Suzie were permitted to enter the program after missing 28 hours of instructional time. The hierarchical nature of learning mathematics made it frustrating for both of them, particularly since their earlier struggles in mathematics were extensive. I tried to find time for the one-on-one time that they desperately needed but far too much was being asked of them. They had been set up for failure and only time would tell how much this would impact on their relationship to mathematics in the future. Other influences became apparent as the program developed including the length of time the students had been out of school, perceived need for one-on-one instruction and the expectations of self. Teaching to concepts was imperative to many of the students in order for them to move forward with their learning. Finally, the interviews themselves played a part in the overall dynamics of individual progression.

All participants had been out of school for more than four years. The length of time away from mathematics education affected each participant's learning curve differently.

Elizabeth was likely the most impacted by her time away from school. "I have not been to school in over 30 years," she expressed during her interview. Kaylee also struggled with a long time gap since her attendance at school but pursued the program with a robust enthusiasm that was refreshing. David and Maureen had been out of school for several years but both had taken

upgrading courses which they claimed helped them remember how to be a student. Indeed, many of the students struggled with time management, homework, organization and other attributes that needed to be developed for successful learning. This topic was discussed both inside my classes and in workshops set up by the Director.

One-on-one learning in the GED program provided transition for participants who had disengaged from the lessons and discussions. It was powerful and liberating for student learning because it helped to fill conceptual gaps and procedural proficiencies, while building trust through bonding.

Cara learned one-on-one. She told me on the second day that she could not learn any other way. She would not write anything down unless I asked her to pick up her pencil and copy what we were doing. After being asked to do this, at times I would walk over to see her doodling instead. She insisted over and over again that a doctor had told her that she needs one-on-one to learn. When I did get the chance to sit one on one with her, I found her to be a bright student who learned more quickly than many of the other participants. The situation confused me and I told her so.

Elizabeth exhibited the most prevalent correlation between identity issues and learning of all of the participants. She also scored, along with Suzie, the lowest on the initial evaluation. She did, however, know her multiplication tables and knew how to add and subtract two digit numbers. She was sensitive to the perceptions of others and said nothing in class. It took her some time to become comfortable with other people being around while we worked together. Twice she got up and left the class early. When I caught up with her, she told me “I feel dumb, like everyone else understands and I don’t. I have problems at home with my kids. It’s too

much.” She returned the next day where I made a point to work with her again. “I can’t remember,” she complained one day, “The beatings made it so that I have no memory for this.” Trusting my words that she was doing just fine, she returned again and again and made solid progress.

When asked for anonymous feedback after 1 ½ months into the GED program, I found that the participants were honest, some asking me to slow down, some asking to work in groups of four instead of the horseshoe formation that one participant had requested at the beginning of our sessions together. Some asked for more one-on-one time while others expressed appreciation for their learning. I provided initiatives to negotiate the direction of their learning by providing a suggestion box at the back of the class every day.

During class time the participants largely set the pace. Scaffolding quickly became complex because their learning curves were different. I continued with evaluations for the purposes of feedback for the students. I gave them license to write these evaluations when they felt they were prepared to write them. The students were given an opportunity for unlimited formative feedback using each evaluation. This experience was very different to that of their early mathematical summative assessments which could be seen as oppressive.

I knew that the exams were looming but also that the students could not tackle problems that they did not have at least procedural understanding of how to do. To complicate matters, procedural understanding was not enough for most of the participants. After the first day, they demanded more of me. We developed a conceptual groundwork in all topic areas.

It was only after I began to interview the participants that I began to realize that the interviews themselves were triggering one-on-one bonding between us. Additionally, the

interviews gave us a chance to talk openly about individual student progress and I found that the participants used them to provide me with feedback on their progress. Telling me about their lives seemed important to most of the participants which made sense since I had told them about mine. All of the participants that I asked to be a part of my study complied without hesitation. The interviews took place late in the program and they affected the program deeply.

Tina was consistent with her attendance and work habits. I was impressed with her progress. I knew that she had a good comprehension of the basics of algebra and her work was showing promising results. Yet, she spoke up on more than one occasion saying she did not understand the concepts. I knew she did. On one of the rare occasions she spoke up amongst her peers, she told me she did not understand an algebra question we were working through on the board. I went back to the beginning of the question and asked her solve the first step. She did. I continued moving through the question, not giving any hints along the way and she answered the entire question and got the correct answer. After indicating that the answer was correct, she looked up and said “but I don’t know how to do it.” Never, in my 25 years of teaching mathematics had I encountered a similar situation and felt that I needed to reflect on what Tina was *really* saying. I announced to the class the following day that there were two individuals in the class who did not believe that they understood concepts that they indeed did. I believed that Tina, along with Kaylee, were exhibiting indicators of learning too much, too quickly. When I finally interviewed Tina, she expressed shock that I had included her in my list of two students. She began to speak up in class far more often after the interview, even openly challenging the strongest student in the class.

The participants were asked in the interviews how important they felt it was that they were given deeper understanding of each concept as well as the procedure for solving each problem. I was excited to take the tools I had obtained from the education program that deepened my own understanding of some concepts to the participants in this program. Having taught mathematics to mainstream students out of high school, older adults and at-risk students for many years, it was my sense that the older adults and the at-risk students generally relied heavily on conceptual understanding in their learning. I believed at the time that the reason for this was the fundamental issue of trust. Older adults and at-risk students did not trust the world around them and that seemed to manifest itself inside of the classroom. They needed to be convinced. It quickly became apparent by the questions I was being asked in the GED program that conceptual understanding was vitally important. Eight of the eleven participants admitted that they need a strong conceptual understanding before they could learn the procedure involved. Three spoke of not needing to understand to do the work. I noted that on several occasions, both Elizabeth and Cara were not able to move on to learn anything else until those gaps were filled. Anne commented “When I had to work on paper I thought it was boring but when the teacher would give us something to work with (manipulatives) it was more easy to understand.” Sarah agreed when she compared how she was taught geometry compared to the conceptually-based comprehension she was experiencing in our GED program. “I didn’t really like math in elementary school.” “I didn’t really like all the formulas in high school.” “I liked geometry. My teacher didn’t teach geometry like you did and I didn’t understand.”

While teaching in the GED program, I gave the participants my phone number, my e-mail address, my home address and told them to call or e-mail me anytime with problems and that I

would help them from afar. I asked them if they had long distance. No one did. Some did not have telephones. None had internet. We set up a code system where they would phone me and let the phone ring 2x and I would call them back. After several weeks of no one contacting me, I began to telephone the recreation centre daily, asking if anyone needed help. Two participants took advantage of this form of communication, but only once. No-one ever phoned or e-mailed about specific mathematics problems although I was contacted several times to give rides to participants and their family members. I began to ask the participants why they were not contacting me for help. Anne felt confident, “that I knew enough to pass the exam. I just wanted to pass and I felt that I had done enough.” Alternatively, Tina responded, “I didn’t feel that I could do it on the phone or by e-mail. I wanted you there sitting beside me. It just wouldn’t have worked and I knew that.” I asked her why she did not come and see me when she came to Thunder Bay. She replied, “My uncle would always drive me and he didn’t want to make extra stops. He got a very bad scare on the highway a few years ago and he doesn’t like the responsibility of driving anyone to Thunder Bay. So I could never stop.”

The struggles that the students experienced in the GED program were surmountable with an unlimited time frame for program support. A limited budget, however, was the reality that all of the students were required to confront. The inadequate time-frame set most of the students up for failure because 3 ½ months to tackle seven years of mathematics education was not an achievable goal for them. My fear is that many students left the program with more frustration than when they began, further wounding already fragile identities in the process. I had offered them non-oppressive pedagogies for 3 ½ months but in the end, and despite their learning under those conditions, they ran when they were faced with the oppressive assessments that were

offered by the GED exams; oppressive assessments that they had plenty of negative prior experience with.

Along with identity, social issues such as friction with the coordinator, problems at home and attendance challenged the participants' ability to learn within the program. Students had difficulty with homework due to overcrowded housing. The exam schedules were inflexible, intensifying the impact of all of the issues identified in my study.

Struggles at Home: Social Issues

Throughout the program I observed signs of students overcome by personal difficulties on a weekly basis. Students who were normally full of fun and upbeat would arrive only to sit and stare into space for the day. I suspected that this would go on all week because often they would continue this into my next weekly visit. Some students would tell me about their difficulties, some would talk to the Coordinator. Tanya became pregnant and lost her baby on the long walk home from class later in the program. She spent several weeks recovering as a result during the lead up to the exams. Kaylee lost a family member to prison and another died during the program. Tina's children lost both their grandfather and their father when they died within a three month period of one another. Additionally, she was later hired full time by the band and had to quit the program. Michael was also hired by the band which resulted in him later quitting the program. Anne, who was pregnant when she entered the program, found herself trying to manage several children at home along with her growing pregnancy and school work. David's wife was given a job with the band which resulted in him having to quit the program to look after his children.

Cracks in some of the factors that influenced identity of the participants began to emerge shortly before I was instructed by the director to begin teaching directly to old GED exams. The students were provided with their own laptops to use while in the program. I immediately loaded several you tube files that I had downloaded on to each computer. Attendance was becoming an issue for the first time. Cara preferred to work at home when she did not have the one-on-one time she felt she needed. Kaylee complained openly that they were not being paid when they were late for sessions. Michael grumbled that he was not being allowed to go on the internet. Two months and three weeks in, it was time to drop everything we were doing to study directly for the exam. Our efforts to develop conceptual understanding were trumped by the need to focus on the procedural.

Many of the participants seemed incapable of doing work at home. Overcrowded housing seemed to be the predominant reason with six of the eleven having young children at home to return to after class. For this reason, these participants seemed to value their classroom time, concentrating fully on their work while given uninterrupted time and an environment conducive to learning.

I decided that it would be prudent to set up a mathematics ‘marathon’ of sorts where students would be introduced to the exams over a five day period. In this way, I hoped to have them attempt the exams, and after marking, go over the questions together in detail and give them an opportunity to do each exam a second time. My main concern was that students, who were moving forward with their comprehension, thus enjoying increased confidence, would be alarmed at their initial exam results and react by removing themselves from the program. I asked the Coordinator to set up five consecutive days over a long weekend.

Medical appointments, hunting season and child-care issues resulted in attendance issues throughout the program but attendance overall was relatively stable prior to the “five day marathon.”

The five days were well attended by Sarah, Tina and Maureen and somewhat attended by Anne and Michael. Kaylee, who had expressed frustration with the Coordinator on several occasions, did not attend because the Coordinator attempted to cancel the first day of the marathon citing weather conditions. Michael told me of the situation between himself and the Coordinator coming to a head when she closed his computer abruptly. He expressed frustrations that the Coordinator was treating him like “a child.” Elizabeth later told me that she considers her weekends her own. She did not attend any of the five days. Suzie said she had to “go to town to take my child to get medical attention.” David told me he had to look after his children. Tanya was recovering in the city from the loss of her baby. We worked through four exams, giving the students in attendance an opportunity to write them twice. Although all of the marks were well below passing on the first attempt, all exams were above passing on the second.

At our next regular session, I made copies of all of the exams and solutions for the missing students. I observed that the gap between those who had attended the marathon and those who had not became very distinguishable and altered the tone inside of the classroom. Elizabeth, Kaylee, Suzie and Michael, who attended one of the five days, all quit attending classes. Elizabeth, Kaylee and Suzie did not write the exam. Michael did but talked with Anne throughout much of the exam time until the GED examiner told them if they did not stop, they would have to leave. Cara told me later that she did not do any calculations. She guessed at most of the answers which were largely multiple-choice.

Students who wrote but who did not pass with the required mark for a GED pass on their mathematics examination were given a second opportunity to write the exam. I returned to the community to tutor the students. Anne worked hard for one day but had to leave her family in the city where Health Canada had placed her until she had her baby. She stopped attending after the second session. Michael returned once, briefly, promising to come back. He did not return. Cara stayed and worked diligently, one-on-one with me. She had come a long way in the preceding months and I felt that with one more two day session, she would have a chance at a passing mark. When she did not arrive, I woke her up at home. She told me that she had stayed up most of the night drinking. When she did arrive, she was not capable of learning due to her physical state. The next day we tried again but the alcohol poisoning had lasting effects. We ran out of time. She was unsuccessful the second time and did not show up for the sessions that led up to the third exam that five students had registered for. When I asked her why she told me, “I am fed up because I didn’t pass.” Anne expressed similar frustrations when I asked her why she did not show up for the third set of sessions. “I guess I feel frustrated because I didn’t pass. I think that is why.”

Discussion

Identity issues seemed to drive the analysis in my study at every turn. The interviews revealed that identity disconnects have been experienced by the participants in many different ways and that for some, those disconnects continued to take place within the GED program itself. Throughout the study, I implemented many of the measures I have used in my teaching of at-risk students in the past. I felt this was warranted because all of the students have come from at-risk backgrounds in that they did not graduate from secondary school with their peers. The

data from my study seems to challenge Widdowson and Howard's (2008) claim that schools that work well for all students work for at-risk students too especially in secondary school experiences. The participants repeatedly talked about the transition from elementary school to high schools that work well for the mainstream population as being, for them, a setup for dropping out of school. Homesickness, not recognizing the mathematics they were expected to know, cultural disconnects which included changes in diet and incongruities with trends in the mainstream student population all contributed to the breakdown in their engagement with their educational experience during this transition.

These findings concur with Dei's (2002) claim that students who do not engage will eventually drop out of school. McLaren (2002) would see the participants of my study as “spitting in the eye” of the system when they did so, in a desperate attempt to maintain what was left of who they were. Sadly, history may have repeated itself in this regard when the GED students who were not successful with the exam and discontinued their efforts despite being offered extensive tutoring. If Gustein's (2008) approach had been an option for the tutoring of these students, it may have been possible to help with empowerment and overall interest in the mathematics the students were learning by incorporating critical thinking into their math program. Unfortunately, I was teaching to an exam schedule that had no room for Gustein's suggestions of flexibility in student engagement. It could be argued that the GED program itself is a form of oppression through which the Band Council can claim that it was the participants who failed to deliver.

Initial evaluations indicated that for the most part, early learning by the participants up to grade 5 in mathematics was relatively well developed procedurally. The participants could all

add and subtract using procedural methods. They all knew their times tables to some degree and could multiply two digit numbers. The implications that they all ended up dropping out of school are somewhat at odds with the claim by the Education Quality and Accountability Office (2010), and the Expert Panel on Student Success in Ontario (2004) that students who master the fundamentals in mathematics are likely to succeed later. The cornerstone for these participants' experiences in mathematics seemed to be heavily influenced by their claims of not being taught beyond grade five. This claim strengthens Kajander's 2010 argument that Aboriginal students have good reason to be suspicious of what they are being taught. Certainly Kajander's prediction that trust issues play out in students' ability to learn was observed later in the GED program. Several attempts were made to address this critical trust issue that linked the participants' identity issues to that of their ability to learn.

Early life experiences that shaped the participants attitudes toward education discussed during the interviews included being beaten at home, bullying and homesickness. Many issues could find their generational ties to the effects of residential schooling of the parents of the participants, and in the case of Maureen, the participant herself. Substance abuse by parents, claims of sexual abuse, and parental attitudes toward school, all affected by a general sense of oppression, of which residential schools are one form of outworking. If Chrisjohn's (1997) contention that Aboriginals are a people whose minds have been deliberately rendered dysfunctional are true, then the participants in this study can lay claim to its generational effects.

Claims that the various charges of dysfunction that were recorded in the interviews heavily impacted the participants' ability and desire to learn reconciles with Broatch's (2011) claim that children and young adults' experiences both in and out of the classroom directly

impact their overall learning curve in school. Additionally, they agree with Gustein's (2008) contention that students are often dealing with all-consuming social problems and that solid cultural and social identities are essential for students to be who they are. Social issues appeared to continue to play a role in the ability of the participants to engage in their learning to varying degrees indicating that for these students, Broatch's claim was valid for older adults as well. It would appear that Agbo's (2001) argument that it is crucial for teachers to comprehend the culture they are teaching was indeed critical for learning to take place inside of the classroom of the participants.

Not to be lost in the effects of social problems, students additionally claimed to be positively influenced by their social conditions. Sarah's reflection on her parents' positive influence on her decision to enrol in the program and to work hard to pass the exam was one example. Wanting to live up to her mother's desire that she become a nurse likely motivated Anne to return to school, re-establishing previously broken ties of engagement with her learning. This supports Kajander's (2010) contention that the role of parents is intertwined with the role of educators and that both support student learning.

Other early childhood issues complicated matters such as a doctor's diagnosis interfering with Cara's clearly capable abilities to learn mathematics. Cara, among others may have unknowingly been victimized by what Agbo (2002) claims is the tendency for students not to learn when they view themselves as failures.

The fact that cultural sessions were being held within the program to strengthen ties to students' traditional roots, gave the participants a focal point to reflect on the importance of traditions and culture in their own learning. Although Lunney (2010) observed that verb centred

language needed to be considered when teaching in First Nations communities, this did not reconcile with the participants in my study. Although the participants seemed divided as to the value of traditions and culture in the learning of mathematics, most agreed that it was important to learn about their traditional roots somewhere in their education program. This challenges Widdowson & Howard's (2008) study that implied that culturally sensitive programs were not part of the answer. Their "out of control classrooms" (p. 259) were cited as problematic for many participants in my study, particularly for those participants who were bullied while attending their community school. Concerns from Anne that whites only made matters worse when they attempted to teach Aboriginals their own core values, supports Jenkins' (2004) claim that discussions of stereotypical imagery such as dream catchers were contributing to the problem. The notion that the traditions of one culture can be taught by another is clearly ludicrous to the participants. McPherson & Rabb (2010) and Adams (2010) agree, arguing that Aboriginals are a people without their own identity and this loss of identity manifests itself in students' ability to learn. Indeed, several participants voiced concerns of a loss of language and traditional roots. Sarah's comment that "cultural components are important because they help you learn better and they help you be a better all-round person" was indicative of someone who knows her own mind well. It is interesting to note that Sarah was the only participant to pass all of her GED examinations in her first attempt.

One-on-one learning became a solution as much as it became an issue supports At Risk Students (N.D) findings that one-on-one teaching is effective in the teaching of at-risk students in mathematics. The At-Risk Students report also supports my suspicions that Cara's need for one-on-one learning may stem from not being brought up by her mother when it suggested that

at-risk students need a connection to their educational assistant or tutor as much as they require the learning of topic areas.

Gustein (2008) suggested that students need to see themselves as capable of changing the world. My analysis of the data would alter that contention somewhat, suggesting instead that the participants needed to see themselves as capable of changing *their* world. With the exception of Michael, all of the future aspirations of the participants included areas of education which would directly impact the lives of those people in their community. Nursing, teaching, paramedics and starting up a restaurant in her community were all included in participant goals with nursing predominating. The participants were keenly aware of niches within the community where they might provide a service to meet immediate needs.

At the same time Gustein (2008) argued that development of the social and political underpinnings of society requires a deep understanding of mathematics and its practical applications. Five of the participants complained of not being taught beyond grade five. One participant admitted to being tested by Sylvan learning at a grade four level of mathematical comprehension prior to her enrolment in the GED program. Their lived experiences reinforce the findings of the Auditor General Report (2010) that identified that Aboriginals are 28 years behind their mainstream Canadian counterparts, an education gap that speaks to the proportion of Aboriginals in their communities who have high school diplomas. As a researcher, I was not prepared when I came face to face with the evidence. How did this happen?

The data itself indicates that many of the participants in my study were sent to the larger outlying city for their secondary education, some based on grade levels passed, one based on his size and another based on her biological age. The three participants that were sent to the city to

board with strangers based on the grade levels passed, all claimed that they had passed grade eight in their community school. Consistent with Deyhle & Swisher's (2007) contention that students from their study were being given the same work over and over again, two participants from my study remembered being given the same worksheets multiple times, with Cara accusing the teacher involved of “playing with my emotions.”

How does this data stand up in the face of the Province’s own equity ideals. How does it fit in with NCTM's equity principle which claims to deliver all students with “access to an excellent and equitable mathematics program that provides solid support for their learning and is responsive to their prior knowledge, intellectual strengths, and personal interests” (Principles and Standards for School Mathematics, 2000, p. 12)? It does not. The truth is, the equity principle does not even apply to First Nations reserves. Enforcement of the provincial curriculum is not mandatory on Indian reserves (*The Indian Act*, 1985). As a result, teachers in First Nations communities have the flexibility to teach whatever they choose to teach in their mathematics programs. This begs the question of why teachers would not want to teach the children of First Nations communities full mathematics programs? Did they themselves not have the mathematics skills needed to teach beyond grade 5? Who were these teachers? In order to attempt to answer these questions through the data and through the literature, I will first examine Widdowson and Howard's (2008) argument that standards for assessment of Aboriginals are being lowered, resulting in lower educational expectations. This argument is used by the authors as a reason why the education of Aboriginals should not be in the hands of Aboriginals. To clarify this point, it is important to note that the teachers teaching on First Nations reserves are graduating from provincial teacher education programs and that this fact alone lends itself to

wonder if Aboriginals could possibly do any worse than what the provinces are doing in providing well qualified teachers to First Nations communities who are prepared to stay and build the level of trust that underpins the success of their students. In addition to the repetition of the same level of work and uninspiring teaching strategies, participants complained of bullying inside of their classrooms indicating difficulties with class-management practices. Participants remembered fellow students throwing items around the class on a regular basis. Several participants remember “learning nothing” inside the walls of their classrooms. These charges seem a lifetime away from the metacognition and deep reflection of teaching practices that Rodriguez & Kitchen (2005) propose.

Complicating matters, Cara and Michael both talked about teachers not staying in the community for long periods of time, often leaving mid-year to take teaching positions elsewhere. These two participants named a long list of teachers that affected them one way or another in their tiny school of less than 50 students in total. It seems, for the participants in my study, that teaching mathematics at the intermediate level, was, for some reason, beyond their capabilities. It seems possible from the data that the teachers that taught the intermediate grades to some of the participants did not want to be teaching in this First Nations community, perhaps any First Nations community, but chose to because they were not offered jobs by school boards upon graduation. If so, did that mean that these teachers had less to offer students than those who were hired by the boards? We will likely never know the answers to these and other questions surrounding the mathematical competence of the teachers themselves.

Leading Math Success (2004) recognizes that teachers that teach mathematics to grade seven and eight students require a strong conceptual comprehension themselves. Conceptual

comprehension was certainly an area for concern with all of the participants but many of them, according to their initial evaluation, had no intermediate procedural skills either. Some could not draw an x, y axis. Recognition of symbols such as the various symbols for multiplication and division was sparse at best. So many students did not know that the line under a number, separating the numerator and denominator represented division that I felt that I had to teach this to the entire class.

It is possible that two of the visibly older participants had forgotten some of these basic notations but I find that unlikely in the remaining participants who were, largely in their early 20s and likely not out of school long enough to indicate that the bulk of the problem lay with memory loss. The memory of not being taught beyond grade five indicated at least one reason, other than identity loss, for the plight of these participants. I would suggest that the fact that many of the participants were not taught beyond grade five in mathematics is symptomatic of a breakdown of educational equity across the province. Agbo (2002) argued that students are critically impacted by their learning culture. What kinds of learning would the participants derive from the atmosphere of their elementary school classroom and the organizational design of their school? One can only speculate about the impact of being subjected to humiliation in their first weeks of high school, at such a tender age, and how that must have impacted on their identity. These speculations resonate with the interviews in this regard that the effect was so deep in fact, that mainstream scholars cannot possibly understand on any level what this might mean for the participants who now must overcome these hurdles to move forward with their learning. The fact that all of the students dedicated themselves to the program every day, all day, for close to three months before attendance became an issue is nothing short of miraculous and

speaks to their character and will to continue against all odds. These participants are a people to be admired.

The participants were all questioned about their conceptual requirements for learning the various concepts that we were investigating. Eight of the eleven participants claimed to need to understand the concepts well before they were able to learn the associated procedures. Indeed, questions that arose in class indicated a demand for understanding of concepts. Most of the participants did not hold back their questions when they needed further conceptual understanding. As their instructor, I used a combination of conceptual and procedural based approaches. This combination of approaches was supported by Balfanz, MacIver, and Byrnes (2006) who argue that at-risk students require a program that is a mixture of conceptually-based mathematics augmented by procedural knowledge. Further, the Ontario Curriculum Grades 1-8: Mathematics (2005) has specified that conceptual-based learning is important especially for at-risk students. Stigler and Hiebert (2005) agreed that more conceptual understanding leads to higher achievement in mathematics. The data supports these views as the students were, indeed, learning. The class average rose from 42% on the first initial evaluation to 74% when asked to write it a second time. Additionally, it was noted that the participants were using conceptual comprehension to derive the circumference of a circle rather than rote memorization.

Both in and out of the classroom, many of the participants were telling me that they had never been taught like I was teaching them. These comments reconciled with Anyon's 1980 study which determined that the poorest sectors of society were being taught by rote procedure. Clearly, the participants related well to conceptually-based learning of mathematics. They were relating so well, in fact, that eight participants arranged to come to the city where I lived one

Sunday on their own time so they could connect with the conceptual methods that I was offering them, pedagogies which were largely augmented by the teacher education program that I had recently graduated from. Did the data indicate that the participants left school because they were being subjected to teacher-directed learning? Did they find such learning to be oppressive? Certainly Anne indicated that manipulatives helped to hold her interest while attending a provincial school. The participants did not admit to feeling oppressed by the way they were taught mathematics, but if they dropped out of mathematics programs because they felt the material was beyond them, this would indicate that the level of their elementary learning was itself oppressive.

Most of the participants openly and regularly asked questions in class and openly challenged me if they felt that they had something further or contrary to offer. This did not support the findings of Kajander and Zuke (2007), which indicated that conceptually-based learning might not be congruent with Aboriginal tendencies to remain quiet in their conceptually-based classrooms.

Michael's memory of using old books and unfamiliarity with manipulatives indicates reconciliation with Agbo's (2002) assessment that education offered in First Nations communities will remain mediocre until the Federal Government commits fully to the funding, resources and support needed for a full jurisdictional transfer for education.

Lack of internet access was a problem for augmenting what the participants were learning, especially given that the time I was able to commit to teaching was limited to two days per week. Further, without internet access and computers of their own, students learning mathematics at an intermediate level are at a distinct disadvantage when compared to their mainstream

counterparts. They are unable to take advantage of provincial on-line homework tutors, unable to access Ministry Critical Learning Instructional Paths Supports (CLIPS) and Target Implementation and Planning supports (TIPs) resources, you tube videos such as that offered by khanacademy.com and other on-line resources that help move students forward. Friction that the students experienced with the Coordinator denying them access to e-mail and Facebook might never have been an issue if the participants had daily access to internet sites in their own homes. As it was, and according to Michael and Kaylee, the friction that resulted due to varying factors between the Coordinator and these students contributed to the participants removing their emotional presence from the program. Introduction to previous exam sets also proved too much for some students who were expected to learn through eight grade levels in 3 1/2 months. Those that were allowed to enter the program late had even less time to manage this feat. One cannot help but wonder what long term effects were experienced by the five students who wrote but did not pass the exams. Certainly, despite being offered additional tutoring without program supports, the participants did not return with the same level of motivation that they had displayed early in the program. In fact, the last four tutoring sessions leading up to their supplementary exams were unattended. This data alone indicates that the process of being asked to do too much, too quickly, further damaged the fragile identities of these students. The fact that they moved forward with their learning is of little consequence if they do not feel capable of re-visiting their learning in the future.

Attendance issues, although non-existent early in the program, became prevalent when the students were asked to study to the exams which coincided with the friction developing inside of their working environment. Attendance was closely monitored by the coordinator who reported

her data to the director of the program. This close monitoring was consistent with the literature which claims that First Nations communities recognize the need for close monitoring of attendance for academic success (McLeod-Shannon, 2008). Additionally the data on elementary school attendance that was provided indicated that attendance data was important and influenced decisions for moving forward.

The attendance data collected in the elementary school while the GED program was progressing was important because of the numbers of absences it revealed. Clearly, attendance in the elementary school in this community is an issue affecting students later in life. Kajander and Zuke (2007, pp. 12, 19 & 20) note a strong correlation between attendance along with other social issues and their role in contributing to becoming at-risk in mathematics:

Issues which may not seem to be directly related to mathematics itself, such as attendance, behaviour and school transfers, have all been suggested to have contributed to a student becoming at-risk in mathematics. In addition to these issues are those with respect to beliefs about mathematics learning. Students who have low levels of confidence as well as lack of self-motivation will likely have difficulty persevering through mathematical problems if they do not have a strong belief in their ability.

On the surface, the data appears to support the notion of attendance, behaviour and school transfers adding to the problem. After scratching the surface, however, it quickly became evident that these issues were symptoms of the problem, not the problem itself. Cara complained of not attending school because of her experiences of being bullied. This begs the question of why the children were bullying her. She spoke of “knowing more” than her counterparts because she came from a town school. Was the perception of being educated in the city contributing to the issue? Were these students themselves experiencing difficulties at home and taking it out on her? If so, why? If their home lives were less than harmonious, this in turn begs the question of

why? The same level of questioning needs to take place for all issues that appear to determine students' risk for experiencing difficulties in mathematics.

Conclusion

Where then does it end for the participants? Many of the problems plaguing the students could be traced to their treatment at the hands of the dominant culture. This fact is important because it has infiltrated and affected every aspect of who they are. What then, is to be done and who is to do it? In this study I watched the students move from a place of high motivation and drive, willing to face massive challenges on a day to day basis, to walking away in frustration and anger with equal determination.

My point here is that at all stages, the decisions to act and react were theirs and theirs alone. Not being taught mathematics beyond grade five, some might argue, is deplorable. If such is the case, the participants needed to know that and generally did but it is also important to note that it was not *their* behaviour that caused it to happen. Their responsibility began and ended with their reaction to what happened *to* them. I would argue that what was happening to them is still happening. These students were being offered the GED program as a gateway into higher education. The GED program can substitute for a high school diploma for some students entering the work force. Yet mature student admission into their local university requires only two years out of school and grade 12 English for the entrance prerequisite of many of the programs offered. The local college offers upgrading programs and extra supports for mature students wanting to register. Why were the GED exams being offered rather than upgrading programs to those students who were interested in pursuing higher education? During the program and as a researcher I observed the participants disengaging themselves from

responsibility that clearly did not belong to them. This freed them to learn, and learn well, for the time they chose to commit. In First Nations communities the sense of alienation is so complex and so deeply steeped in their history since contact, that sorting through the causes and effects could take a lifetime, and even then there is no guarantee of complete understanding. Collectively, however, and as a community willing to engage in critical thinking and research, these participants might have a chance to face their realities in such a way as to strengthen and bind their broken identities in truth and responsibility for self.

McPherson and Rabb (2010) support the dissemination of the data when they argue that critical thinking and research are where First Nations communities need to concentrate their efforts. The age old philosophical question, “Who am I?” might be more poignant in the hands of these people than of anyone else in Canada. The question of identity will only ever be answered through education and unless answered, my data indicates that programs such as the GED program will provide band aid solutions to a massive wound. Further, the function of this band aid itself is questionable. The uncertainty of whose education system we talking about here takes us back to Burke's central question: “How can you expect your culture and identity to survive if you give all the responsibility for education to another group of people” (Maslen, 1995, p. 47).

When interviewing Anne about traditional teachings her words ring out as poignant to what I observed, as a white researcher in the community of a dominated culture. Anne's comment, I believe, is fundamental to my study, “If it is taught at school I get frustrated because it isn't taught right and then I refuse to do the work.” The decision to take control is an individual one, but it is also collective. It is collectively a community issue. It is collectively an Aboriginal

issue. At best, and as part of the dominant culture, all I or any other part of the dominant culture will ever be able to offer is support. Any more than that is to add to the already massive list of crimes committed against these people, namely the participants.

Whether we, as educators in the dominant culture, are best equipped to take responsibility for the education requirements of the children of the participants is one question. As a researcher from the education system of the dominant culture that enjoys lifestyles that are diabolically opposed to the living conditions of all of my participants while in their community, I have my own responsibility in all of this. We all do.

My participants, however, will decide when to act and when to disengage. As a teacher, my responsibility is to help bring the support together and to make it available for when and if they are ready to rise up once again. As a teacher, I sit here, being paid to wait for students who likely will not come again for a long time, if ever. I use my time as a researcher, documenting their absences, their deliberate removal from an education system which, once again has shown them that their trust in it, will always let them down.

As much as I believe that I am observing in the participants the need to critically analyze their position in all of this, why all of it has been done to them and where they fit in it all, I now, as a result of engaging in this study as a researcher, think that mathematics itself may be part of the solution.

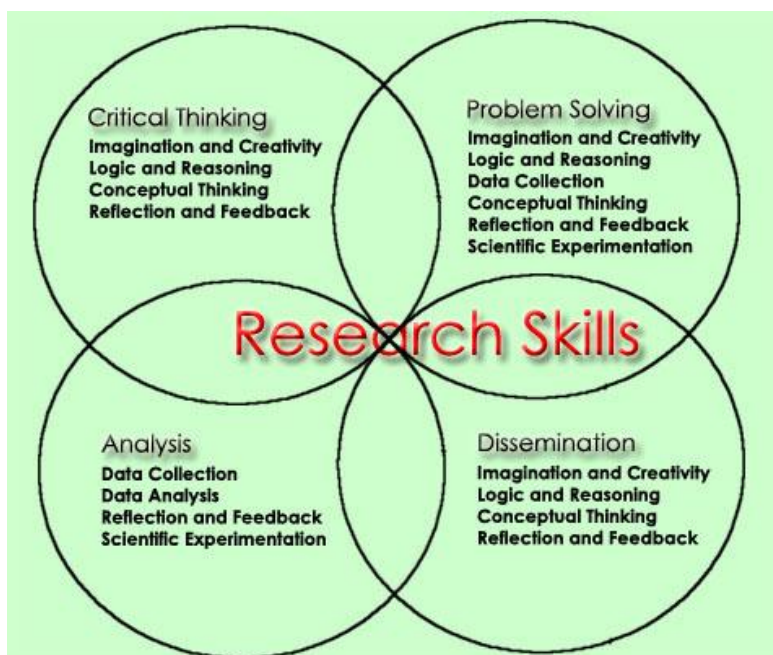


Figure 1

Strong analytical skills are required for success in mathematics programs. Additionally, mathematics requires problem solving skills. The Venn diagram found in Figure 1 ties both the skills needed for mathematics and the skills required for critical thinking back to research skills when combined with skills of dissemination. More research is needed to determine what role mathematics might play in this First Nations community. My observations, however, clearly indicate that identity problems do exist; even in older adults returning to school and that these problems are interfering with their ability to learn. Avoiding failure became important for many of the participants, even if it meant giving up on their dreams albeit temporarily.

When the participants dropped out of secondary school they “spit in the eye” of those who had set them up for failure. As older adults, they may have looked back on that experience and viewed it as a mistake on their part. Consequently, they set in motion a course of action that they believed would meet with success. I assured them that they were all capable of passing the

exam, with the provision that they would have to set aside their lives to do it. In a community where family is the centre of all values, this was not possible for any of them when their families met with crisis. Given that most participants endured crisis situations while I was there, and that student perception of failure/success was centred around their performance during the exam, there is no doubt in my mind that they were set up for failure once again and that I helped to set that in motion. If these students were indeed measuring their own achievement by the standards of the dominant culture, three students were saved through the experience because three students passed the exam. Two students talked and laughed throughout the exam, thus removing themselves from the possibility of 'perception of failure' during the last hours. Three students did not write the exam, thus engaging in a similar form of "spitting in the eye" that they had when they were teenagers. One student guessed at the answers, putting her self-perceptions in a similar light. That left two students, who did not pass the exam and who walked away with a perception of failure that they did not have of themselves when they entered the program. Further, when I worked extensively with Cara after the first exam, she became the third student whose identity was altered by a perception of failure when she wrote and did not pass the second exam. Her decision to drink large amounts of alcohol before our last study time, may have been her attempt to "spit in the eye" of my belief in her ability to pass the exam without guessing at the answers.

Where did this 'perception of failure' begin for Aboriginal people in relation to their education? Did it begin before contact or is the 'perception of failure' a European construct that has been imposed on Aboriginals? Was 'perception of failure' instilled by residential schools in First Nations communities? Were residential schools the inception of this negative notion of self

for Aboriginal people? If so, what about work ethic? Certainly the one participant who was a residential school survivor, worked very hard at her studies indicating a strong work ethic. Most of the students worked hard inside of the classroom but few continued their efforts at home. As a student, I remember looking for any area of public space that I could find to study when I needed a quiet environment. I observed an incredible work ethic in the older adult students I taught at Seneca College, a refusal to give up or give in that I did not generally witness in their younger counterparts. In this First Nations community, I witnessed a similar phenomenon but only inside of the classroom and only while the classroom culture remained intact. I saw no evidence of the participants joining study groups outside of the classroom or requesting quiet areas around the community. When we made the decision to start studying to the exams, when relationships between some students and the Coordinator began to break down, many of the participants simply gave up, each in their own way. In my ten years of teaching older students at Seneca College, not once did I encounter an older student who 'gave up' the way these participants did. One participant remarked that weekends were her own and disengaged, others wanted to go to the city despite their families not relying on them for groceries. Others began to sleep in. Others began to not show up at all. Their desire to get off of welfare and further their dreams came to a grinding halt with the exception of two who were hired out of their dreams by the Band.

There is no doubt in my mind that the GED exams, which appeared to aid a few but hurt more, instilled feelings of failure in many. Was I witnessing the same sense of disempowerment, the sense of worthlessness, and sense of failure that is responsible for the highest rate of suicide of any cultural grouping in the world? Is it possible that attendance issues in their early

education would have improved with a strong mathematics program that met their needs at their community school? What is the relationship between improved teacher retention and student attendance? Is it possible that if students began attending school on a more regular basis that teacher turnover would improve in these schools? These are questions that are to be left for future studies. Who benefited from the delivery of the GED program itself? I would argue that several individuals profited from the program and because I was a paid tutor, my name would have to be included.

As a mathematics tutor, I console myself that despite the participants' disengagement from the GED program in general, and despite my own doubts about how appropriate the GED program was for these students, there is no doubt that their math skills have been strengthened in the process. Perhaps these stronger mathematics skills will one day add to the problem-solving and analytical skills that may be necessary for them to move forward as a people.

Appendix A

Appendix A

Interview Questions

1. Which elementary school did you attend and in what years?
2. Which secondary school did you attend and in what years?
3. Describe your mathematical experiences in your elementary years.
4. Describe your mathematical experiences in your secondary school years.
5. Describe the support you received, both at home and at school, for your mathematics education.
6. What did you feel about the mathematics that you were taught in school?
7. Could you comment on the relevance of the mathematics you learnt at school to your everyday life?
8. Why are you pursuing the GED certification?
9. How best do you believe you learn mathematics?
10. How important is it for you to understand mathematical concepts in order to apply the methods you are taught.
11. How important is it to you that your cultural or traditional understandings be reflected in the mathematics you are learning.

Appendix B

Appendix B

Absences at Kateri Elementary School

Grade	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6	Student 7	Student 8	Student 9	Student 10
JK	23	16								
SK	1	45	25.5	57						
One	1	6	8	47.5	43.5	13				
Two	26	55	56							
Three	55	17.5	21	7.5	52	43.5	55	0	14	19
Four	<i>NO</i>	<i>DATA</i>								
Five	18	19.5	30.5	47	32	34	48			
Six	30.5	37	27.5	24.5	31.5					
Seven	39.5	38.5	28.5	5.5	34.5					
Eight	32.5									

Table 1: Absences between September and March of 2011 by grade (Band Councilor, 2011)

Appendix C

Appendix C
Initial Evaluation

Your name please _____

Solve the following questions using any method you like.

$\begin{array}{r} 21 \\ + 43 \\ \hline \end{array}$	$\begin{array}{r} 29 \\ + 43 \\ \hline \end{array}$	$\begin{array}{r} 2.3 \\ + 5.2 \\ \hline \end{array}$	$\begin{array}{r} 2.6 \\ + 6.8 \\ \hline \end{array}$	$\begin{array}{r} 44 \\ - 22 \\ \hline \end{array}$	$\begin{array}{r} 43 \\ - 28 \\ \hline \end{array}$	$\begin{array}{r} 4.3 \\ - 2.8 \\ \hline \end{array}$	$\begin{array}{r} 24.2 \\ - 12.6 \\ \hline \end{array}$
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$$\begin{array}{r} 25 \\ \times 48 \\ \hline \end{array}$$

$$\begin{array}{r} 28 \\ \times 2 \\ \hline \end{array}$$

$$\begin{array}{r} 29 \\ \times 14 \\ \hline \end{array}$$

$$125 \div 5 =$$

$$423 \div 6 =$$

$$\frac{2}{3} + \frac{4}{6} =$$

$$\frac{3}{5} - \frac{4}{10} =$$

$$\frac{3}{4} \times \frac{1}{3} =$$

$$2\frac{1}{3} \times \frac{1}{4} =$$

Show -3 on a number-line (draw the number-line)

Draw an "x axis" and a "y axis"

Fill in the blanks

\div means _____ $+$ means _____ π means _____

\times means _____ \leq means _____ \geq means _____

x^2 means _____ \neq means _____

∞ means _____ \pm means _____ $/$ means _____

$<$ means _____ $>$ means _____ micro (μ) means _____

β means _____ α means _____ milli (m) means _____

kilo(k) means _____ mega (M) means _____

Draw a right angled triangle

Draw a rectangle

Draw a circle. Show the radius. Show the diameter.

What does “perimeter “ mean?

What does “circumference” mean?

In the formula $x^2 + 2x + 3 = 0$, what does the 2 mean?

Why is “x” used?

In the formula $n^2 + 2n + 3 = 0$ will the value of $n =$ the value of x in $x^2 + 2x + 3 = 0$?

Draw a cylinder.

Describe in words what a pattern is.

What is a square?...describe.

Draw a parallelogram.

What is the formula for the circumference of a circle?

What is the formula for the area of a circle?

What is the formula for the perimeter of a rectangle?

What is the formula for the area of a triangle?

Solve $-2 - (-4)$

Expand $(n + 3)(n + 2)$

Write a story problem that could be used to generate $3 \frac{1}{4} \div 2$. Solve your story problem (solve the division).

Write a story problem that could be used to generate $3\frac{1}{4} \div \frac{1}{2}$. Solve your story problem (solve the division).

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