

Manitoba Mathematics Education and the Programme for International Student Assessment:

Goals, Analysis, and Comparisons

by

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Abstract

The 2012 Programme for International Student Assessment (PISA) focused on assessing the mathematics abilities of fifteen-year-old students from 65 participating countries from around the world, including Canada. Both quantitative and qualitative data from this PISA assessment were released by the Organization for Economic and Community Development (OECD), revealing relationships between absenteeism, low socioeconomic status, and poor mathematics performance for Canadian students. Manitoba students ranked just below the international mean PISA mathematics score, and near the bottom of Canadian provincial mean scores.

Manitoba media editorials, Manitoba Government news releases, and local special interest groups' reactions to PISA 2012 results for Manitoba students were mostly swift and negative, calling for further curriculum reform, the creation of a joint professorship in mathematics and education to improve mathematics teacher training, and systematic standardized testing.

This thesis answers the question of whether and to what extent the goals of PISA align with the Manitoba Government's goals and priority action areas, and whether the published results of PISA 2012 provide information that addresses the Manitoba Government's education goals and priority action areas, within the context of mathematics. This thesis provides a qualitative analysis of three PISA 2012 documents, and explores and compares Manitoba PISA 2012 achievement data to Manitoba grade 9 mathematics credit achievement data for English and Français program students, EAL and Aboriginal students to determine whether and to what extent the goals of PISA align with the goals and priority action areas of Manitoba Education and Training, and whether the published results of PISA 2012 provide information addressing the goals and priority action areas of Manitoba Education and Training, within the context of

mathematics. The conclusion reached is that the goals of PISA, and the published results of PISA 2012, provide very little information towards addressing Manitoba Education and Training's goals and priority action areas. Further research needs to be done on the correlation between poverty and educational achievement, which may help educators and policy makers to understand their own positions of power within society and the education system, and how current systems of education and assessment support or eliminate inequities and address socio-economic differences for specific groups of students.

Key words: mathematical literacy, proficiency, equity, poverty, socio-economic status, PISA, OECD, immigrant, EAL, Aboriginal, AAA

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I am thankful for the support of my twin sister, Janis Thiessen, who forged her own path of post-secondary education to obtain a Masters and a Doctorate in another field. Her encouragement through my occasional bouts of self-doubt helped bring this thesis to completion.

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Dedication

For my father, who was my first and best example of what it means to be a lifelong learner and of what it looks like to critique existing conditions while seeking justice and equity for all. Requiescat in pace.

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Manitoba Mathematics Education and the Programme for International Student Assessment:
Goals, Analysis, and Comparisons

Chapter One: Introduction

Background Context

Standardized assessments have become part of the educational landscape across the globe. National and global comparisons of students' achievement in mathematics, reading, and science are made possible through increasing participation in these assessments by school divisions, provinces, and countries. Results of students' achievement are published and analyzed through media outlets, online blogging communities, and Ministries of Education. Along with global academic comparisons and the drive towards globally competitive economies, content areas such as mathematics and science have received increased importance in both post-secondary institutions and in the eyes of employers (Amgen Canada Inc., 2013).

With an emphasis on student performance in specific content areas such as mathematics as a prerequisite for further study or for job opportunities out of secondary school, Manitoba graduation requirements reflect this emphasis with the requirement to complete a grade 12 mathematics course (Province of Manitoba, 2014a). Manitoba curriculum documents have been revised to reflect the purposes of education as career training and as preparation for post-secondary study (Manitoba Education, Citizenship and Youth [MECY], 2009a, p.16). Manitoba students participate in various formative and summative provincial assessments of numeracy and literacy at grades three, four, seven, eight, and twelve (Manitoba Education, 2013b). As well, Manitoba students participate in the national standardized assessment known as the Pan Canadian Assessment Program (PCAP) and the international standardized assessment known as

the Programme for International Student Assessment (PISA). The decision to participate in these national and international assessments is made by Manitoba's Ministry of Education.

The Manitoba Ministry of Education is formally known as Manitoba Education and Training (MET), and my entire career as an educator has been within Manitoba under the purview of MET. I am a third generation Canadian, with parents who grew up through the 1930s depression era. My mother and father worked hard for everything they obtained, and as I grew up I heard many stories from them of their resilience and persistence despite experiencing many hardships in rural Manitoba. Just prior to my birth and the birth of my twin sister, my parents faced severe financial hardship and moved from rural Manitoba and an agricultural life into Winnipeg and an urban environment. Growing up in Winnipeg, I remember always having enough food and clothes, but never having extra dollars to contribute to field trips at school or to purchase the latest clothing styles. With a home environment that encouraged hard work and persistence, I paid my own way through university to obtain a Science degree majoring in mathematics and chemistry and an Education degree majoring in senior level mathematics and science. I taught mathematics, science, chemistry, and physics at the middle and high school levels for fifteen years.

During my time as a teacher, I joined provincial curriculum and assessment committees, creating and revising senior level mathematics courses. Under contract with a rural school division, I created and published three senior level computer programming courses for credit. Under contract with Manitoba Education and Training, I created a student book and teacher support guide for the Health and Radiation Physics portion of Manitoba's grade eleven physics course. I also completed my Level I and II Administrator's certification, applied for and obtained the principalship of a kindergarten through grade twelve school in Manitoba. I was principal of

that rural school for five years. During that time, I began course work towards my Masters in Education degree. I then became a mathematics consultant for a school division in Winnipeg and held that position when the results of the mathematics-focused 2012 Programme for International Student Assessment (PISA) were released. Because of my role as a mathematics consultant at the time, I was particularly interested in the PISA 2012 reports as well as in the local government and media reactions to the PISA 2012 published results. My then role as mathematics consultant, plus my years of teaching and administration, my background of studies, and home environment of hard work and perseverance led me to my own exploration of PISA, its goals and published results, and Manitoba Education's goals for mathematics education. Now that I am currently the principal of an urban school of kindergarten through grade six students, I continue to explore the goals of PISA and the goals of Manitoba Education and Training (MET).

Manitoba Education and Training (MET)

Education of children in Canada is a provincial responsibility, with the exception of First Nations children on reserves who fall within the Federal Government's responsibility in cooperation with First Nations Tribal Councils. Who has access to Manitoba public education, what is taught and when, as well as who can teach are all issues addressed in the *Public Schools Act* (P.S.A.) of Manitoba (2010). Manitoba's *Public Schools Act* allows for public schooling, both funded and non-funded independent schooling, and home schooling (2010, § 262). Education in Manitoba has grown and evolved since the inception of the *Public Schools Act* in 1890, both in terms of student population as well as goals and policy.

Manitoba Education and Training (MET) currently has four overarching goals, in place since the 2009 - 2010 school year:

1. to ensure education in Manitoba supports students experiencing and learning about what it means to live in a sustainable manner;
2. to ensure that education practice and policy in Manitoba is guided by the principle of inclusion;
3. to significantly increase achievement levels of those students who have historically been less successful;
4. to continue to increase the overall provincial graduation rate (Manitoba Education, 2010a).

Prior to the establishment of these four goals, MET established eight priority action areas in 2007 - 2008, which were revised to six priority action areas in 2012 - 2013, including numeracy and literacy, education for sustainable development, education in low-income communities, Aboriginal education, rural education, and education in northern communities (Manitoba Education, 2013b). Each of these priority action areas are encompassed within one or more of the four overarching goals. Manitoba Education and Training (MET) requires teachers to evaluate numeracy and literacy levels of students through various formative and summative assessments in grades three, four, seven, eight, and twelve, as well as testing a sample of students through participation in the Programme for International Student Assessment (PISA).

Programme for International Student Assessment (PISA)

In an effort to provide a tool for participating countries to collect comparative data on mathematics, reading, and science performance of their students, the Programme for International Student Assessment (PISA) was created by the OECD in 2000. This assessment program was designed to test fifteen-year-olds in reading, mathematics, and science. Since the first PISA test in 2000, these assessments have rotated their emphasis triennially on one of those

three content areas for assessment (OECD, 2012). Because international comparisons are made within PISA tests, the OECD has focused testing on age rather than grade level.

Although the test is administered to fifteen year old students, the ages of individuals participating in PISA can range from 15 to 16 years old (OECD, 2013b). For students in Canada and in Manitoba, the majority of participants were 15 years old and in grade ten when they participated in PISA 2012 (Brochu, Deussing, Houme, Chuy, 2013). In 2012, the focus of PISA was on mathematics, the second time since 2003 that this content area was focused on by PISA assessments. The PISA 2012 assessment included not only content area questions that asked students to apply their mathematics knowledge and skills to new situations, there were also separate questionnaires which students and teachers completed to address other areas such as engagement, the educational and home environments of participants, and family socioeconomic data (OECD, 2013b). The results from PISA 2012 showed Manitoba students who participated were almost at par with the OECD mean student achievement, and below the Canadian mean student achievement, in paper-based mathematics (OECD, 2013b).

Table 1. PISA 2012 Country and province paper-based mathematics mean scores and standard errors (adapted from p.19 of Brochu, Deussing, Houme, Chuy, 2013).

Country or Province	Mean Score	Standard Error
Quebec	536	3.4
British Columbia	522	4.4
Canada	518	1.8
Alberta	517	4.6
Ontario	514	4.1
Saskatchewan	506	3.0
New Brunswick	502	2.6
Nova Scotia	497	4.1
OECD Mean	494	0.5
Manitoba	492	2.9
Newfoundland and Labrador	490	3.7
Prince Edward Island	479	2.5

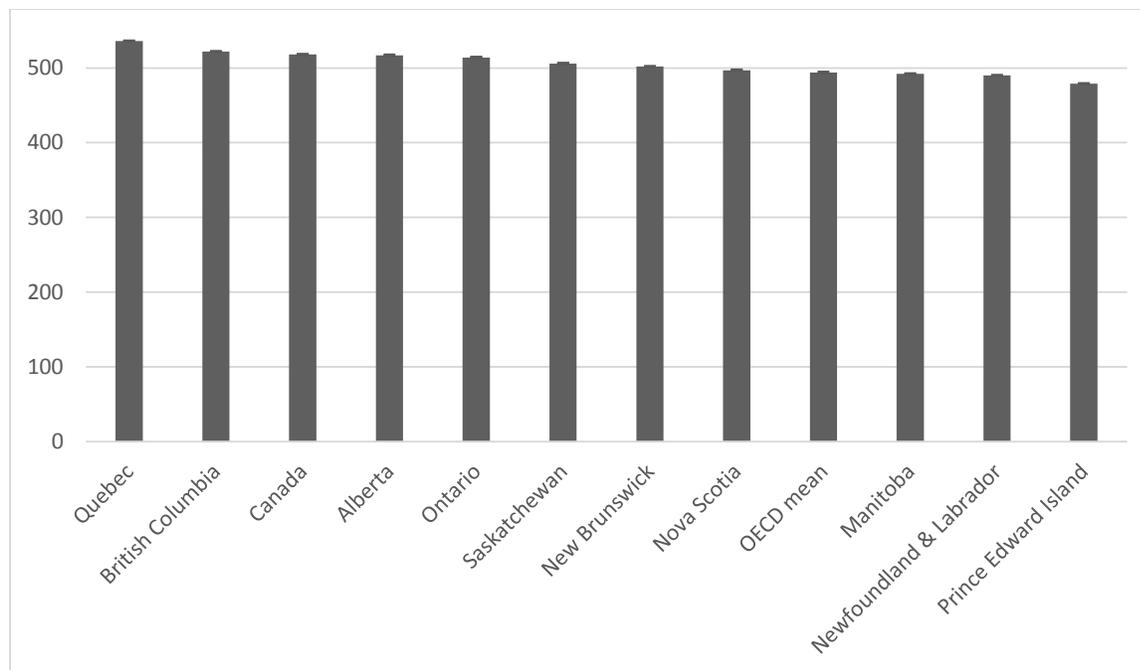


Figure 1. PISA 2012 Country and province paper-based mathematics mean scores (adapted from p.19 of Brochu, Deussing, Houme, Chuy, 2013).

Contextual reports of the PISA 2012 results were published and released by the OECD. These reports provided summaries and country comparisons of the results of student and teacher questionnaires, analyzed socioeconomic factors and equity in education for participating countries (OECD, 2013b; OECD, 2014). With PISA 2012 results showing Manitoba students’ being third last in Canadian provincial mean scores for paper-based mathematics, and with one of the priority action areas of Manitoba Education and Training’s being numeracy, there is value in exploring the goals of PISA, and the published results of PISA 2012, and whether and how much information they provide to address the goals and priority action areas of Manitoba Education and Training within the context of mathematics education.

Purpose of Study

The purpose of this thesis is to compare the goals of PISA, and the published results of PISA 2012, with the espoused goals of Manitoba Education and Training within the context of

mathematics education. This thesis seeks to answer the question of whether, and to what extent, the goals of PISA align with MET's goals and priority action areas, and whether the published results of PISA 2012 provide information that addresses MET's goals and priority action areas, within the context of mathematics education. Three main documents published by the Organization for Economic and Cooperation and Development (OECD) were analyzed qualitatively: *PISA 2012 assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy* (OECD, 2013a), *PISA 2012 results: What students know and can do (volume 1, revised edition)* (OECD, 2014), and *PISA 2012 results: Excellence through equity: giving every student the chance to succeed (volume II)* (OECD, 2013b). The qualitative analysis of these documents sought out all portions of text using language related to the espoused goals and aims of PISA. Text themes from this qualitative document analysis related to the espoused goals of PISA, and the published results of PISA 2012, were compared to MET's stated overarching goals and priority action areas to determine any similarities and differences. Because Atkinson and Coffey (1997) emphasized that no documents should be treated "as firm evidence of what they report" (p.47), a data set external to PISA was also used in this research study: Manitoba grade nine mathematics credit achievement data from 2008 through 2012.

In order to contextualize the qualitative analysis of goal-related language and Manitoba results presented in the PISA 2012 documents and published PISA 2012 results, this research study qualitatively compared Manitoba's PISA 2012 results as published by the OECD to the results obtained from a data set provided by MET within the framework of MET's goals. The MET data set used in this study contains information on core mathematics credits earned by Manitoba grade nine students over five school years from 2008 through 2012, including the

results for English program students, EAL students, and Aboriginal students. Since the OECD has claimed that achieving level 2 in PISA 2012 “is considered the baseline level of mathematical proficiency that is required to participate fully in modern society” (Brochu, Deussing, Houme, Chuy, 2013, p.24), and because Manitoba Education and Training establishes grade nine mathematics as the final year for all Manitoba students to complete the same course of study in mathematics, this thesis analyzes Manitoba students’ mathematics achievement patterns in PISA 2012 and compares this to Manitoba students’ mathematics achievement patterns specifically on their first attempt at obtaining a grade nine mathematics credit. Grade nine mathematics credit achievement is a requirement for graduation in Manitoba, one of the four MET goals. Pass/fail patterns in Manitoba grade nine mathematics are compared qualitatively to PISA 2012 mathematics results for Manitoba, exploring what similarities and differences there are in the comparative data, and providing further context for the comparison of PISA goals and published results to Manitoba Education and Training goals within the context of mathematics education.

Significance of Study

With an increasing number of countries participating in the Programme for International Student Assessment (OECD, 2013a), and with the increased focus in 2013 by the Manitoba Government, local media, and special interest groups on Manitoba students’ drop in the PISA mathematics achievement rankings (Government of Manitoba, 2013a; Zwaagstra, 2013; Craigen, 2013), this study of whether, and to what extent, the goals of PISA and the published results of PISA 2012 align with Manitoba Education and Training’s education goals specific to mathematics contributes to the published literature which has focused on rankings tables and the OECD’s PISA 2012 contextual reports. To my knowledge, no one has yet performed a

qualitative analysis of the OECD's PISA 2012 documents nor taken an in depth look at to what extent the goals of Manitoba Education and Training are compatible with the espoused goals of PISA or its published results. The current lack of qualitative study of PISA documents, and the extent to which the goals of PISA are compatible with MET's goals, means that this thesis is a significant contribution to the gap in current literature. Additionally, the literature at present does not contain a qualitative comparison of Manitoba's PISA 2012 results to those of Manitoba mathematics credit achievement in grade nine, providing further contribution to gaps in current literature.

Analysis of OECD documents related to PISA 2012 provides qualitative research on text portions related to PISA goals and aims published by the OECD. Atkinson and Coffey have referred to documents as "social facts" (1997, p.47), and it is the intent of this research study to analyze and compare "social facts" from OECD documents to the goals of MET. Focusing only on three specific PISA 2012 documents published on the OECD website narrows the research study. Although the OECD's PISA website collection of documents may have inherent limitations, or may be a collection that Yin may have deemed to have "biased selectivity" (2009, p.80), a qualitative analysis of any PISA documents from this collection is currently lacking in published literature. This thesis compares the goals of PISA and published results of PISA 2012 with the espoused goals of Manitoba Education and Training, within the context of mathematics education, contributing to a gap currently in the literature.

Within the exploration of the goals of PISA and published results of PISA 2012, and whether and to what extent they align with the goals of MET, it is important to define terms and phrases such as mathematics literacy, proficiency, socio-economic status, immigrant, EAL, and

Aboriginal within the context of PISA documents and Manitoba Education and Training documents used in this thesis to guide understanding of this research study and its results.

Definition of Terms

There are several key terms that are used in this thesis that need to be defined, and the definitions of these terms as stated by the Organization for Economic and Community Development (OECD) and Manitoba Education and Training (MET) need to be compared for the purpose of this research study. These key terms are used within the PISA 2012 documents, the goals and priority action areas of Manitoba Education, and within the PISA 2012 published results and the Manitoba grade nine mathematics credit data set. If a comparison of PISA 2012 results and MET credit data is to be made, PISA 2012 documents analyzed, and the goals of MET and those of PISA are to be compared, definitions of these terms is an important step in the process. Both the PISA 2012 results and the MET data set focus on mathematics achievement of students in Manitoba, thus important definitions to be compared are the words mathematics, mathematical literacy, and proficiency in mathematics.

Mathematics and mathematical literacy. The Organization for Economic and Community Development has defined mathematics and mathematical literacy similarly, as the “capacity to reason mathematically and use mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena, and to make well-founded judgements and decisions needed by constructive, engaged and reflective citizens” (OECD, 2014, p.17). Manitoba Education and Training has defined mathematics as “one way of understanding, interpreting, and describing our world” (MECY, 2009a, p.12). Mathematical literacy is defined by MET as the ability to “solve problems; communicate and reason mathematically, make connections between mathematics and its applications” (MECY, 2009a, p.5).

Mathematical proficiency. The OECD has defined mathematical proficiency as “the capacity of individuals to formulate, employ and interpret mathematics in a variety of contexts ... to reason mathematically and use mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena” (OECD, 2014, p.25). MET has defined a student with mathematical proficiency as one who “understands the context, has a holistic grasp of relationships, considers alternatives and independently integrates ideas into efficient solutions, makes ongoing adaptations automatically” (MECY, 2009a, p.6).

One of MET’s overarching goals is “to significantly increase achievement levels of those students who have historically been less successful” (Province of Manitoba, 2014a). As well, two of MET’s priority action areas include education in low-income communities and Aboriginal education. With the provincial government consistently identifying immigrant and Aboriginal populations in Manitoba as populations with significantly lower socio-economic status than other groups in Manitoba (Government of Manitoba, 2013b), it is therefore important to define the phrase socio-economic status, and to define the terms immigrant, EAL learner, Aboriginal, and equity as used by both the OECD and MET for the purpose of this study.

Socio-economic status. The OECD has created an index of Economic, Social, and Cultural Status (ESCS) “based on such indicators as parental education and occupation the number and type of home possessions that are considered proxies for wealth, and the educational resources available at home” (OECD, 2014, p.37). Highest occupational status of parents, highest educational level of parents, years of education of parents, possessions such as books and technology in the home, were all factors identified through questions answered by students in PISA’s student questionnaire and used by the OECD to calculate the ESCS (p.136). The PISA 2012 data set included students’ ESCS values in comparison to their PISA scores. Although the

Manitoba Education data set used for this research study did not include information on students' socio-economic status, the population-based research of Brownell, Roos, Fransoo, Roos, Guevremont, MacWilliam, and Levin (2006), which guided the origin of MET's goal to improve achievement of those students historically less successful, used a socioeconomic index that included "unemployment, high school completion, lone-parent households and female participation in the work force" (p.9).

Immigrant, English as a Second Language (ESL), English as an Additional Language (EAL), and international students. Within the OECD's PISA 2012 published results, there were three types of student immigrant status: "native students", "second-generation students", and "first-generation students" (OECD, 2014, p.72). Students could self-identify themselves within one of these three categories through the student questionnaire, and responded to questions identifying whether English is their Second Language (ESL). Students within the Manitoba grade nine data set used in this study were not identified as immigrants since Manitoba Education used a different identifier. Students were identified as English as an Additional Language (EAL) learners within the data set, a status allocated to students when their "first or primary language(s) is other than English, and who require and receive specialized programming and/or additional services to develop English language proficiency and realize their potential within Manitoba's school system" (Manitoba Education and Advanced Learning [MEAL], 2014b, p.33).

Students' EAL status is determined when filling out an application for registration at a Manitoba school, where parents or guardians are able to identify which language is spoken at home (MEAL, 2014b). MET has distinguished between EAL learners and newcomer students, in that newcomers "are in their first year of being reported [in school data], arrived in Canada from

another country between July 1st of the preceding school year and the reporting date, and whose first or primary language is other than English” (Brownell et al., 2006, p.35). For the purpose of this study, the MET data set has identified EAL learners and not newcomer students. The MET data set did distinguish EAL learners from “international students”, those students who are in Manitoba on an international visa but whose primary residence remains outside of Canada.

Aboriginal, and Aboriginal Academic Achievement (AAA) learners. The OECD’s PISA 2012 assessment framework does not provide any method for Aboriginal student identification within the student sample set. In the Manitoba data set used for this research study, Aboriginal students were identified through data obtained from the Aboriginal Identity Declaration form. This form is distributed by schools annually to all students, giving parents and guardians the opportunity to identify their child(ren) as “First Nations (North American Indian), Métis, Inuk (Inuit), Anishinaabe (Ojibway/Saulteaux), Dene (Sayisi), Oji-Cree, Inuktitut, Ininiw, Dakota, Michif, or Other” (MEAL, 2014a). Although multiple categories were possible within the declaration form, the data set used in this research study has indicated students as falling within the “AAA” category, an acronym for the Manitoba Government’s Aboriginal Academic Achievement grant. This AAA category is used by MET to provide per-student funding to divisions for every student identified as Aboriginal through this data collection process.

Equity. The OECD has defined equity in education as “providing all students, regardless of gender, family background or socio-economic status, with opportunities to benefit from education” (OECD, 2013b, p.13). Manitoba Education has defined educational equity as “a condition of fairness with respect to educational opportunities, access, and outcomes for all people” and “equitable opportunities to participate fully in the educational system in Manitoba” (MEY, 2003, p.4).

Research Questions

The major research question addressed by this thesis is: whether, and to what extent, the goals of PISA align with MET's goals and priority action areas, and whether the published results of PISA 2012 provide information that addresses MET's goals and priority action areas, within the context of mathematics education. In the course of this thesis exploration, other questions were addressed to explore the extent to which PISA's goals and published results align with the goals and priority action areas of MET. What are the explicitly stated goals of PISA? What text portions of PISA documents use goal and objective language? To what extent are PISA's goals compatible with MET's goal of education for inclusion? To what extent are PISA's goals compatible with MET's goal of education for sustainable development? To what extent are PISA's goals compatible with MET's goal of improving achievement of students that are historically less successful in Manitoba? To what extent are PISA's goals compatible with the goal to increase graduation rates in Manitoba? To what extent do the OECD published results for Manitoba students in the PISA 2012 mathematics assessment provide information to address the goals and priority action areas of MET? How does the mathematics achievement of Manitoba students who participated in PISA 2012 compare to student credit achievement trends for Manitoba grade nine mathematics? The answers to all of these sub-questions helped address the main purpose of this thesis, determining to what extent the goals of PISA and the published results of PISA 2012 align with the education goals and priority action areas of Manitoba Education and Training within the context of mathematics.

This thesis seeks to answer the question of whether, and to what extent, PISA's goals and published results align with the goals of Manitoba Education and Training for mathematics education, going beyond qualitative document analysis of three PISA documents, and

qualitatively comparing the Manitoba PISA 2012 mathematics results to Manitoba credit achievement patterns in grade nine mathematics. In particular, PISA's espoused aim "to determine the extent to which young people have acquired the wider knowledge and skills ... [in mathematics] that they will need in adult life" (OECD, 2013a, p.14) was explored through data from PISA 2012 and MET grade nine mathematics credit data, including immigrant, Aboriginal, and English and Français program student data. This thesis further explored the MET mathematics credit data set to determine mathematics achievement patterns in the Manitoba grade nine student population, including EAL and Aboriginal students, and particularly compared the 2011 and 2012 Manitoba mathematics credit student data to the other years within the five year Manitoba mathematics credit data set and to the PISA 2012 Manitoba results.

Within this thesis, the articulation, analysis, and comparison of the explicitly stated aims and goals of PISA and the portions of text using goal-related language in OECD PISA 2012 documents to the goals and priority action areas of Manitoba Education and Training, and the comparison of PISA 2012 published results for Manitoba to the goals of MET and to student achievement in mathematics within the Manitoba grade nine credit data set, serves various purposes. It serves to determine whether the goals of PISA are compatible with MET's overarching goals and priority action areas related to mathematics education and to provide research to continue conversation around goals for mathematics education in Manitoba. Comparing trends in OECD published PISA 2012 Manitoba students' mathematics results to the goals of MET and to mathematics credit achievement patterns in Manitoba's grade nine student population provides context for PISA's aim to monitor students' acquisition of skills. It also enhances the discussion of to what extent the espoused goals of PISA align with the goals of

Manitoba Education and Training by showing what is emphasized within OECD published PISA 2012 results in comparison to MET espoused goals and priority action areas.

This thesis qualitatively analyzed three documents about PISA 2012 published by the OECD to determine text portions in the documents that used language related to PISA's espoused goals and analyzed that language to determine the extent to which both the explicitly stated PISA goals and the goal-related text portions in PISA documents align with the espoused goals of MET. The three main documents published by the Organization for Economic and Cooperation and Development (OECD) that were qualitatively analyzed in this thesis are the *PISA 2012 assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy* (OECD, 2013a), *PISA 2012 results: What students know and can do (volume I, revised edition)* (OECD, 2014), and *PISA 2012 results: Excellence through equity: giving every student the chance to succeed (volume II)* (OECD, 2013b). Qualitative exploration of goal related language within these three published OECD documents about PISA 2012 provides an important set of data to determine whether MET goals and priority action areas within the context of mathematics education are compatible with PISA goals, as well as to promote further study of the use of standardized assessments in Manitoba. Comparison of OECD documents' text portions related to aims and goals of PISA to the goals of MET support the exploration of the limitations and rationalizations of using PISA results as part of what guides and formulates mathematics education policy, within the Manitoba context.

Limitations

There are a variety of variables within this research study beyond the control of the researcher, which may place restrictions on either the methodology or the conclusions of the study, or both. The researcher had no control over the PISA 2012 data set, neither the student

population sample nor the methods used to analyze PISA assessment results. Although I had some control over the Manitoba data set obtained from MET, specifically requesting the number of students that passed their grade nine mathematics course for credit upon their first attempt at completing the course in public schools in Manitoba, and specifically requesting a time frame of five years encompassing results from 2008 through 2012, what was not in control of the researcher were the methods of assessment and the professional judgments made by educators to determine whether a student ultimately passed or failed grade nine mathematics in Manitoba. This lack of standardization could provide some limitation in discussion of patterns in results. However choosing to analyze grade nine mathematics achievement patterns by pass/fail patterns serves to focus the analysis on grade nine mathematics credit achievement, a requirement for graduation in Manitoba which is tied to one of the four MET goals for education.

The number of school years requested for the Manitoba data set was limited to a five-year span encompassing results from June 2008 through June 2012, being specifically chosen by the researcher. These years were chosen to include the school year the revised Manitoba grade nine mathematics curriculum became mandatory for implementation (2009 - 2010) and two school years prior to this implementation, the year the most recent mathematics-focused PISA test was administered (2012), and the year the majority of students who participated in PISA 2012 were first enrolled in grade nine mathematics (2011). The data set was limited to five school years, to encompass four years of credit data prior to the year most PISA 2012 Manitoba participants were first enrolled in grade nine mathematics, as well as data from 2012 – one year following the year most PISA 2012 Manitoba participants were first enrolled in grade nine mathematics. To further limit the focus of the research study, the data set from Manitoba Education and Training was also limited to include only those students enrolled in public schools in Manitoba, and did not include

independent schools, or First Nations schools which have an agreement with Frontier School Division in Manitoba.

Limitations in both the Manitoba and PISA data sets can be found in the way students are identified as English as an Additional Language (EAL), English as a Second Language (ESL), immigrant learners, or Aboriginal learners. In the Manitoba data set, EAL learners are tracked through registration data collection by schools (MEAL, 2014a). In the PISA data set, EAL students are referred to not as EAL learners but as ESL (English as a Second Language), and their status is tracked through self-identification in the student qualitative survey through both language as well as immigrant status (OECD, 2014, p.72). In Manitoba's public schools, students' Aboriginal status is tracked through a self-identification process via a form parents or guardians voluntarily fill out at the beginning of each academic year (MEAL, 2014a). In the PISA 2012 data set, there was no way provided to track students who self-identify as Aboriginal. Thus this research study's conclusions are limited to the degree that students and parents or guardians are diligent in their self-identification process within both the Manitoba data set and the PISA data set for EAL learners, and within the Manitoba data set for Aboriginal learners.

The documents used in the qualitative analysis portion of this research study were limited to three documents published on the OECD website specifically tied to PISA 2012. The following three documents were qualitatively analyzed in this research study: the *PISA 2012 assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy* (OECD, 2013a), *PISA 2012 results: What students know and can do (volume I, revised edition)* (OECD, 2014), and *PISA 2012 results: Excellence through equity: giving every student the chance to succeed (volume II)* (OECD, 2013b). Limiting this research study to these three documents serves to narrow the study on mathematics education as focused on by PISA

2012 as well as focused on the framework, the results, and the equity analysis documents related to PISA 2012 that were published by the OECD. Although Yin may claim the OECD's website collection of published documents to have "biased selectivity" (2009, p.80), it is this selectivity and the espoused goals of PISA which are the focus of this research study.

Delimitations

This study is focused solely on the OECD's PISA 2012 assessment and its goals, not on other national or international mathematics standardized tests or ranking systems. This is because within Manitoba the local media, the Department of Education, special interest groups, and the Progressive Conservative Party's most recent provincial election platform all focused on PISA 2012 results and the ranking of Manitoba students' mathematical achievement (Government of Manitoba, 2013a; Zwaagstra, 2013, December 5; Craigen, 2013, December 19; Progressive Conservative Caucus, 2014). Because of this, data sets from other standardized tests were not explored.

This research study does not focus on non-funded schools in Manitoba, nor on federally funded First Nations schools in Manitoba, neither does this study focus on analysis of student data sets by sex, mainly to narrow the focus of the study and not because these areas are not worthy of further exploration. This research study does not focus on data from provinces or territories outside of Manitoba, nor on data from national results outside of Canada, in part to narrow the focus of the study and in part because the researcher is interested in the local Manitoba context. It is worth noting that neither the PISA 2012 results nor the MET data set used for this research study include student data from non-funded schools or federally funded First Nations schools in Manitoba.

This research study's qualitative analysis of PISA 2012 documents does not focus on documents not published by the OECD, mainly to narrow the focus of the study and to determine goal-related language in text solely within OECD documents related to PISA 2012. Although a comparative qualitative analysis of documents related to PISA 2012 not published by the OECD may add to the literature, it was not the purpose of this research study.

This research study's literature review focuses for the most part on literature within Manitoba because this study is focused on local data, local contexts, and Manitoba's education goals. Definitions of the key terms used in this thesis focus on definitions used by Manitoba Education and Training (MET) and are compared to the OECD's definitions for similar terms, such as the definitions of EAL and ESL learners, and the definition of mathematical literacy. Definitions of key terms focus on MET and OECD definitions and not on local media's nor on special interest groups' definitions of these terms since the focus of this research study is on OECD PISA 2012 textual analysis to determine the extent to which the goals of PISA and published results of PISA 2012 are compatible with MET's goals for education within the context of mathematics.

Chapter Summaries

Chapter One has provided the background to the current accepted use of the global PISA standardized assessment in mathematics and to the current goals of Manitoba Education and Training, with the context for this exploration of Manitoba students' achievement providing an introduction to the exploration of the extent to which PISA goals and results align with MET's goals for education within the context of mathematics. Chapter Two outlines the conceptual framework for this research study, a framework based on the published goals of MET: the principle of inclusion, education for sustainable development, improvement of the achievement

of students that have been historically less successful, and increasing the provincial graduation rate (Government of Manitoba, 2015). Relevant literature focused on each of these four goals of MET are summarized, as background towards answering the main question of this research study: to what extent do PISA's goals and the OECD published results of PISA 2012 align with MET's goals and priority action areas, within the context of mathematics education. The conceptual framework forms the basis of the review of predominantly Manitoba Government published literature related to those four goals, including: a summary of Manitoba literature on inclusion, a synopsis of Manitoba literature on education for sustainable development and its connections to mathematics education, literature on historically less successful subgroups in Manitoba including low socio-economic status as well as immigrants and Aboriginals in Manitoba, and a review of the literature on Manitoba graduation rates.

With this thesis focusing on determining whether and to what extent the goals of PISA and the published results of PISA 2012 align with MET's goals and priority action areas within the context of mathematics education, Chapter Three provides the theoretical framework for this thesis exploration, concentrating on a mixed methods approach through the lens of poverty. The discourse in the local media and stakeholders' reactions to PISA 2012 results focused on a quantitative analytical approach to the statistics provided by the OECD through its PISA 2012 rankings tables and contextual reports. Because PISA rankings were analyzed quantitatively through the Rasch statistical model by the OECD, I provide a brief summary of the methodology behind this model of quantitative analysis. What was missing from the local media discourse was a focused inclusion of qualitative analysis of OECD PISA 2012 documents and a lack of qualitative critique of PISA's goals. Chapter Three outlines the research methods and procedures for that analysis and critique. The procedures for quantitative analysis of the MET data set are

provided. As well, I outline how my own assumptions and underlying life experiences, as well as my gender, culture, and socioeconomic status influenced both the research questions formulated for this thesis as well as the approach taken in analyzing the PISA 2012 documents, and the published data from the PISA 2012 and MET grade nine mathematics credit completion data sets.

Chapter Four provides a qualitative analysis of three OECD published documents related to PISA 2012 from the OECD website. Text portions using language related to goals and objectives are analyzed to determine similarities and differences to MET's four goals for education in Manitoba. The Manitoba results for PISA 2012 paper-based mathematics are summarized and qualitatively analyzed to compare what is emphasized in the published results of PISA 2012 to the goals and priority action areas of MET, within the context of mathematics education. To provide further context for the qualitative data patterns from PISA 2012 documents and the PISA 2012 results for Manitoba, an external data set is analyzed in Chapter Five.

Chapter Five provides an analysis of a five-year MET grade nine mathematics credit completion data set for students in Manitoba. Specifically, the pass/fail rate for students' first attempt at a grade nine mathematics credit is calculated and compared to the pass-fail rate for students' first attempt at grade nine mathematics credit in 2008, 2009, 2010, 2011, and 2012. Pass/fail rates for EAL learners and AAA students are calculated and compared to non-EAL and non-AAA students in each of the five years of the data set. These pass/fail rates are all compared to the overall English and Français program pass/fail rates for each of these five years to determine what, if any, trends may be seen within the data set. This data set is part of this research study because it includes those students who were sampled for the PISA 2012

assessment, because a grade nine mathematics credit is required for graduation in Manitoba, and because grade nine mathematics is the final compulsory course in Manitoba prior to students choosing different mathematics courses for compulsory credits in grades ten through twelve.

Chapter Six provides a comparison of the results of the qualitative analysis of the three PISA 2012 documents from Chapter Four to MET's espoused goals, and provides a qualitative comparison of the PISA 2012 Manitoba paper-based mathematics assessment results from Chapter Four to the Manitoba grade nine mathematics credit completion data from Chapter Five. Comparisons are made of the PISA 2012 documents' goal-related text portions, Manitoba's PISA 2012 published results, and patterns of achievement from the MET grade nine mathematics credit data set, within the context of the goals of MET to determine the extent to which the four goals of MET are addressed within the goals and aims of PISA and within the published PISA 2012 results.

Chapter Seven states conclusions surrounding the extent to which PISA's goals align with MET's goals and priority action areas. I outline what are possible questions for further research to determine whether all students in Manitoba are receiving an equitable education in mathematics to prepare them for full participation in society. Using the qualitative analyses from both the PISA 2012 documents and the PISA 2012 Manitoba results compared to the qualitative analysis of MET grade nine mathematics credit completion results, I provide questions for further research surrounding Manitoba Education and Training goals, questions for exploration about Manitoba education in general, and mathematics education specifically. With an understanding of whether and to what extent the goals and published results of PISA align with MET's goals, further discussion regarding the goals of education, achievement, and assessment in Manitoba is possible.

Chapter Two: Literature Review

Conceptual Framework of the Study: Manitoba Education and Training Goals

In the *2009 - 2010 Manitoba Education Annual Report*, four goals were formalized that remain the current four goals of Manitoba Education and Training: the principle of inclusion, education for sustainable development, improving achievement of student populations that have historically been less successful, and increasing the overall provincial graduation rate (Manitoba Education, 2010a). These same four goals are used within this research study to frame the review of Manitoba literature, and were used to frame the analysis of the PISA 2012 documents, published results, and the Manitoba mathematics credits data set to determine to what extent the goals and 2012 published results of PISA align with the goals of MET within the context of mathematics education. First, however, a brief review of the systems influencing MET goals is provided as background.

Systems Influencing Manitoba Education and Training Goals

Canadian context (Council of Ministers of Education in Canada, Western and Northern Canadian Protocol). The Council of Ministers of Education in Canada (CMEC) was founded in 1967 to provide provincial and territorial Education Ministers with “a forum to discuss policy issues related to education”, to undertake “mutually beneficial education projects”, and to “provide a unified voice for Canada’s educational interests” in international forums (CMEC, 2010). In 1993, some provinces within the CMEC signed the Western and Northern Canadian Protocol (WNCP) agreement, which sought to align the western provinces’ and northern territories’ mathematics curricula. Within the following three years a common mathematics curriculum framework for kindergarten through grade nine (K - 9) was created by these provinces under the WNCP banner. As well, a framework for grades ten through twelve

(10 - 12) mathematics was created through the work of the WNCP. Manitoba signed the Western and Northern Canadian Protocol (WNCP) agreement, and revised its mathematics curriculum documents to align with the WNCP framework. Manitoba piloted its kindergarten through grade eight curriculum outcomes in 2006, and its grade nine outcomes the following year. Manitoba revised its grades 10 - 12 mathematics curriculum outcomes and aligned them with the WNCP framework, with implementation of all WNCP aligned Manitoba grade level frameworks of outcomes required by 2012 (Manitoba Education, 2011). Manitoba Education and Training made minor revisions to their kindergarten through grade eight mathematics curriculum outcomes in September 2013, with the addition of end-of-grade outcome expectations for basic facts and the explicit incorporation of the teaching of traditional algorithms for the four mathematical operations as part of the outcomes dealing with understanding of the operations (Manitoba Education, 2013a).

While the work of the WNCP was continuing, in an ongoing attempt to recognize inequity and rectify socio-economic inequality, An Act to Eliminate Poverty in Canada was first put before Parliament in 2011 as Bill C545, subsequently reinstated to a more recent session of Parliament under the name *Poverty Elimination Act* or Bill C233 (2011). On completion of its first reading, one of the items addressed by this Act was the amendment of the *Canadian Human Rights Act* to include “social condition” as a prohibited ground of discrimination (2011, sections 27.2 and 28.3). J.J. Flessa prepared a report for the Elementary Teachers’ Federation of Ontario in 2007, and emphasized a need for examining poverty and what schools can do from a differences point of view rather than from a deficit framework (2007, p.5). His exploration of research led him to conclude that a Canadian framework to explain the relationship between poverty and schooling was nonexistent (p.14). He described how the effective schools movement

rejected the notion of a need for societal change, and focused instead on system change within schools to address the effect of poverty on educational outcomes, whereas much of the rest of literature focuses on the need to fix societal norms and systems to address poverty first before addressing educational achievement and inequities within student populations (p.37). With Canada researching the effect of poverty on education, exploring ways to bring mathematics education under one unifying framework and protocol, and working on an Act of Parliament to address inequity, across the border in the United States there were similar attempts at research on equity in education and unification of mathematics curricula.

American context (National Council of Teachers of Mathematics). The National Council of Teachers of Mathematics (NCTM) has stated that they approach the teaching and learning of mathematics through the lens of constructivism and a “sociocultural theory of learning”, emphasizing in all of their standards documents the context of equity for all learners in mathematics education, regardless of socio-economic background (NCTM, 2004). In the past 25 years, NCTM has published several standards documents on curriculum, teaching, and assessment of mathematics. NCTM’s *Curriculum and Evaluation Standards for School Mathematics* (1989) stated that, “no student should be denied access to the study of one topic because he or she has yet to master another” (p.69). This document began a conscious shift from: a curriculum dominated by memorization of isolated facts and procedures and by proficiency with paper-and-pencil skills to one that emphasizes conceptual understandings, multiple representations and connections, mathematical modeling, and mathematical problem solving (p.125).

NCTM’s *Professional Standards for Teaching Mathematics* (1991) emphasized that students’ ability to perform mathematical computations was not the best measure of their

mathematical ability (p.146), and encouraged teachers to focus on conceptual understanding and problem solving. Three NCTM Standards books were updated and consolidated into one overarching publication in 2000 titled *Principles and Standards for School Mathematics*. The work of NCTM and its *Principles and Standards* were used by Manitoba Education and Training in the creation of Manitoba's curriculum and framework documents. NCTM's *Principles and Standards* (2000) document is referenced in *Kindergarten to grade 8 mathematics: Manitoba curriculum framework of outcomes* (Manitoba Education, 2011) and in *Grades 9 to 12 mathematics: Manitoba curriculum framework of outcomes* (MECY, 2009a).

The National Council of Teachers of Mathematics addressed the issue of equity and the requirement that expectations and support for all students remain high, with “reasonable and appropriate accommodations” and “appropriately challenging content” accessible to all students in their *Principles and Standards for School Mathematics* publication (2000, p.2). A more recent NCTM publication for administrators emphasized providing “equitable mathematics learning of the highest quality for all students” and detailed how administrators could support teachers in this endeavour (2010, p.v). Prior to these publications, Dubiel stated that the development in the 1990s of NCTM's Standards documents for curriculum, teaching, and assessment of mathematics and the Western and Northern Canadian Protocol agreement were supported by educators who believed there was a “curriculum crisis”, where the focus in mathematics education had become a “shopping list of skills to be mastered by children, which is held within many constituencies, notably politicians and some vocal parent groups, and pressures put on schools to reinforce these” which allowed for easier assessments (1997, p.69).

Within the same timeframe of the work of Dubiel, the amalgamation of Standards documents of the NCTM in the United States, the work of the WNCP in Canada, and the use of

the NCTM standards documents in development of Manitoba mathematics curricular frameworks, the Programme for International Student Assessment (PISA) was created by the Organization for Economic Cooperation and Development (OECD).

Organization for Economic Cooperation and Development (OECD). After the ravages of World War II, Europe was financed by the United States over a span of four years under the European Recovery Plan – something the Organization for Economic Cooperation and Development states was an effort to modernize, industrialize, and connect European economies (OECD, 2005). The Organization for European Economic Cooperation (OEEC) was created in 1948 as the group in charge of rebuilding European economies after World War II. The OEEC became the Organization for Economic Cooperation and Development (OECD) after the Canadian and American governments signed the newly created Convention of the OECD in 1960, with the OECD officially coming into existence in 1961 (OECD, 2005). According to the OECD itself, its ongoing purpose was to provide a “forum for international cooperation to create policies and promote economic growth” while identifying, discussing, and analyzing potential problems inhibiting growth (OECD, 2005). The OECD stated that during its fifty years of existence, it has “promoted collaboration on solving social, economic, and environmental problems through research and policy recommendations”, with thirty-four OECD member countries actively participating to date (OECD, 2005). The OECD has included the assessment and comparison of skill levels of students soon to be in the workforce as part of its work (OECD, 2005), and developed the Programme for International Student Assessment (PISA) to measure mathematics, reading, and science achievement of fifteen-year-old students. Although none of Canada’s territories participated, all of the ten provinces including Manitoba had students participate in the PISA 2012 assessment.

Manitoba Education and Training Goals

With the New Democratic Party (NDP) winning a majority of seats in the 1999 Manitoba election, this began almost seventeen years of the NDP holding power as the government of Manitoba until early 2016. During this time, the Department of Education provided annual reports starting in 2000 (MET, 2000). These annual reports indicate that Manitoba Education and Training established eight priority action areas in 2007 – 2008 which included numeracy and literacy. These priority action areas remained in place and were referred to in annual reports through 2009 (MECY, 2009b). In 2010, Manitoba Education switched the language it used in its annual reports, referring to four overarching goals rather than priority action areas (Manitoba Education, 2010a). In 2012 - 2013, Manitoba Education's annual report indicated that the province included the language of both overarching goals as well as priority action areas. The eight priority action areas of 2007 through 2009 were reduced to six priority action areas including numeracy and literacy, education for sustainable development, education in low-income communities, Aboriginal education, rural education, and education in northern communities (Manitoba Education, 2013b). The overarching goals in the 2013 Manitoba Education annual report were the same as the ones referred to in the 2010 annual report on education in Manitoba.

Manitoba Education and Training (MET) currently has four overarching goals in place since the 2009 - 2010 school year, as noted earlier. MET currently also has six priority action areas, including numeracy (Province of Manitoba, 2014a). At the time of the PISA 2012 assessment, Manitoba's mathematics curriculum documents reflected other priority action areas such as education for sustainable development and Aboriginal education (MECY, 2009b; Manitoba Education, 2013a). Mathematics is a high priority for MET, reflected in the fact that

the province has required its students to complete at least one mathematics credit for each of four senior years as part of Manitoba's graduation requirements (Province of Manitoba, 2014a).

Mathematics is prioritized for graduation in Manitoba, it is subsumed within the overarching goal to "significantly increase achievement levels of those students who have been historically less successful", and it is subsumed within the overarching goals of ensuring that education practice and policy is guided by the principle of inclusion and of education for sustainable development.

Inclusion. The development of the *Manitoba Human Rights Code* (1987), after the *Canadian Charter of Rights and Freedoms* (1982) entrenched into legislation the requirement to provide reasonable accommodations to people with special needs, spurred the creation of the *Appropriate Educational Programming Amendment* (2005) to the *Public Schools Act*. This marked a significant legislative acknowledgement towards supporting the philosophy of inclusion in education. In the years following this amendment, schools and divisions were required to move towards more intentional inclusion of all students into their classrooms, and Community Living Manitoba published a document analyzing progress made by the province towards "appropriate education for all" (2009).

Following that report, Manitoba Education and Training published a document to guide schools in further implementing the principle of inclusion (Government of Manitoba, 2011). Both of these documents highlighted the need for regular annual updating of Individualized Educational Plans (IEPs) for students with specific needs, and for regular collection and analysis of data to determine whether implementation of plans had been effective. The principle of inclusion was formalized as one of the goals of Manitoba Education in 2010 (Manitoba Education, 2010a). Both socio-economic status as well as historic funding patterns were

acknowledged by Manitoba Education as factors affecting equity in education for students with special needs (Community Living Manitoba, 2009, p.39). While Manitoba Education worked to improve equity for students with special needs during the time following the creation of the *Appropriate Educational Programming Amendment* (2005), the number of families and individuals living in low income in Manitoba steadily increased (Murphy, Zhang, and Dionne, 2012).

While the Government of Manitoba worked on legislation and support documents on the principle of inclusion, work was also going on towards legislation and curricula incorporating MET's second goal of education for sustainable development.

Education for sustainable development. Sustainability is part of MET's mission statement, is one of its overarching goals, and is also one of its priority action areas (MET, 2015, p.1). Although the concept of sustainability has been a department-wide initiative for Manitoba Education and Training since the 1999 - 2000 school year (MET, 2000), it was in 2009 that it became formalized as a goal for education in Manitoba (Manitoba Education, 2010a). Since then, schools are required to include in their school planning documents a description of how they will address education for sustainable development, either formally or informally, through their annual school plans (MEAL, 2014b).

Not only is sustainability an overarching goal, education for sustainable development is a priority action area for Manitoba (Province of Manitoba, 2014a). Manitoba Education and Training has published a summary document of a decade of their efforts to encourage schools around the province to incorporate living sustainably into their planning. This document, *Education for Sustainable Development in Manitoba Education and Advanced Learning* (MEAL, 2015), highlights key steps in the progress MET has made towards its goal of having

students experience what living sustainably means. Curriculum documents that have been revised within the past decade have incorporated sustainable development, including a high school course focused on global issues and sustainability (MEAL, 2015, p.3). As well, MET has created guides for schools and divisions wishing to embed sustainability within whole school and whole division planning, and documents for teachers which show linkages to science, social studies, and physical education curricular outcomes as well as the underpinning of skills from mathematics and language arts curricula (MEAL, 2015, p.4).

Legislation in Manitoba promoting sustainability include the *Sustainable Development Act* (1997), the *Climate Change and Emissions Reduction Act* (2008) and *Manitoba's Green Plan* (Province of Manitoba, 2014b). The purpose of the *Sustainable Development Act* was “to create a framework through which sustainable development will be implemented in the provincial public sector and promoted in private industry and in society generally” (1997). The Act includes methods for public consultation, a Round Table committee to guide the process of implementation of sustainability practices, and regular accountability and reporting requirements every five years (1997). In 2013, the Manitoba Government proposed a new sustainability act, tentatively titled the *Green Prosperity Act* (Province of Manitoba, 2014b). Public consultation was initiated and this draft proposal was incorporated into a revised provincial green action plan, *TomorrowNow – Manitoba's Green Plan* (Province of Manitoba, 2014b). Within this plan are specific steps to incorporate education for sustainability into public education in Manitoba in its ongoing efforts towards addressing the second of four overarching goals of MET.

Simultaneously during the work on legislation towards sustainability, the Manitoba Government was exploring ways to improve the achievement of student populations that were

historically less successful, including students from northern communities, low income communities, and Aboriginal students.

Historically less successful students. Within its annual report on education for 2009 - 2010, Manitoba Education's focus on the achievement of "historically less successful" students was formalized as a goal (Manitoba Education, 2010a). Prior to this, Manitoba Education and Training had established eight priority action areas on which to focus, including education in northern communities, Aboriginal education, and education in low-income communities (MECY, 2009b). These priority action areas were guided by the work of the Manitoba Centre for Health Policy and Brownell et al (2006), which summarized research that linked students who had historically less successful school outcomes to low socio-economic status (SES) (p.4). The work of Brownell et al (2006), as well as the more recent work of Murphy, Zhang, and Dionne (2012), both quoted Manitoba data which showed that subgroups with the highest rates of families and individuals living in low income in Manitoba were Aboriginal and recent immigrant populations, and those living in northern Manitoba. Murphy, Zhang, and Dionne (2012) highlighted Manitoba as having the second highest number of families living in low income and the fourth highest number of individuals living in low income of all the Canadian provinces.

Manitoba's *Poverty Reduction Strategy Act* became law in June 2011, holding the provincial government accountable through legislation to create a strategy with specific targets, report annually on progress, and ensure that provincial budget discussions take poverty reduction and social inclusion into account (2011). Seven priority areas were established for a 2012 through 2016 five-year poverty reduction plan, including targeting supports for those most in need, closing the gap for Aboriginal Manitobans, and creating opportunities for youth (Government of Manitoba, 2013b). The most recent Manitoba-focused report on progress

prepared by Campaign 2000 was released in 2015, which quoted statistics showing that Manitoba's child poverty rate for 2013 at twenty-nine percent (29%), the highest of all provinces in Canada, and that over eighteen percent (18%) of Manitoba's children in two parent families are living in poverty. It further quoted statistics that Manitoba's children are using food banks at more than twice the rate of all of Canada (Campaign 2000, 2015). The Manitoba-focused report on child poverty that was released in 2010 quoted statistics that the child poverty rate among Manitoba's Aboriginal children under six years of age was more than three times the rate for non-Aboriginal children in Manitoba, and that for the majority of the past three decades, Manitoba ranked either first or second highest for provincial child poverty rates in all of Canada (Social Planning Council of Winnipeg, 2010). The work of Brownell et al (2006) took socio-economic status and poverty rates in Manitoba and explored the connection with educational outcomes.

Using Manitoba student data, Brownell et al (2006) concluded that Manitoba "students who fall behind or drop out are disproportionately children from disadvantaged backgrounds, [and that] school-based testing limits our ability to assess the real inequalities in educational achievement" (p.4). They noted that standards tests capture snapshots of students in school and not of those who have dropped out – providing a gross underestimation of inequalities that may be present within the public education system (p.19). Ken Osborne's work highlighted that a shift in public thinking towards education occurred in the 1990s, with "traditionalism now praised as evidence of high standards", citing a Manitoba task force that recognized a shift in educational focus from the arts and humanities to the economic needs of Manitoba (1999, p.14). During this same period of time, Manitoba mathematics curriculum development focused on the creation of a Consumer Mathematics stream, emphasizing mathematics for careers and life as a

consumer in society. With the adoption of the WNCP framework and the aligning of Manitoba curriculum documents to mathematics, some local critics decried the revisions as having an over-emphasis on conceptual understanding rather than traditional algorithms and mathematics procedures. This led, according to these critics, to the weakening of Manitoba students' achievement in mathematics and the lower PISA 2012 results for Manitoba (Craiggen, 2013; Zwaagstra, 2013). During the decade prior to PISA 2012, Manitoba became the province with the highest percentage of children accessing food banks (Staff Writer, 2013), Manitoba's urban Aboriginal population increased (Statistics Canada, 2010a), and the immigrant population steadily increased in Manitoba (Manitoba Immigration and Multiculturalism, 2013, p.5).

Socio-economic status. Following the release of PISA 2012 results, then Manitoba Teachers' Society president Paul Olsen highlighted the lack of local reporting on the connections between socio-economic status and PISA scores (Ponticelli, 2013, December 3). With the announcement from the Province of Manitoba of an increase in funding to public education (Government of Manitoba, 2014, January 30), Olson expressed pleasure in seeing funds "directed to equalization for school divisions" (Manitoba Teachers Society, 2014, January 30). Olson was quoted in the local media expressing concern over the "hollowing out of the middle" group of students in PISA results, that more Manitoba students were ending up in the lower levels of the PISA 2012 rankings than in the middle or upper levels, and wondered about connections to the high rate of Manitoba children using food banks and living in poverty (Ponticelli, 2013, December 3).

In 2006, Manitoba had 11.4% of its population living in low income after taxes and ranked third highest for percentage of population living in low income in Canada at the time (Citizens for Public Justice, 2012). The research of Murphy, Zhang and Dionne (2012) into low

income in Canada showed that, whether looking at the Low Income Cut-Off (LICO) or two other indicators of low-income, the Low Income Measure (LIM) or the Market Basket Measure (MBM), the incidence of low income decreased in Manitoba from 2000 through 2009 (p.45). When looking at the data specific to Winnipeg, residents had similar low-income rates in 2008 and 1976 using LIM statistics (p.46), although general trends for the LICO and LIM were in decline. The LIM was in decline, meaning that the median household income in Manitoba decreased from 1976 to 2008. The LICO was in decline, meaning that the threshold at which families spend “20 percentage points more than the average family on food, shelter, and clothing” (Statistics Canada, 2015) decreased from 1976 to 2008.

When attempting to rank provinces by low income incidence using statistics from 2010, Manitoba fell anywhere from fourth to seventh depending upon which measures were used (Citizens for Public Justice, 2012, p.50). According to other data available through Statistics Canada and quoted by the CMEC, 20% of the school-age population (ages 5 - 24) in Manitoba were living with one lone parent in low income in 2010, and 7% of the school-age population in Manitoba were living with two parents in low income (CMEC, 2010).

Immigrant. Using the most recent census data, out of the total population of Manitoba in private households, 15.7% are of immigrant status (Statistics Canada, 2011). Within Manitoba’s population of immigrants, 31.2% of these individuals immigrated to Manitoba between 2006 and 2011, and 13.1% of immigrants came to Manitoba between 2001 and 2005 (Statistics Canada, 2011). The age of 38% of Manitoba’s immigrants at immigration was between 25 to 44 years old, and 31.8% of immigrants at immigration were under 15 years old at the time of immigration. Immigrants under the age of 18 are required to register for schooling under the *Public Schools*

Act. Public schools that register immigrant students are provided some supports through Manitoba Education and Training.

Manitoba Education and Training provides support for immigrant students through the English as an Additional Language (EAL) grant and through an Intensive Newcomer Support (INS) grant (MEAL, n.d.). INS Grant funding is designed specifically to support students who come from refugee or war-affected backgrounds, and who have had significant disruptions to their schooling. Access to these funds is provided to divisions who write a proposal meeting guidelines outlined by Manitoba Education and Training. EAL Grant funds are designed to support curriculum, programming, or services for students whose primary language is not English (MEAL, n.d.). Manitoba Education has reported that from 2001 to 2006, the number of students eligible for EAL funding almost doubled. In 2012 - 2013, the province provided over \$10 million in funding to schools through the EAL and INS grants (MEAL, n.d.).

Aboriginal. Approximately 60% of First Nations students in Canada attend schools on reserves, which are under the purview of the Federal Government through its Department of Aboriginal Affairs and Northern Development Canada (AANDC, 2015). Funds are distributed to Band Councils and First Nations education organizations, which are responsible for the management and delivery of education to these students, with seven reserve schools in Canada receiving services directly from the AANDC. Students who live on a reserve but attend provincial schools off reserve are also supported through funding from the AANDC.

Any Aboriginal children of school age who are not living on reserve can attend public schools, independent funded schools or non-funded schools in the province in which they live, however these children receive no support through the AANDC. In 2011, the Canadian Government began consultations which led to the development of a proposed First Nations

Education Act to provide guidelines for the governance, operations, and funding of reserve schools (AANDC, 2015). Although the federal schools' student populations merit further study – in terms of policy, equity, curriculum and achievement – this thesis does not address students receiving their education within federally funded band schools. The Aboriginal student population that is found within provincial education jurisdiction – those students of First Nations, Métis, and Inuit background that are not band members and are not part of the federally funded band schools – are addressed by this thesis. These students form part of the sample group of students who participated in PISA 2012 tests for Manitoba, and it is their mathematics achievement data which is explored through the Manitoba grade nine mathematics credit achievement data in this research study.

Aboriginal peoples and recent immigrants continue to experience a greater prevalence of low-income status across Canada. Overall, Manitoba has 6% of its families in low income status, tied with two other provinces for second highest overall percentage in Canada (Citizens for Public Justice, 2012). Out of the total population of Manitoba in private households, 16.6% are of Aboriginal identity and 15.7% are immigrants (Statistics Canada, 2011). The rate of low income status among Aboriginal peoples living off reserve in Manitoba was 15.2%, significantly higher than the overall Manitoba rate of 6% (Statistics Canada, 2011).

MET has provided some level of support through the Aboriginal Academic Achievement (AAA) grant and, beginning in September 2014, through a numeracy-specific grant to close the Aboriginal student achievement gap (Government of Manitoba, 2014, January 30). At the beginning of each school year in Manitoba, parents and guardians are given the opportunity to fill out an Aboriginal Identity Declaration, which triggers funding to be distributed to the child's school for the following school year through the AAA grant (Government of Manitoba, 2010).

As well, Manitoba has established an Aboriginal Education Directorate whose mandate is to provide leadership and coordination of provincial initiatives in Aboriginal education and training to further support the unique needs of Aboriginal students in the public education system (Government of Manitoba, 2010). Manitoba Education and Training acknowledged the need for protocols for Aboriginal students transitioning between public and First Nations schools, with Manitoba First Nations Educational Resource Centre (MFNERC) partnering with the Department to create such a protocol (Manitoba Education, 2010b).

Graduation rate. Since the establishment in 2009 - 2010 of the goal for the province to increase the overall provincial graduation rate, Manitoba Education and Training (MET) has published reports showing steady increases in the overall percentages of students graduating annually (Government of Manitoba, 2015). MET has prioritized mathematics for graduation, requiring students to complete one mathematics credit for each of grades nine, ten, eleven, and twelve in order to graduate with a Manitoba diploma (Province of Manitoba, 2014a). Several of MET's priority action areas are encompassed within the overarching goal of increasing graduation rates – including numeracy and literacy, education in low-income communities, Aboriginal education, rural education, and education in northern communities.

Manitoba requires students under 18 years old to earn thirty credits towards a graduation diploma, with specific core credits required at each of grades nine, ten, eleven, and twelve. Manitoba offers only one full course approved for credit towards graduation in grade nine mathematics. There are two mathematics courses approved for credit towards graduation at the grade ten level: one course option is titled Introduction to Pre-Calculus and Applied Mathematics; another course option is titled Essential Mathematics (MECY, 2009). There are three approved choices for mathematics credit in each of grades eleven and twelve: Pre-Calculus

Mathematics, Applied Mathematics, and Essential Mathematics. Further to these approved choices, students in grades eleven or twelve may instead choose Accounting as their mathematics course choice for credit (MECY, 2009a). The revised curriculum documents for high school mathematics courses state that the goal of studying mathematics in Manitoba high schools is for either career entry or further study (MECY, 2009a).

Manitoba students graduate with a minimum of four credits in secondary level mathematics courses, whereas in comparison students graduating from Alberta are not required to have a grade 12 mathematics course to receive their diploma (Alberta Government, 2014). Manitoba students wishing to further their education at post-secondary institutions find varying entrance requirements depending on the institution as well as the programs offered by the institution. For example, only the grade twelve Pre-Calculus Mathematics Manitoba credit is recognized in Alberta post-secondary institutions as an acceptable pre-requisite for further study in mathematics or science. However Applied Mathematics is acceptable for general admission (Alberta Government, 2014). Manitoba students entering a Bachelor of Education program in a Manitoba post-secondary institution may have any of the grade twelve mathematics courses as pre-requisites for general admittance into first year university programs. The University of Winnipeg stipulates that students currently entering their Bachelor of Education program with a grade twelve mathematics credit that is not Pre-Calculus or Applied Mathematics may be required to take a mathematics entrance test or complete a not-for-credit mathematics course (University of Winnipeg, 2016).

Statistics Canada data (2010b) stated that the percentage of the population that was not a high school graduate and was not attending school in Manitoba in 2009 - 2010 was the second highest provincially (6.3%) for 16 to 17 year olds, and second highest provincially (10.9%) for

20 to 24 year olds. Comparatively, the Canadian mean percent for 16 to 17 year olds was 5%, and for 20 to 24 year olds was 8.5% for the same time period (2010b). The students represented by these statistics are those who have dropped out of the education system, are not part of the PISA assessment sample, and were highlighted by Brownell et al as one of the reasons why assessments such as PISA are not providing an accurate picture of student achievement (2006).

Trends in the Literature

The literature review highlighted that there are specific student populations in Manitoba that show signs of greater inequities in terms of poverty and socio-economic status – specifically immigrant and Aboriginal populations. The literature review also highlighted that the Manitoba Government has been working within the last decade to pass legislation supporting three of their four education goals: inclusion; education for sustainable development; and improving education achievement in student populations that have been historically less successful. The literature review has shown that Manitoba Education and Training provides education grants to specifically support some of its goals and priority action areas, including grants for special needs students to support inclusion programming, for Aboriginal students and for EAL students to improve the academic achievement of these historically less successful student subgroups.

Manitoba Education and Training has created support documents to help schools and educators with the implementation of two of its four goals, inclusion and education for sustainable development, and has embedded its goal of inclusion as well as its priority action areas of numeracy and Aboriginal education within its revisions of its mathematics curriculum documents. The literature review also showed that statistically, the Province of Manitoba has an increasing percentage of immigrants and Aboriginals within its population over the last decade,

and that within those two subgroups there is a significant percentage of individuals with low income or low socio-economic status.

This research study is an important addition to the literature to analyze whether and to what extent the goals of PISA and OECD published results of PISA 2012 align with the goals of Manitoba Education and Training. Any research and questions posed about the education goals of PISA and Manitoba Education and Training in this study must be done while acknowledging the privileged status of myself as a researcher and educator in society. Without an understanding of my own ontological, epistemological, axiological and methodological approaches, attempts to address the research question posed are difficult at best. Chapter Three will outline the positioning of the researcher, as well as the theoretical framework for this research study.

Chapter Three: Theoretical Framework

The theoretical framework for this exploration of the extent to which the goals of PISA and OECD published results of PISA 2012 align with Manitoba Education and Training's goals within the context of mathematics education is based on a mixed methods approach. Creswell provides the simplest definition of the mixed methods approach – that of combining qualitative and quantitative data and analysis in a single study (2003). This thesis provides a qualitative analysis of three PISA 2012 documents from the OECD website, as well as a qualitative analysis of quantitative Manitoba student achievement data from the PISA 2012 assessment and five years of grade nine mathematics credit achievement data from Manitoba Education and Training. Because both quantitative and qualitative data are being presented, and because the analyses of the documents and the achievement data are qualitative in nature, a mixed methods design is used as the theoretical framework for this thesis (Steckler, McLeroy, Goodman, Bird, and McCormick, 1992).

Tashakkori and Teddlie's mixed method design (1998) is used to integrate and interpret both the quantitative and qualitative data. This mixed method design is used not just because the document analysis is qualitative and the credit completion analysis is both quantitative and qualitative, but also because the lines between quantitative data and qualitative data become blurred in the analysis of trends and potential reasons for the trends in the data. Using Morse's (1991) labeling of mixed methods approaches, this mixed methods study is sequential in its approach. Quantitative data was collected and published first through the work of the OECD on PISA 2012 documents and results, and by MET on grade nine mathematics credit achievement. Qualitative data on what Atkinson and Coffey called "social facts" (1997) were gleaned by the researcher from multiple readings of three OECD PISA 2012 documents. Multiple readings of

these documents determined patterns in language (Glaser and Strauss, 1967). The MET grade nine mathematics credit achievement data set was analyzed qualitatively in order to provide context for the “social facts” gleaned from the qualitative analysis of OECD documents and published PISA 2012 results (Atkinson and Coffey, 1997).

Summary of Research Methods

Text portions using goal-related language were gathered and analyzed from three PISA 2012 documents published on the OECD website: *PISA 2012 assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy* (OECD, 2013a), *PISA 2012 results: What students know and can do (volume I, revised edition)* (OECD, 2014), and *PISA 2012 results: Excellence through equity: giving every student the chance to succeed (volume II)* (OECD, 2013b). A multiple-reading approach similar to the approach of Glaser and Strauss (1967) was used to locate text portions using goal-related language, to determine themes within the goal-related text portions, and to compare those themes within the conceptual framework of the research study: the four overarching goals of MET. A simple quantitative statistical analysis as noted below was performed on the MET grade nine mathematics core credit data set to determine qualitative patterns in achievement for various population subgroups in the data set. A qualitative comparison of the MET data set patterns was made to PISA 2012 results for Manitoba, adding to the qualitative analysis of the extent to which the goals of PISA and published results of PISA 2012 align with the goals of MET.

Research Procedures and Data Analysis

Programme for International Student Assessment (PISA) quantitative analysis: Rasch statistical model. The Programme for International Student Assessment (PISA) report for 2012 stated that the Rasch statistical model was used in the analysis of student achievement data

to determine rankings for countries and to provide analysis of the qualitative data within the student and teacher surveys (OECD, 2013b). The Rasch statistical model is typically used in the analysis of categorical data, and the OECD has chosen to use a simple Rasch method whereby five plausible scores are generated for students on the basis of their responses to questions in all subjects on the assessment, regardless of whether students answered few, some, or all of the questions (OECD, 2009b). PISA's *Data Analysis Manual* described how these five generated scores for each individual student are used to extrapolate extra sampling error and calculate overall country, territorial, and provincial mean scores (OECD, 2009a). In contrast to this PISA 2012 data analysis, the analysis of PISA 2012 documents in this research study was qualitative in nature, and was performed by the researcher to determine whether and to what extent the goals of PISA align with the goals of MET.

Programme for International Student Assessment (PISA) 2012 documents:

Qualitative analysis. Three key documents related to PISA 2012 that are posted on the OECD website were analyzed using a multiple readings approach similar to Glaser and Strauss (1967) to determine portions of text with language related to goals and aims of PISA. Specifically, the following three documents were qualitatively analyzed: the *PISA 2012 assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy* (OECD, 2013a), *PISA 2012 results: What students know and can do (volume I, revised edition)* (OECD, 2014) and *PISA 2012 results: Excellence through equity: giving every student the chance to succeed (volume II)* (OECD, 2013b). The first reading of these documents focused on searching for portions of text that used language related to goals, aims, or objectives of PISA. Text portions found upon first reading were organized into themes, which were then used to guide a more detailed second reading of the documents. The third reading of the documents was done with the

conceptual framework of the research study in mind, searching for any text using similar language to the four overarching goals of Manitoba Education and Training.

Manitoba Education and Training (MET) data set quantitative analysis:

Percentages. The Manitoba mathematics credit data set is a collection of line-by-line individual entries anonymously indicating individual Manitoba public school students' pass/fail status on first attempt at their grade nine mathematics credit. Raw counts of students who passed divided by the total number of students in any given school year were used to determine the percentage of students that, on first attempt, passed their grade nine mathematics course for credit in each of the school years provided in the MET data set. These percentages were also calculated for students who self-identified as Aboriginal (AAA), for those who were labeled EAL learners, for students who did not fall into either of those categories, and for English and Français program students. One overarching percentage of students who passed grade nine mathematics was also calculated for each of the five years. Percentage pass rates for English program were compared to Français program pass rates, EAL and AAA pass rates were compared to the non-EAL, non-AAA, and to the overall pass rate percentages to determine what, if any, patterns there were in the population sub-groups. The percentages of students who passed grade nine mathematics upon first attempt were compared to the percentage who passed in 2008, 2009, 2010, 2011, and 2012.

Comparisons and Interpretations

A qualitative analysis of the results of the readings of the PISA documents was performed to determine any similarities, differences, and patterns in espoused PISA goals to stated MET goals. A comparison of the percentage of students who passed grade nine mathematics in 2011 was made to the percentage of Manitoba students in the PISA 2012 data set that obtained level two (2) or higher in PISA ranking, level two being defined by PISA as the

basic competency level expectation of all students (OECD, 2014). As well, a comparison of the population sub-groups' pass rates for EAL and AAA students was made to sub-groups in the PISA 2012 data set, focusing on those that obtained level two (2) or higher in PISA 2012 results. These comparisons are provided in part to contextualize the qualitative data from the PISA 2012 document analysis, to determine whether the Manitoba grade nine mathematics core credit data corroborates or contradicts the OECD pattern of declining mathematics scores for Manitoba, and more specifically to further explore the main research question of this study – whether, and to what extent, the goals and published results of PISA align with the goals of Manitoba Education and Training within the context of mathematics.

Researcher Positioning

The OECD has not provided detailed analyses of their ontological, epistemological, or axiological approaches to their own research and data analysis. Thus the remainder of this chapter focuses on my own approach towards the qualitative analysis of the PISA 2012 documents and of the quantitative data from both the PISA 2012 published Manitoba results and the MET grade nine mathematics credits data set, as well as the formulation of the research question for this thesis. It is the ontology, epistemology, and axiology of the researcher which formed the basis of the mixed methods approach of qualitatively analyzing the quantitative data sets.

Ontology. The state of mathematics education and student performance in mathematics in Manitoba being in crisis became a “reality” for me as a mathematics consultant in 2013, defined and entrenched by the myriad of media reports and the OECD and CMEC contextual reports of PISA 2012 results. This thesis exploration stemmed from that “reality” with qualitative analysis of PISA documents, and qualitative comparisons of PISA 2012 Manitoba student

achievement data to MET grade nine mathematics credit completion data. Curiosity on my part surrounding two particular populations within the Manitoba student data, specifically English as Additional Language (EAL) students and Aboriginal students, formed the foundation of the ontological approach to this thesis. EAL and Aboriginal students' performance and socioeconomic status in Manitoba can become hidden within the overall trends reported for Manitoba, both within contextual reports released by the OECD and CMEC and by reports in the media. Delanty and Strydom would suggest that because of this lack of transparency, these populations then require significant inquiry (2003).

This thesis delves deeper into the quantitative and qualitative data presented in PISA 2012 documents' texts as well as PISA 2012 results, and the Manitoba grade nine mathematics credit data, to determine whether the goals of PISA align with the goals of MET, and to determine whether the general trend in mathematics performance for Manitoba students is representative of these two particular student populations that are part of the focus of MET's goals and priority action areas. With the current educational, social, and economic realities in Manitoba, disadvantaged populations such as Aboriginal students and immigrants with English as an Additional Language need to be explored in detail with relation to educational outcomes and specifically to performance in mathematics, to determine whether the "reality" of equity in Manitoba education as highlighted by the OECD's PISA reports of results compare to data from grade nine mathematics credits earned for EAL and Aboriginal students, and to explore the extent to which the goals of PISA align with MET's goals for education, within the context of mathematics.

Epistemology. In describing the epistemological approach of my thesis, I need to establish the relationship between myself as the researcher and the subjects of research. Denzin

and Lincoln recommended “objective detachment or value freedom” (1998, p.201) in order for the research study to have valid or “real” conclusions. The data being used for this thesis includes qualitative data from PISA 2012 documents, quantitative data from the OECD’s PISA 2012 reports, and quantitative Manitoba grade nine mathematics credit completion data for the years 2008 through 2012. I maintained objective detachment from all data sets for this thesis: I was not involved in writing the PISA documents, or in creating the questions or collecting the data for PISA 2012 and the Manitoba grade nine mathematics credit data used in this research study. In terms of detachment and objectivity with the two specific student populations under scrutiny, EAL and Aboriginal students, I neither fit the definition of those populations nor have I been a part of those communities while being a student in school. This allowed me to provide a perspective for analysis of data that clearly maintains objectivity and detachment throughout this portion of the research process. Because I am of Caucasian origin and I am currently part of a socioeconomic class that is deemed more powerful in its relationship with society and political entities, I needed to ensure that the objectivity and detachment I suggest I have and that I maintained throughout the research process acknowledges the power relationships amongst my own culture and the cultures of the populations which are under study. Although I am arguably also part of a gender group which can sometimes experience marginalization or inequity, an awareness of the nature of my own cultural identity and its powerful position within Manitoba and Canadian society needed to remain at the forefront of all the analyses of data which I performed. It is worth noting that because this research study utilized already published qualitative and quantitative data from various sources, with the exception of the Manitoba mathematics credit completion data set, and the researcher had no direct contact with any of the subjects of study within the published data sets, the collection, analysis, and publication of

results of analysis for this thesis did not fall under the Research Ethics Board's purview and the Tri-Council Policy Statement on the Ethics of Research Involving Human Subjects (2011) did not apply. However, because every researcher does have their own set of values and a framework with which they use to explore data sets, it is also important for me as a researcher to acknowledge and explore the axiological approach of this research study.

Axiology. Researchers have realized that inquiry is done through the lens of assumptions that each individual makes towards the topic they are exploring, thus it is important to outline the assumptions I have and recognize when approaching this research study. My gender, culture, lifestyle, and socioeconomic status all played a role in what research questions I formulated, as well as how I viewed and interpreted the data and provided analysis and critique. In terms of axiology, qualitative researchers believe that research is influenced by the values held by the researcher as well as by the theories, hypotheses or the framework that the researcher is using in his or her particular situation (Tashakkori & Teddlie, 1998). It is these frameworks or hypotheses that influence the types of questions asked in research, not merely the prior identified factors of gender, culture, lifestyle and socioeconomic status. Quantitative researchers have claimed that science is rooted in objective verification but do not account for the subjective nature of the researcher's decisions made throughout the stages of the research process (Onwuegbuzie & Leech, 2005). In my research for this thesis when exploring quantitative data provided by the OECD's PISA 2012 results, qualitative data from PISA documents, and the Manitoba mathematics credit completion data, I know that my own beliefs and values framed the original questions I wished to explore, as well as my initial decision to explore the data through the lens of poverty – searching for meaning in the data by framing it with contextual socioeconomic data from the PISA student surveys and Statistics Canada reports.

The personal experience which shaped this research study to some extent is that of growing up feeling poor, family poverty. Having grown up in a family where I was thankful never to have experienced a lack of food, clothing, or shelter, yet still being acutely aware that I was one of those students who never had an extra dollar for a field trip fee or lunch money for cafeteria food, my awareness of poverty issues and how they may affect learning opportunities stems from my own, albeit limited, background experience. Having grown up in a family where I was part of the first generation to earn a university degree, I am acutely aware of how the lack of a role model in higher education affected my own confidence in my abilities as well as my motivation to complete course work and degree study. Having completed a degree program in Science, with majors in both Mathematics and Chemistry, and having experienced a patriarchal culture favouring male students within both the student population and some of the professors in the Faculty at the time, my gender as a female defines and influences the kinds of questions I ask regarding disadvantaged student populations and the analysis of data regarding equity in education. Thus my socioeconomic background, the lack of a role model for further education within my family, and my gender all influenced which research questions I formulated and which groups of Manitoba students became the focus of my own analysis of data for this thesis.

Although my gender and socioeconomic background provides some degree of experience that helps formulate a perspective that is equity and poverty focused, I must acknowledge that I have been born into a cultural group and I am currently in a socioeconomic class that puts me in a power relationship with the populations that are explored in this thesis. With the trends in literature showing that student groups such as Aboriginal learners and those with EAL backgrounds can come from socioeconomically disadvantaged families, this thesis attempts to determine whether the goals of PISA are compatible with the goals of MET within the context of

mathematics education, including priority action areas of MET which address equity in disadvantaged populations. There may be other biases or influences on my approach to research and formulating the questions for this thesis of which I am unaware, thus my attempt at analysis of currently held beliefs and my socio-economic position within society can be neither impartial nor entirely objective.

Chapter Four: Qualitative Analysis of PISA 2012 Documents

Three key documents related to PISA 2012 published by the OECD on their website were analyzed to determine goal-related language in these texts. Specifically, the following three documents were qualitatively analyzed: the *PISA 2012 assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy* (2013a), *PISA 2012 results: What students know and can do (volume I, revised edition)* (2014), and *PISA 2012 results: Excellence through equity: giving every student the chance to succeed (volume II)* (2013b). The first reading of these documents focused on portions of text that referred to goals, aims, or objectives of PISA. Text portions found upon first reading were organized into themes, which were then used to guide a more detailed second reading of the documents. The third readings of the documents were done with the conceptual framework of the research study in mind, to uncover any portions of texts using similar language to the goals of MET.

First Reading: Goals of the Programme for International Student Assessment (PISA)

The *PISA 2012 assessment and analytical framework* document explicitly stated that the “primary aim of the PISA assessment is to determine the extent to which young people have acquired the wider knowledge and skills in reading, mathematics and science that they will need in adult life” (2013a, p.14). It also stated three broad areas as the key goals of PISA: a “monitoring structure that provides reliable comparative information on educational systems”, an “international study contributing to our knowledge base on educational effectiveness”, and a “data source for the study of educational contexts in general ... and the study of educational variables in economic and sociological contexts” (2013a, p.169). There are other phrases throughout the *PISA 2012 assessment and analytical framework*, *PISA 2012 results (volume I)*, and *PISA 2012 results (volume II)* documents that had language associated with aims and goals,

however. Upon completing a first reading of these documents looking for such goal related language, phrases found in the documents related to goals and aims were organized into themes for a second reading of the documents.

Second Reading: Goal-Related Language Themes

Phrases that used language associated with goals and aims in the three OECD documents analyzed were grouped into themes. Phrases relating to the three explicit goals of PISA were found throughout the three documents, focused on educational effectiveness, monitoring education systems, and educational contexts or variables influencing those systems. The third explicitly stated goal of PISA made reference to studying “educational variables in economic and sociological contexts” (2013a, p.169), and there were frequent references specifically to economic success throughout all three documents. Thus economic success was deemed a fourth theme within the first reading of the documents that used language related to goals and aims. One other theme emerged within the first reading of all of the documents that used language related to goals and aims, that of improving student achievement. These five themes – educational effectiveness, monitoring structure, educational contexts, economic success, and improving student achievement – were used to guide a second reading of the two OECD documents.

Educational effectiveness. All three documents analyzed within this research study reflected the language of educational effectiveness explicitly stated as one of the goals of PISA. PISA is touted by the OECD as a measurement tool for educational effectiveness in all three documents, having stated that PISA measures mathematics “knowledge acquisition ... [for] adult life” (2013a, pp.14, 125), for participation in society as “constructive, engaged and reflective citizens” (2014, pp.4, 37), and that PISA can determine to what extent the education system

provides students with skills for their “personal, civic, and professional lives” (2013a, pp.23, 44) to become an “engaged and reflective citizenship” (pp.23, 44). Analyzing education systems’ effectiveness in preparing students for “real-life situations” (p.13) as well as “full participation in society” (2013b, p.19; 2014, p.37) or “for life in modern society” (2013a, p.24) is emphasized throughout all three of the documents analyzed in this research study, in keeping with one of PISA’s three stated goals.

Monitoring structure. PISA’s second goal is to provide a structure for monitoring education systems. The OECD claimed PISA to be “the most comprehensive and rigorous international programme” of assessment (2013a, p.17), allowing participating countries and regions to compare student performance in mathematics, science, and reading. Interspersed throughout all three documents are phrases that emphasize the goal of PISA as a monitoring structure. In one document, PISA is stated to provide “indicators that monitor the functioning, productivity and equity of education systems” (p.169), with PISA’s aim being “to assess the cumulative yield of education systems” (p.14). In two of the documents analyzed, PISA is stated to monitor “the knowledge and skills of students” (p.16; 2013b, p.19). Single words and two-word phrases found within all three OECD documents continue the description of what PISA promotes itself to be monitoring, such as the “quality”, “efficiency” (2013b, p.3; 2014, p.3) and “effectiveness” (2013a, p.168; 2013b, p.105; 2014, p.33) of these systems, and providing “benchmarks” (2013a, p.17) for improvement and growth for education systems.

Educational contexts. PISA’s third goal of providing details on the educational contexts within countries and regions that participate in the assessment was threaded throughout all three documents. The *PISA 2012 framework* document referred to student questionnaires that provided information on “attitudes, beliefs and emotions” of participating students (2013a, p.42) “assessed

as non-cognitive outcomes” (p.183). The *PISA 2012 results (volume I)* document referred to the information gleaned from student and school questionnaires as purposeful to “inform policy development in pedagogical orientations and curricular content” (2014, p.254). All three documents made reference to the OECD definition of equity, highlighting their focus on “gender, family background or socio-economic status” (2013b, p.13) not impeding achievement in mathematics for students.

Economic success. Economic success was not a separate, explicitly stated goal of PISA, although all three documents analyzed made references to countries’ and regions’ economic success hinging on their students’ acquisition of knowledge and skills in mathematics. Although the third goal of PISA explicitly stated by the OECD made reference to providing data for studying education systems within economic contexts (2013a, p.169), there were portions within each of the three OECD documents analyzed for this research study that explicitly tied mathematics achievement of students to the future success of participating countries’ and regions’ economies. The *PISA 2012 framework* document stated that, “since mathematical competency is one of the most important prerequisites for success in the modern, technology-rich and knowledge-driven world, it is given priority status by most educational systems” (p.183). The *PISA 2012 results (volume I)* document stated that, “the future economic and social prospects of both individuals and countries depend on the results they actually achieve” (2014, p.36). All three documents provided references to the importance of developing “human capital” for the “prosperity and well-being of society” (2013a, p.168), and tied acquisition of knowledge and skills in mathematics to “better jobs” (2013b, p.3; 2014, p.3) in order to “boost productivity” (2013b, p.3) and create growth in countries (2014, p.4).

Improving student achievement. Words and phrases found within two of the OECD documents analyzed suggested PISA's underlying goal of improving student achievement, with phrases such as "best performing" (2014, p.89) and "rapidly improving" (p.3; 2013b, p.19) education systems. The *PISA 2012 results: Excellence through equity (volume II)* document highlighted through its title that the OECD monitors equity within student achievement of PISA's participating countries and regions (2013b). Within the opening pages of this document, the OECD stated that the future of public policy itself hinges "on the skills of citizens" (p.3), and that the level of knowledge and skills displayed by students in the PISA 2012 mathematics assessment may play a role in the future "fairness, integrity and inclusiveness" of participating countries' future government programs (p.3). The *PISA 2012 results (volume I)* document further stated that the very "future economic and social prospects of both individuals and countries" hinged on the success of countries' achievement levels in PISA 2012 (2014, p.36). Within the *PISA 2012 assessment and analytical framework* document, there were multiple references to student achievement and monitoring trends (2013a, pp.13, 16).

Third Reading: Using the Conceptual Framework

The purpose of this research study is to answer the question of whether, and to what extent, the goals and published results of PISA align with MET's four overarching goals of inclusion, education for sustainable development, improving the achievement of historically less successful populations, and improving graduation rates, within the context of mathematics. With this purpose in mind, the third reading of the three PISA documents analyzed for this research study was done using the conceptual framework: the four goals of Manitoba Education and Training. Although PISA's three explicitly stated goals of being an education system monitoring structure, of "contributing to [the] knowledge base on educational effectiveness" and of

collecting data “for the study of educational contexts” (2013a, p.169) do not overtly use language directly tied to Manitoba Education and Training’s goals for education, I was curious about whether and to what extent the four goals of MET were reflected in goal related language contained within the three documents qualitatively analyzed for this thesis.

Inclusion. It cannot be assumed that the principle of inclusion is implicit within PISA’s goal of “providing a data source for the study of educational contexts in general”, in that inclusion is one context that could be explored by other researchers using the PISA data set. This research study’s third reading of the three OECD documents sought out explicit references to inclusion, inclusive practices, and special needs students. There were no explicit published results of PISA 2012 for students with special needs. However, there were some references within the documents analyzed in this research study to students with special needs and percentages of students that countries and regions were allowed to exclude from the PISA 2012 assessment. The *PISA 2012 framework* document stated that students with special needs participating in the PISA 2012 assessment received booklets with two clusters instead of four clusters to complete (2013a, p.19). The *PISA 2012 results (volume I)* document mentioned that exclusions for “intellectually disabled” students, those “with functional disabilities”, and students “with limited proficiency in the language of the PISA assessment” were kept to 2% or less (2014, p.27), and that countries and regions overall were allowed to “exclude up to a total of 5% of the relevant population” (p.265). The document does not explain why 2% and 5% were chosen as maximum exclusion values. The *PISA 2012 results: Excellence through equity (volume II)* document published detailed numbers of students that were excluded from the assessment for physical or intellectual disability as well as for language barriers by participating countries and regions (2013b, p.150). Although student mathematics achievement was explored

by the OECD in relation to variables of gender, socio-economic status, immigration, parents' level of education, school factors, students' exposure to formal and applied mathematics, and students' level of pre-primary education received within the *PISA 2012 results: Excellence through equity (volume II)* document, there was a notable absence of discussion of the principle of inclusion in education systems in any of the three documents analyzed for this thesis.

Education for sustainable development. One of the goals of MET is to “ensure education in Manitoba supports students experiencing and learning about what it means to live in a sustainable manner” (Manitoba Education, 2010a). The language of education for sustainable development was embedded within Manitoba Education and Training mathematics curriculum documents at the time of the PISA 2012 assessment, with introductory sections emphasizing students learning about their physical environment through mathematics (MECY, 2009a; Manitoba Education, 2013a). Living in a sustainable manner, education for sustainable development, or ecologically focused mathematics content were neither explicitly stated nor implied within the goal or aim related language of the three OECD documents analyzed. There were only two instances that the word “sustainable” came into play in the OECD documents analyzed for this research study, and that was that PISA was touted twice within the *PISA 2012 framework* document as a “sustainable database for educational policy” (2013a, pp.167, 199).

Historically less successful students. The OECD stated that PISA “provides insights into the factors that influence the development of skills and attitudes ... and examines how those factors interact and what the implications are for policy development” (2013a, p.14). Various subgroups of students that participated in PISA were monitored in the assessment for trends, including student subgroups based on gender, socio-economic status, immigration, parents' level of education, school factors, students' exposure to formal and applied mathematics, and students'

level of pre-primary education received (2013a, p.16; 2013b). PISA assessed the “level, diversity and equity of life skills” (2013a, p.168), and claimed that “student performance [is] measured at the end of compulsory schooling” (p.170). There were no explicit references to students or subgroups of students that are “historically less successful”. However, the OECD’s definition of equity explicitly referred to “gender, family background or socio-economic status” (2013b, p.13), and their *PISA 2012 results: Excellence through equity (volume II)* document reflected an emphasis on those subgroups, as well as immigrants and different education systems within countries and regions such as English program and Français program education systems (2013b). Improving or monitoring achievement levels, the first portion of the wording to Manitoba Education and Training’s goal focused on “historically less successful” students, was explicitly stated with goal-related language in all three of the OECD documents analyzed for this research study (2013a, p.36; 2013b, p.3; 2014, p.183).

Graduation rate. The OECD’s focus on mathematics as one of only three content areas for global assessment provides an indication of the importance the Organization has placed on the subject, with one document analyzed stating that an “understanding of mathematics is central to a young person’s preparedness for life in modern society” (2013a, p.24). The *PISA 2012 framework* document highlighted the student questionnaire as containing questions related to students’ educational aspirations, truancy patterns, learning motivation, interest level in mathematics, their commitment to school and their sense of belonging (p.190). Both this document and the *PISA 2012 results (volume I)* document highlighted how those preceding variables can affect the school climate and potentially help in predicting school dropout behaviour (p.174; 2013b, p.141), and thus indirectly, but not explicitly, graduation rate.

Programme for International Student Assessment (PISA) 2012 Manitoba results

The document *PISA 2012 results: Excellence through equity: giving every student the chance to succeed (volume II)* (2013b) provided detailed regional results for participating countries, including Manitoba-specific achievement patterns, which were qualitatively analyzed to determine themes within the language of the reporting of the results. These OECD published Manitoba-specific PISA 2012 mathematics achievement results were qualitatively analyzed using the conceptual framework for this research study – that of the four overarching goals of Manitoba Education and Training – to determine whether and to what extent the results published by the OECD for Manitoba students in the PISA 2012 mathematics assessment align with the goals and priority action areas of MET.

Inclusion and education for sustainable development. Within the published *PISA 2012 results: Excellence through equity* document's detailed results of Manitoba students in PISA 2012 for mathematics, data were provided by the OECD on: exclusion rates for students within the sample group that did not participate in the assessment; comparisons of male and female students' achievement; comparisons of mathematics performance and potential variance due to socio-economic status; data on overall school performance and socio-economic status; comparisons of immigrant and non-immigrant students' performance; and comparisons of students' performance in schools situated in villages of 3000 or less people and schools situated in cities of over 100 000 people (2013b). With no specific PISA 2012 results addressing Manitoba's goals of inclusion and of education for sustainable development, there were some data published that provided some information towards addressing MET's two other goals of improving the achievement of student groups that are historically less successful, and improving the overall graduation rate.

Historically less successful students. With one of the priority action areas for Manitoba Education and Training being education in low income communities to ensure equity, there were some data within the published Manitoba 2012 PISA results that would provide MET information towards addressing this priority action area. The OECD published results for Manitoba that the percent of variance in mathematics performance explained by low socioeconomic status was 14.1% (2013b, p.174), whereas for Canada it was 9.4% and the overall OECD average was 14.8% (p.281). The “increased likelihood of Manitoba students in the bottom quarter of (PISA’s) ESCS index scoring in the bottom quarter of the mathematics performance distribution” was calculated by the OECD as a ratio of 2.10 (p.185), with Canada’s average being 1.84 and the OECD average being 2.15 (p.285). The document highlighted a mean score of 488 for Manitoba students who were immigrants, and a mean score of 500 for non-immigrant students (p.227). Canada’s mean scores for immigrant and non-immigrant students were 520 and 522 respectively, with the OECD mean scores being 462 and 500 respectively (p.301).

Further data published by the OECD for Manitoba students’ performance in the mathematics-focused PISA 2012 assessment showed that there was a statistically significant difference in the performance of students coming from socio-economically disadvantaged schools being lower than the performance of students coming from socio-economically “average” schools in cities of over 100,000 people (p.309). As well, there was a statistically significant difference in data showing the “relative risk and population relevance of scoring in the bottom quarter of the performance distribution” for socio-economically disadvantaged, average, and advantaged schools, with effect sizes showing a marked increase in the risk of students from socio-economically disadvantaged schools, and a similar but not as marked increase in the risk of students from socio-economically average schools, scoring in the bottom

quarter of PISA results compared to students from socio-economically advantaged schools in Manitoba (p.311).

Graduation rate. Graduation, or graduation rate, was not explicitly written about in the three OECD documents analyzed for this research study, nor was it addressed in the published results for PISA 2012. The *PISA 2012 assessment and analytical framework* document published results on the “non-cognitive outcomes” of truancy and absenteeism which they suggested could be linked to potential early school-leaving or dropping out, data gleaned in the student and school questionnaires from PISA 2012 (2013a, pp.6-7). This document further cited research studies from various countries including Canada, whose “results contribute to the validation of the PISA performance tests by showing that ... results [of these non-cognitive indicators] predict indicators of educational pathways” including the potential for graduation or dropping out of school (p.6). The *PISA 2012 results: Excellence through equity (volume II)* document published results showing that there was a statistically significant correlation in Canada between student performance and selected student and school characteristics such as “dropout” (2013b, p. 263), between student socioeconomic status and “dropout” (p.264), and between school socioeconomic status and “dropout” or early school-leavers (p.265). In regional results tables published in the online version of the OECD’s equity-focused document, Manitoba results show a statistically significant correlation between school-wide student performance and parental pressure to do well (2013b). Only a minor negative correlation was seen between Manitoba students’ performance and dropout behaviour, as well as a minor negative correlation between school socioeconomic status and dropout behaviour (2013b). So although there were no explicit published results tied to graduation rate from PISA 2012, the OECD documents indicated that there were some data

published that are indirectly indicators of dropping out or graduating, with Manitoba's published results from PISA 2012 showing no statistically significant link.

Summary

The OECD documents analyzed qualitatively for aim and goal related language in this chapter were the *PISA 2012 assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy* (2013a), *PISA 2012 results: What students know and can do (volume I, revised edition)* (2014), and *PISA 2012 results: Excellence through equity: giving every student the chance to succeed (volume II)* (2013b). Five specific themes came out of the first two readings' search for goal oriented language, three themes relating directly to the three explicitly stated goals of PISA: PISA is a "monitoring structure that provides reliable comparative information on educational systems", an "international study contributing to our knowledge base on educational effectiveness", and a "data source for the study of educational contexts in general ... and the study of educational variables in economic and sociological contexts" (2013a, p.169). Two further themes coming from the first two readings dealt with phrases focusing on improving student achievement, and phrases dealing with the connection of PISA achievement to the potential economic success of students and societies.

None of the goal-focused language in the three PISA documents analyzed explicitly used language similar to MET's four overarching goals: the principle of inclusion, education for sustainable development, improving achievement of students historically less successful, and improving the overall graduation rate (Manitoba Education, 2010a). Some details on exclusion of students from, and supporting students with special needs, participating in PISA assessments were provided in two of the documents analyzed. However, there were no published PISA results specifically for students with special needs who participated in PISA 2012. No reference to

education for sustainability was embedded within any of the PISA documents analyzed. In terms of improving achievement levels of historically less successful students, all published PISA documents analyzed for this research study focused on improving achievement. However, there was no explicit reference to groups of students who were “historically less successful” as the language of MET’s third goal states (Manitoba Education, 2010a). Two PISA documents analyzed gave mention to student questionnaire results that addressed attitudes, beliefs, and truancy patterns that affect school attendance and thus may indirectly affect graduation rate. However, no explicit reference to graduation rate was mentioned in any of the three documents analyzed for this research paper.

In terms of the published results of PISA 2012 for Manitoba, there were no results published that provided information towards addressing MET’s goals of inclusion and of education for sustainable development. There were some published results of PISA 2012 that provided information towards addressing MET’s goal of improving achievement of historically less successful populations and MET’s priority action areas of rural and low income communities. However, there was no direct data published that provided information addressing its other priority action areas of northern communities and Aboriginal education. There were some published results of PISA 2012 that indirectly provided some information towards addressing MET’s goal of improving the graduation rate.

The OECD has stated that the “primary aim of the PISA assessment is to determine the extent to which young people have acquired the wider knowledge and skills in reading, mathematics and science that they will need in adult life” (2013a, p.14). Performing at level two out of six levels in the PISA assessment was considered the “baseline level” of achievement for students by the OECD (2013b, p.81) to achieve “success in the modern, technology-rich and

knowledge-driven world” (2013a, p.183). With Manitoba students’ PISA 2012 results being lower than the Canadian average, and having decreased since the PISA 2003 mathematics-focused assessment, and with the purpose of this research study to explore whether and to what extent the goals and aims of PISA are compatible with the goals of Manitoba Education and Training, a second data source was analyzed in Chapter Five to provide context for the Manitoba PISA 2012 results as well as to provide further context for the qualitative analysis of the goal-oriented language in the three PISA documents. The OECD chose to assess fifteen year old students as the age closest to the end of formal required schooling for many participating countries (2013a). MET established the grade nine mathematics credit course as the final mathematics credit that all Manitoba students are required to earn prior to choosing from various mathematics courses for one required mathematics credit for each of grades ten, eleven and twelve. Thus, the second data set for this research study consisted of five years of student data on Manitoba students’ grade nine mathematics credit achievement upon first attempt at the grade nine mathematics course, for the years 2008 through 2012. This mathematics credit achievement data set is quantitatively analyzed in the next Chapter for pass/fail rates, and qualitatively analyzed for patterns relating to student achievement in mathematics in Manitoba.

Chapter Five: Quantitative Analysis of the Manitoba Education and Training (MET) Mathematics Credit Data Set

The purpose of this research paper is to address whether, and to what extent, the goals of PISA align with the goals of MET, and whether the published results of PISA 2012 provide any information that helps to address the goals of MET. The focus of Chapter Four was a qualitative analysis of what Atkinson and Coffey described as “social facts” (1997) for PISA as presented by the OECD. Because these “facts” have inherent bias, a second data set is explored in this research study to contextualize the PISA 2012 published results. The data set chosen by the researcher to provide context is a collection of five years of credit achievement data for grade nine mathematics in Manitoba.

At the request of the researcher for this thesis, Manitoba Education and Training (MET) provided five years of data containing information on students enrolled in public schools at the end of September 30th for each of the years 2008, 2009, 2010, 2011, and 2012. The data set contained the number of students were enrolled in the English program, French Immersion program, and Français program. It also contained which students had EAL or AAA status, and it showed whether the students passed their grade nine mathematics credit upon first attempt. The First Nations schools which have an agreement with Frontier School Division in Manitoba were not included in this data set in order to limit the focus of the research study.

The second portion of this chapter provides data tables showing the percentage of students who passed grade nine mathematics. First, however, this chapter provides various tables showing breakdowns of student enrolment by percentages for each of the years in the data set. For a breakdown of enrolment by the number of students, rather than by percentages, please see

Appendix A. For a breakdown of students who passed grade nine mathematics by the number of students, rather than by percentages, please see Appendix B.

Table 2 shows the percentage of students who were enrolled in grade nine for the first time in Manitoba at September 30th for each of the years in the data set, broken down by the number of students in the English, Immersion, and Français programs. The overall enrolment of students in grade nine mathematics as of September 30th decreased by 419 students during the five-year span from 2008 through 2012, from 13368 to 12949 students. Enrolment in the Français program increased by two students in the same time span, from 344 to 346 students. Immersion program enrolment increased by twelve students, from 1107 to 1119 students, and English program enrolment decreased by 433 students, going from 11917 to 11484 students.

Table 2. Percent of annual student population of English, Immersion, and Français program first time students enrolled in grade nine in Manitoba as of September 30th for 2008 - 2012.

% of student population					
	2008	2009	2010	2011	2012
English	89.1	89.1	89.4	88.6	88.7
Immersion	8.3	8.3	8.1	8.9	8.6
Français	2.6	2.6	2.5	2.5	2.7
Total	100	100	100	100	100

The percentage breakdowns for the English, Immersion, and Français programs in each of these years remained fairly steady, as shown in Figure 2 below.

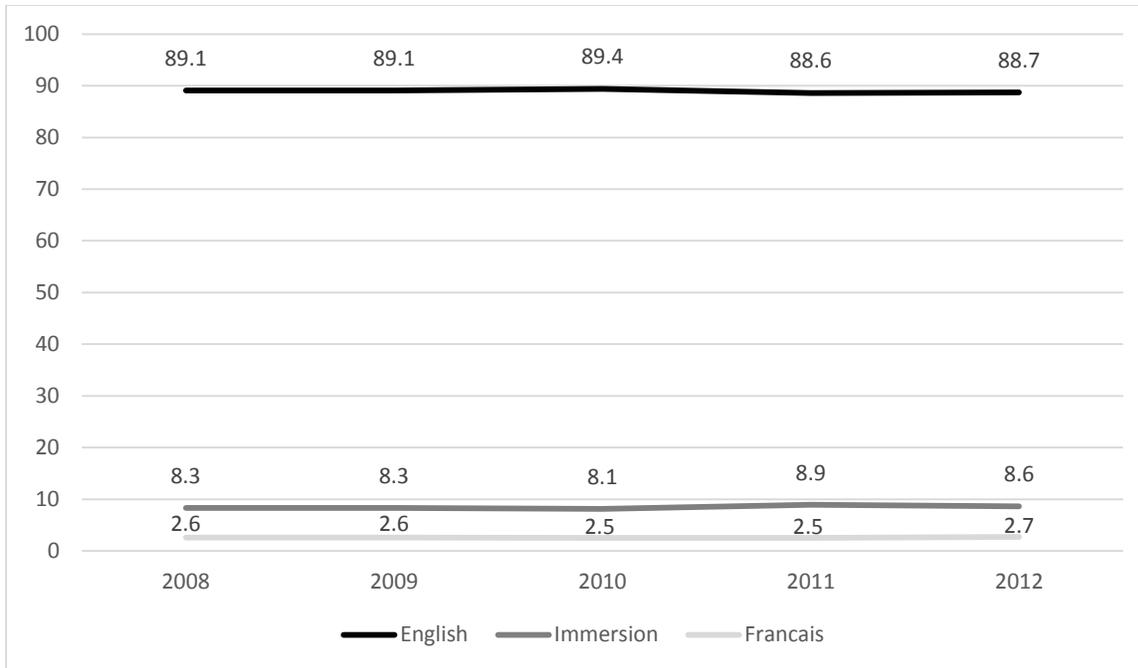


Figure 2. Percent of annual student population of English, Immersion, and Français program first time students enrolled in grade nine in Manitoba as of September 30th for 2008 - 2012.

Table 3 on the following page shows the percent of English as Additional Language (EAL) and self-identified Aboriginal Academic Achievement (AAA) students who were enrolled for the first time in grade nine in Manitoba for the years in the MET data set. Table 3 shows that the EAL percentage of the student population increased for all programs over the five-year span from 2008 through 2012, with the greatest percentage increase in EAL enrolment seen in the English program. The Immersion and Français program EAL percentage student populations increased from 2008 to 2012 as well.

Table 3. Percent of EAL, AAA, EAL & AAA, and non-EAL non-AAA first time students for 2008 - 2012 enrolled in grade nine in Manitoba as of September 30th.

		% of student population				
		2008	2009	2010	2011	2012
All programs	EAL	4.12	5.26	6.46	7.43	7.85
	AAA	13.53	16.26	16.43	16.68	17.54
	EAL & AAA	0.05	0.18	0.07	0.15	0.13
	Non-EAL, non-AAA	82.35	78.47	77.11	75.88	74.61
English	EAL	4.53	5.77	7.11	8.12	8.47
	AAA	13.42	16.55	16.50	17.02	17.68
	EAL & AAA	0.05	0.20	0.08	0.17	0.15
	Non-EAL, non-AAA	82.05	77.68	76.39	74.86	73.85
Immersion	EAL	0.18	0.90	0.37	1.84	2.14
	AAA	10.21	10.28	11.73	11.10	12.78
	EAL & AAA	-	-	-		0.09
	Non-EAL, non-AAA	89.61	88.82	87.90	87.06	85.08
Français	EAL	2.62	1.77	2.99	3.09	5.78
	AAA	28.20	25.96	29.04	24.69	28.32
	EAL & AAA	-	-	-	-	0.29
	Non-EAL, non-AAA	69.19	72.27	67.96	72.22	65.90

Figure 3 below graphs the EAL population enrolment percentages from Table 3, showing an overall increase in EAL population over time in all programs.

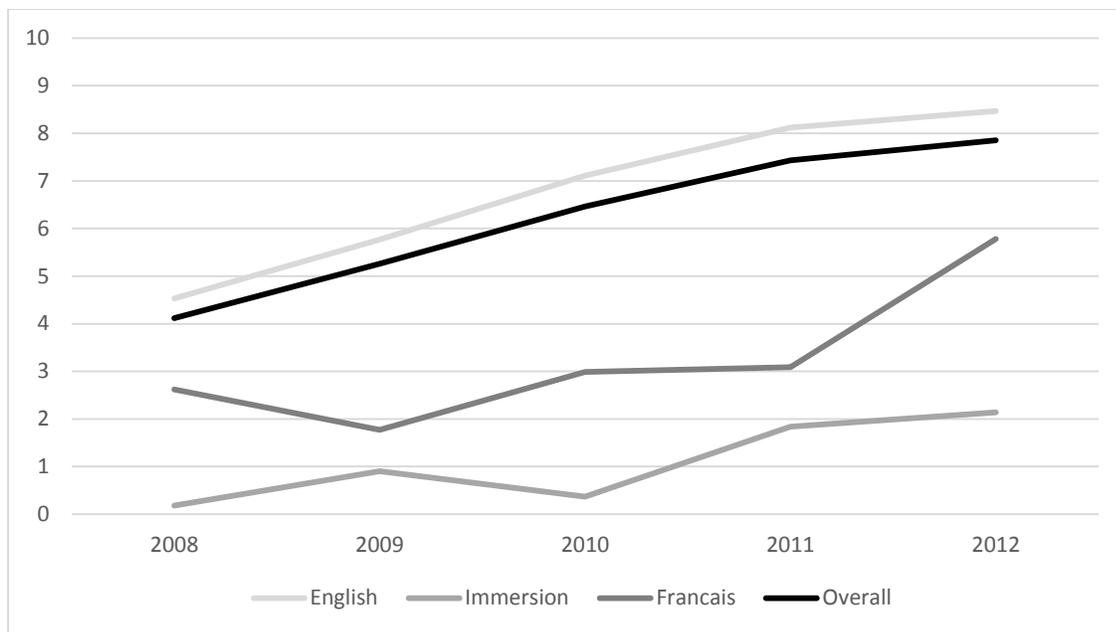


Figure 3. Percent of EAL first time students enrolled in grade nine in Manitoba as of September 30th for the English, Immersion, Français programs, and overall for 2008 - 2012.

Over the five-year span from 2008 through 2012, both the EAL enrolment percentages and the AAA enrolment percentages increased. The greatest percentage increase in AAA enrolment, of 4.01% over the five years, was seen in the English program. Consistently over each of the five years analyzed, the Français program had the highest annual percentage of AAA students. In terms of numbers, however, the English program had the highest number of AAA students enrolled in each of the five years of the data set (see Appendix A, table A2). Figure 4 takes the percent of AAA students enrolled in all programs and graphs them by program.

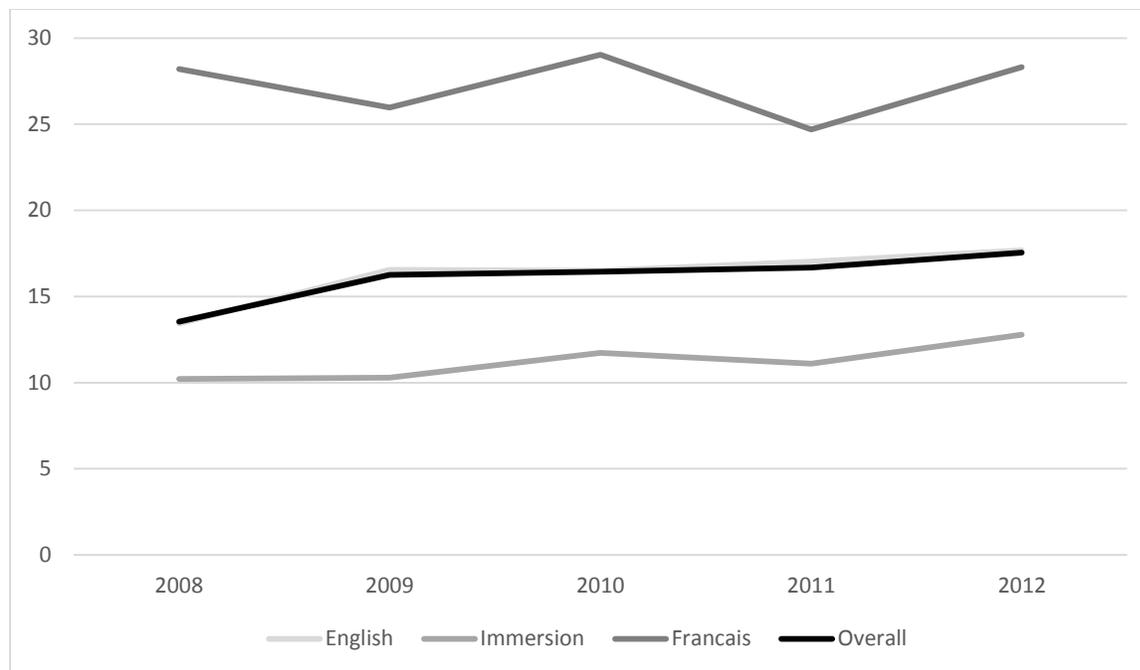


Figure 4. Percent of AAA first time students who were enrolled in grade nine in Manitoba as of September 30th for the English, Immersion, Français programs, and overall for 2008 - 2012.

Overall Pass Rates

Table 4 shows the percentage of English, Immersion, and Français program students that passed grade nine mathematics upon first attempt, as well as the overall percent pass rate across all programs in Manitoba.

Table 4. Percentage of students enrolled in grade nine in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

	% students who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	88.6	88.6	89.8	89.4	89.6
English	87.9	87.8	89.1	88.8	88.8
Immersion	95.4	97.0	97.0	95.2	95.4
Français	90.4	91.7	91.7	92.0	94.8

Table 4 shows similar pass rates overall, of approximately 89%, for each of the years 2008 through 2012. The pass rate for the English program remained close to 89% annually for this

same time span, with Immersion pass rates higher but steady during the same time span. Français program pass rates ranged from approximately 90% in 2008 to approximately 95% in 2012.

These percentage pass rates for all programs are shown in Figure 5 below.

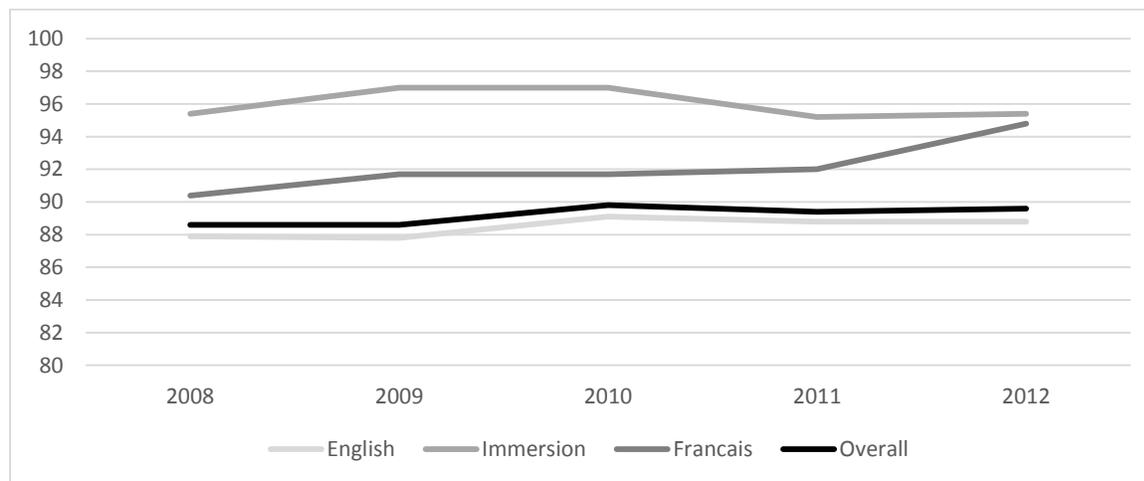


Figure 5. Percentage of students enrolled in grade nine in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

English as an Additional Language (EAL) Pass Rates

Table 5 below shows the percentage of EAL students that passed grade nine mathematics upon first attempt in the English, Immersion, and Français programs.

Table 5. Percentage of EAL students enrolled in grade nine in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

	% EAL students who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	88.75	87.02	92.39	92.66	92.53
English	89.07	86.71	92.62	92.52	93.22
Immersion	100	100	100	100	95.83
Français	66.67	100	70.00	90.00	55.00

Table 5 shows a fairly steady overall pass rate across two of the three programs for EAL students. In the English program, the percentage of EAL students who passed grade nine mathematics upon first attempt was fairly steady. The Immersion program percentage of EAL

students who passed was also fairly consistent. Français program percentages were different for each year of the five years explored. The percentages from Table 5 are shown in Figure 6 below.

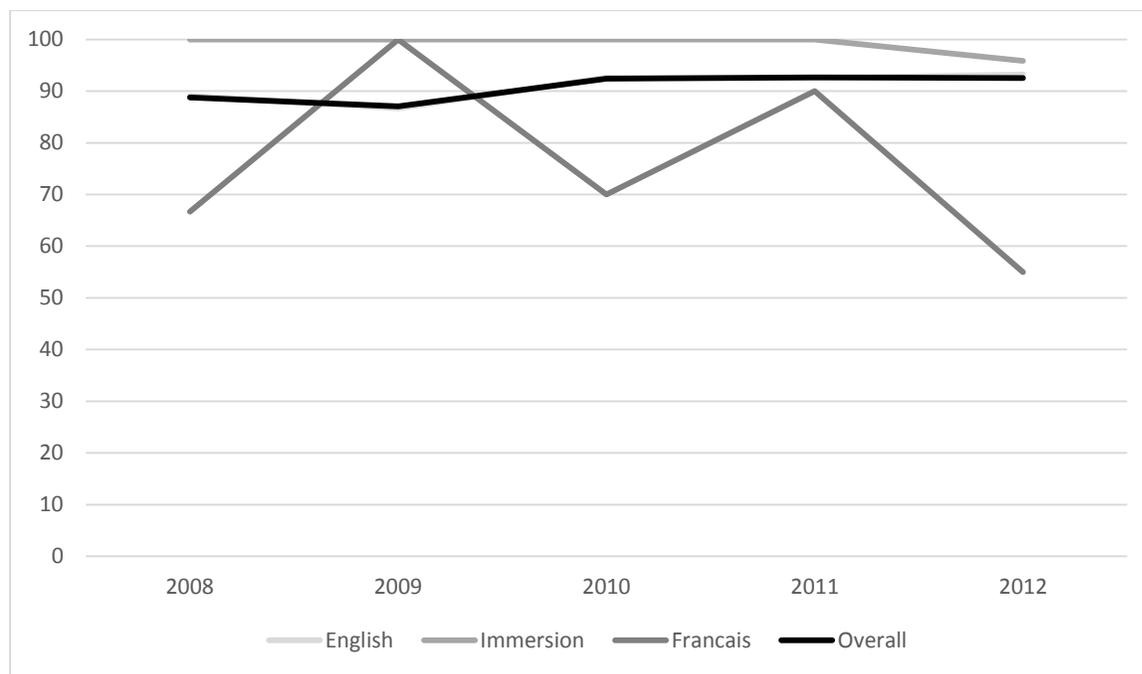


Figure 6. Percentage of EAL students enrolled in grade nine in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

Aboriginal Academic Achievement (AAA) Pass Rates

The percentage of AAA students across all programs who earned their grade nine mathematics credit increased steadily from 2008 to 2012. A similar steady rise in the percentage of AAA students earning their credit is seen in the English and Immersion program numbers. Table 6 on the following page shows the percentage of AAA students in Manitoba who earned a grade nine mathematics credit upon first attempt for each of English, Immersion, and Français programs.

Table 6. Percentage of AAA students enrolled in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

	% AAA students who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	71.70	71.56	72.71	71.93	70.85
English	68.92	69.45	70.67	70.01	68.42
Immersion	92.03	92.10	90.48	86.61	89.51
Français	93.81	92.04	90.72	95.00	93.88

Table 6 above shows approximately 71 percent of AAA students across all programs earning their credit for the range of years studied. In the English, Immersion, and Français programs for the same range of years, the percent of AAA students earning their grade nine mathematics credit upon first attempt remained fairly steady. However the pass rate for the English program was lower than both Immersion and Français programs for AAA students. This is shown in Figure 7 below.

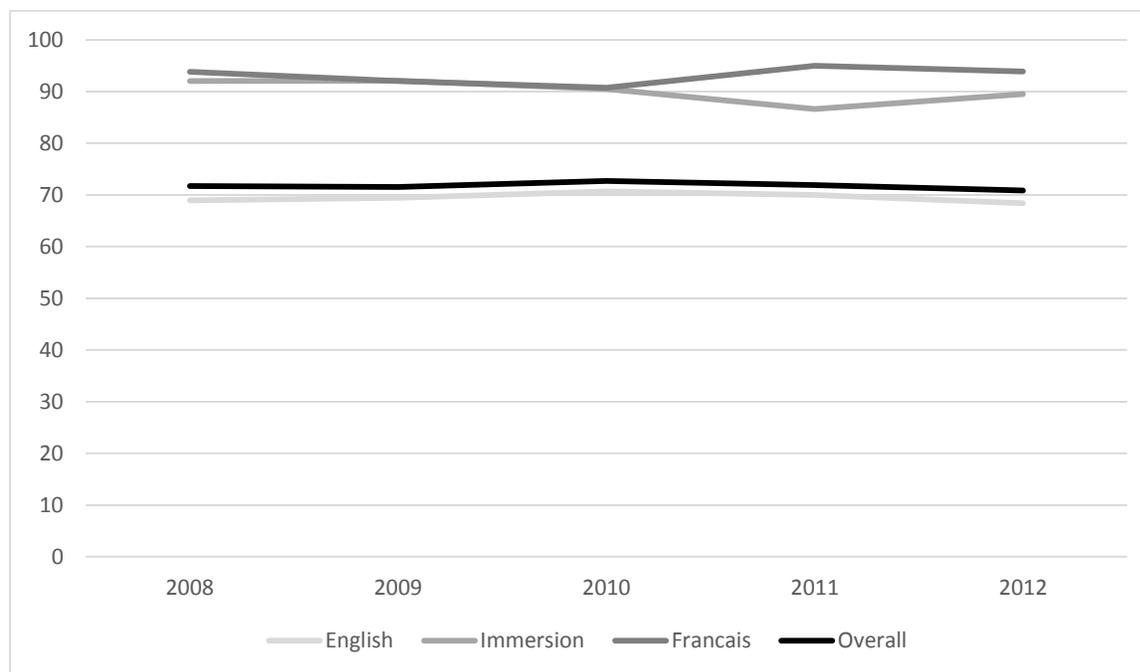


Figure 7. Percentage of AAA students enrolled in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

English as an Additional Language (EAL) and Aboriginal Academic Achievement (AAA)

Pass Rates

Table 7 shows the percentage of Manitoba students across all programs, as well as the percentage of students in the English, Immersion, and Français programs, who earned their grade nine mathematics credit upon first attempt for each year in the data set for students that are listed as both EAL and AAA. It is worth noting that for each of the years 2008 through 2011, only the English program had registered students who were both EAL and AAA.

Table 7. Percentage of students that are both EAL and AAA enrolled in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

	% students that are both EAL and AAA who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	28.57	54.17	60.0	36.84	63.16
English	28.57	54.17	60.0	36.84	58.82
Immersion	-	-	-	-	100
Français	-	-	-	-	100

Pass rates in the English program ranged from a low of 29 percent in 2008 to a high of 60 percent in 2010. The overall pass rate for EAL and AAA students was at its highest in 2012 in the five year range studied. This is shown in Figure 8 on the following page.

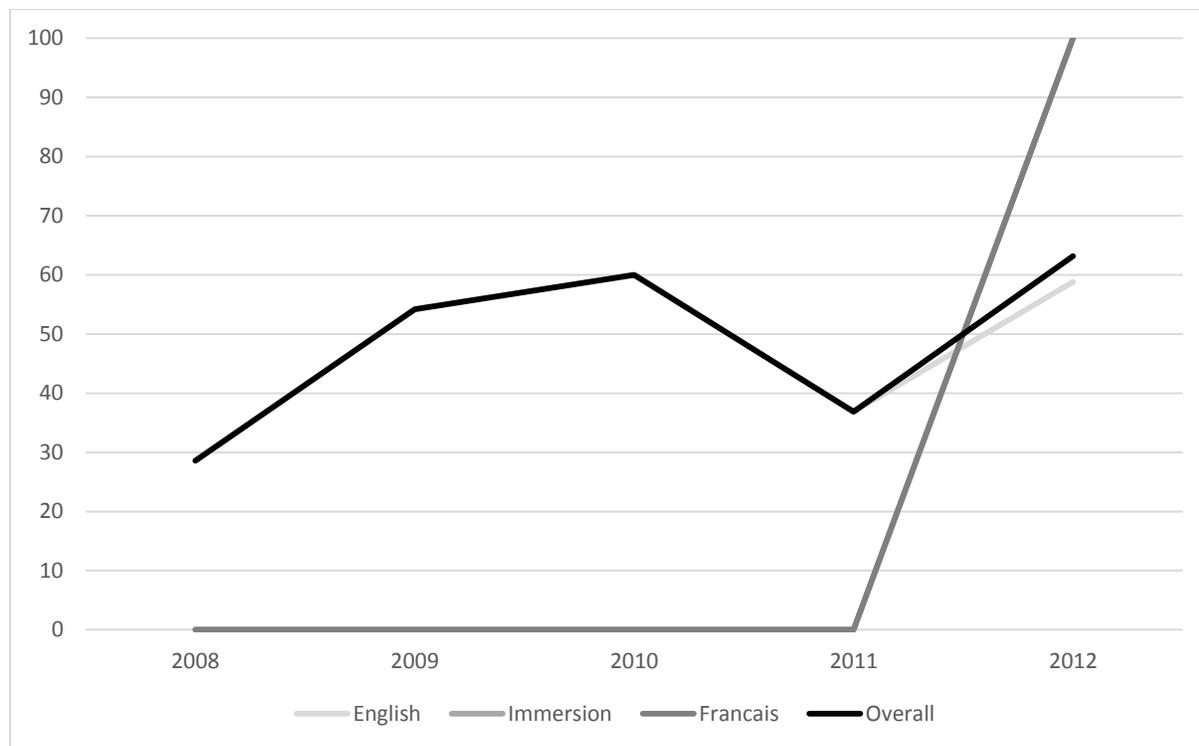


Figure 8. Percentage of students that are both EAL and AAA enrolled in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

Non English as an Additional Language (EAL), Non Aboriginal Academic Achievement (AAA) Pass Rates

Table 8 shows the percentage of students across all programs, as well as the percentage of students in the English, Immersion, and Français programs, who earned their Manitoba grade nine mathematics credit upon first attempt for each year in the data set for students that are listed as neither EAL nor AAA. The table below shows a steady decrease in the percentage of non-EAL, non-AAA students across all programs that earned their credit upon first attempt. A similar steady decrease is seen in the English program numbers. Français and Immersion program numbers remained fairly steady across the five year time span.

Table 8. Percentage of students that are neither EAL nor AAA enrolled as of September 30th who earned their Manitoba grade nine mathematics credit upon first attempt for 2008 - 2012.

	% students that are neither EAL nor AAA who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	91.38	92.27	93.19	92.90	93.64
English	90.97	91.73	92.78	92.69	93.22
Immersion	95.77	97.56	97.46	95.18	96.22
Français	89.92	91.43	91.63	91.03	98.68

Figure 9 takes the percentages from Table 8 above and shows them in graph format. When looking at the graph, the trends across all programs look similar and fairly steady.

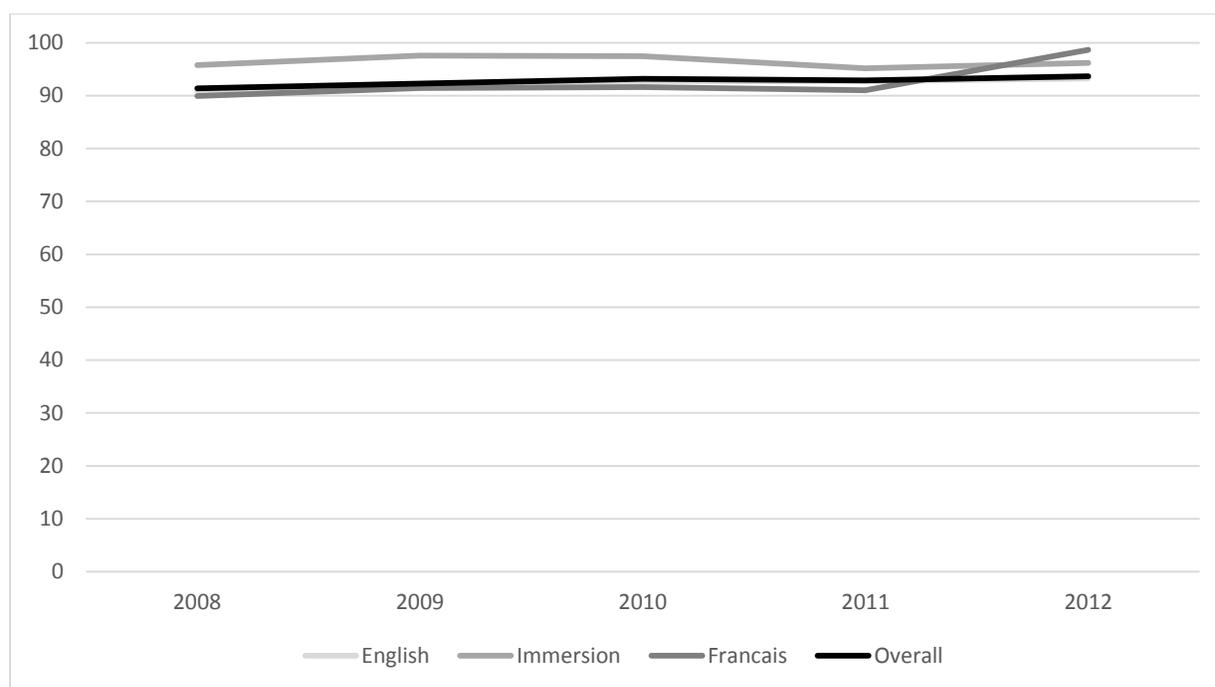


Figure 9. Percentage of students that are neither EAL nor AAA enrolled as of September 30th who earned their Manitoba grade nine mathematics credit upon first attempt for 2008 - 2012.

Summary: Patterns and Comparisons

Approximately 89 percent (%) of the student population enrolled in grade nine mathematics in Manitoba during each of the years 2008 through 2012 were enrolled in the English program. The portion of EAL students across all programs increased from approximately

4% to 8% during that time, and the portion of AAA students increased steadily from approximately 13% to 17%. Comparatively, the percentage of EAL students enrolled in the English program were higher than Immersion and Français programs for all years in the data set. For AAA percentages, Français programming showed the highest percentages for each year in the data set, but the percentages remained steady at or near 28%. In the same time period, the percentage of AAA students in English programming increased from approximately 13% in 2008 to 17% in 2012.

Pass rates for first attempt at grade nine mathematics remained fairly steady during the five years in this research study at around 89% overall, and in the English program. Pass rates for Immersion and Français programs were steady during the five years, but higher than the English program pass rates. EAL students' pass rates were fairly steady over all programs, as well as separately for the English and Immersion programs, the exception being Français program EAL student pass rates ranging from 55% to 100% in the five years studied. Pass rates for AAA students remained steady and close to 71% overall, with English program pass rates for AAA students being fairly steady at 70% over the five years. Immersion and Français pass rates for AAA students were higher and fairly steady, on average 90% for Immersion and 93% for Français AAA students. Very few students registered as both EAL and AAA during the five years studied, with this category of students showing the lowest pass rates in the data set ranging from 29% in 2008 to 63% in 2012 overall. Comparatively, those students who were neither EAL nor AAA showed the highest pass rates for first attempt at grade nine mathematics in Manitoba, with all programs registering pass rates of 90% or better for all years studied.

Chapter Six takes these pass rate results from the MET grade nine mathematics credit data set and qualitatively compares them to the published results for Manitoba students'

mathematics performance in PISA 2012. Chapter Six begins with qualitative comparisons of PISA goals to MET goals using the results of Chapter Four's qualitative analysis of OECD documents, then qualitatively compares published Manitoba results for PISA 2012 to MET goals, to determine whether and to what extent the goals and published results of PISA align with the goals of MET within the context of mathematics.

Chapter Six: Qualitative Comparisons

With Chapter Four providing a qualitative analysis of three OECD documents on PISA 2012 to determine goal-related language similar to MET's four goals within the context of mathematics education, as well as a qualitative analysis of Manitoba results for PISA 2012 using the conceptual framework of MET's four goals, and with Chapter Five providing a simple quantitative analysis of five years of credit achievement data for Manitoba students upon first attempt of their grade nine mathematics credit for the years 2008 through 2012, Chapter Six provides a qualitative comparison of PISA goals and MET goals, a qualitative comparison of Manitoba's published PISA 2012 mathematics results and MET goals, and a qualitative comparison of Manitoba's published PISA 2012 mathematics results and Manitoba grade nine mathematics credit achievement data patterns, to determine whether and to what extent the goals and published results of PISA align with the goals of MET within the context of mathematics education. Indeed, the OECD itself has stated that, "the drawing of causal inferences thus relies on the researcher's willingness to make additional, often un-testable, assumptions" (OECD, 2013a, p.172).

Programme for International Student Assessment (PISA) Goals and Published Manitoba PISA 2012 Results Compared to Manitoba Education and Training (MET) Goals

The OECD has stated that PISA has one overarching aim of assessing the extent to which fifteen year olds have learned mathematics, reading, and science to function in modern society (OECD, 2013a, p.14). PISA has three explicit goals within that aim: a monitoring structure, a data source for exploring the effectiveness of education systems, and of providing data to explore variables and contexts that can affect education systems (p.169). MET has outlined four overarching goals: the principle of inclusion, education for sustainable development, improving

the achievement of students historically less successful, and increasing the overall provincial graduation rate (Manitoba Education, 2010a). From the research presented in Chapter Four, it can be seen that the explicit wording of the goals of PISA and the goals of MET are not directly comparable, however there are some phrases using goal-related language in the OECD documents analyzed that provide a few overlapping areas worthy of highlighting.

Inclusion. The intent of the OECD to minimize the number of students excluded from participating in the PISA 2012 assessment fits with MET's goal of the principle of inclusion. The OECD documents analyzed in this research study indicated that accommodations were allowed by the OECD for those students with physical or intellectual disabilities or language barriers that would otherwise prevent them from being able to fully participate in the assessment. The three OECD documents analyzed for this research study did not explicitly reference the principle of inclusion in their aim and goal related language. One document did however mention that the booklets created for students to participate in the mathematics portion of the PISA 2012 assessment were created with the idea of accommodation in that a specific separate booklet was created for students with special needs, allowing for inclusion of more students through the accommodation of less content to be covered by these students within the same allotted time for completion of the PISA 2012 assessment (OECD, 2013a, p.19).

It is further interesting to note that within the published results of PISA 2012, there are tables detailing the numbers and overall percentages of students excluded for various reasons, broken down by categories of reasons for the countries and regions that participated, yet there are no published tables showing how many students received the booklets containing less content nor are there published details of the performance of those students. There is currently no opportunity within the results published by the OECD to explore the "quality, equity, and

efficiency” (OECD, 2014, p.3) of Manitoba Education and Training, or of any education systems participating in PISA, with respect to students with special needs. Thus there is nothing currently within PISA or the OECD documents’ language that is compatible with MET’s goal of the principle of inclusion other than an attempt to provide some content-related accommodations within the PISA assessment booklets to students with special needs, and to minimize the number of students excluded from the PISA assessment.

Education for sustainable development. Living sustainably, or the concept of education for sustainable development as stated within one of MET’s overarching goals, is neither a part of the goals of PISA nor is this concept embedded within any of the language of the PISA framework or results documents that were analyzed for this research study, within the context of the mathematics portion of PISA 2012. The only reference to sustainability within the PISA documents analyzed was a reference to ensuring that the database created by PISA would be sustainable for future research (OECD, 2013b, p.167). There is no contribution within PISA or the OECD documents towards addressing MET’s goal of education for sustainable development within the context of mathematics education, however there is some information that addresses MET’s goal of improving the achievement of historically less successful student populations.

Historically less successful students. Clearly stated within all three of the OECD documents analyzed in Chapter Four is the underlying goal of improving student achievement (OECD, 2013a; OECD, 2013b; OECD, 2014), although the OECD documents do not use the MET goal’s language of improving achievement of “historically less successful” student populations or subgroups specifically (Manitoba Education, 2010a). The OECD provided detailed comparisons of various subgroups of students from countries and regions that participated in PISA 2012 in both of the results documents analyzed for this research study

(OECD, 2013b; OECD, 2014). It is worthwhile to compare the subgroups of students that the OECD chose to focus on in its detailed exploration of country and region results, to the subgroups of students that are embedded within the priority action areas of MET, to determine if there are any similarities. The OECD chose to focus on sex (male and female), immigration (first generation students, students with immigrant parents, students with languages spoken at home that are different than the language used in the PISA assessment), type of education programming (English or Français programming), and their own calculation of an index of socio-economic and cultural status (ESCS) that encompasses variables such as parent income and the number of books and technology in the home (OECD, 2014, p.37). In the case of MET, the priority action areas for the province of Manitoba provide further details regarding the subgroups of students the Province is interested in exploring, including Aboriginal education, rural, northern, and low income communities (Manitoba Education, 2010a).

In terms of addressing the student subgroups encompassed within Manitoba Education and Training's priority action areas, there is a marked absence of language focused on, or results published by the OECD, that address Aboriginal education. In the PISA 2012 framework, there was no way provided to track students who self-identify as Aboriginal, a significant gap in the PISA data set for Manitoba as it cannot address Manitoba Education and Training's priority area of Aboriginal education (Province of Manitoba, 2014a). Although the documents analyzed do reflect language, and publish results, related to low income communities as well as rural versus urban schools, there is an absence of regional breakdown of results to reflect Manitoba Education and Training's priority action area of northern communities. Information from published OECD data for achievement of students with EAL background and programming, referred to as ESL in OECD documents, are provided within the published regional results for

Manitoba students who participated in PISA 2012 (OECD, 2013b), an area which has some overlap with MET's goal of improving the achievement of students that "have historically been less successful" (Manitoba Education, 2010a). Although there is some overlap in PISA's goal related language as well as published PISA results with MET's goal of improving achievement of student populations that have been historically less successful, this is not the case for MET's final goal – that of improving the overall graduation rate.

Graduation rate. There is no explicit information in the OECD documents analyzed for this research study, whether through goal related language or through published PISA results, that specifically addresses MET's goal of increasing the overall graduation rate. There are published details by the OECD on truancy and attendance patterns from both student and school questionnaires. Manitoba showed no statistically significant correlations, according to the OECD, between student performance and dropout behaviour or between school socioeconomic status and dropout behaviour, while Canada's results showed statistically significant correlations between these variables (OECD, 2013b, pp.263-265). In terms of the correlation between PISA's goals and published results to MET's goal of improving the overall graduation rate, there is no significant contribution within PISA's goals and published results to provide information towards addressing improving graduation rates.

Programme for International Student Assessment (PISA) 2012 Manitoba Results and Manitoba Education and Training Grade Nine Mathematics Credit Achievement

According to the OECD, PISA provides an opportunity for countries and regions to monitor their "student performance ... at the end of compulsory schooling" (OECD, 2013a, p.170). Within Manitoba it is grade twelve that is the final compulsory year of schooling, however grade nine is the final compulsory year of schooling where every student is required to

take the same mathematics course for credit. Grades ten through twelve provide students choices within the one required compulsory mathematics credit per year until graduation in Manitoba. Chapter Five presented a quantitative overview of five years of grade nine mathematics credit achievement data for students in Manitoba attempting the course for the first time, for the years spanning 2008 through 2012. These results included the results of students who would have participated in PISA 2012. For those students in grade ten at the time of participating in PISA 2012, their first attempt at a grade nine mathematics credit would have occurred in 2011, part of the MET data set in Chapter Five. For those students in grade nine at the time of participating in PISA 2012, their first attempt at a grade nine mathematics credit would have occurred in 2012, also part of the MET data set in Chapter Five.

Comparing the overall pass rate upon first attempt of grade nine mathematics for Manitoba students in 2011 and 2012 to the percentage of the Manitoba student population that met the baseline level two achievement or higher in the mathematics portion of PISA 2012, the overall pass rate for all Manitoba students in obtaining their grade nine mathematics credit upon first attempt was 89.39% in 2011 and in 2012 it was 89.56%. This compares to 78.8% of the Manitoba sample of students who participated in PISA 2012 meeting the baseline level two achievement or higher in the mathematics portion of PISA 2012 (OECD, 2014, p.405).

Comparing the overall pass rate upon first attempt of grade nine mathematics for EAL students in Manitoba in 2011 and 2012 to the percentage of the immigrant population that met the baseline level two achievement or higher in the mathematics portion of PISA 2012, for all Manitoba EAL students obtaining their grade nine mathematics credit upon first attempt in 2011 the pass rate was 92.66% and in 2012 it was 92.53%. This compares to 77.3% of immigrant

students in the Manitoba sample of students who participated in PISA 2012 meeting the baseline level two achievement in the mathematics portion of PISA 2012 (OECD, 2013b, table B2.II.12).

Comparing the overall pass rate upon first attempt of grade nine mathematics for English program students in Manitoba in 2011 and 2012 to the percentage of the English program students that met the baseline level two achievement or higher in the mathematics portion of PISA 2012, for Manitoba students registered in the English program the pass rate upon first attempt at their grade nine mathematics credit was 88.82% in 2011, and 88.84% in 2012. The comparison of this percent to the percentage of English program Manitoba students sampled in PISA 2012 obtaining the baseline level two achievement or higher in the mathematics portion of PISA 2012 is not possible with current published results from OECD, as the focus of the published results are on mean scores. Within the two results documents analyzed for this research study, *PISA 2012 results: What students know and can do (volume I)* and *PISA 2012 results: Excellence through equity (volume II)*, there were no specific mean scores for English program students published (OECD, 2013b; OECD, 2014).

Comparing the overall pass rate upon first attempt of grade nine mathematics for Français program students in Manitoba in 2011 and 2012 to the percentage of the Français program students that met the baseline level two achievement or higher in the mathematics portion of PISA 2012, Manitoba students enrolled in the Français program had a pass rate 91.98% in 2011 upon first attempt at obtaining a grade nine mathematics credit, and 94.80% in 2012. The comparison of this percent to the percentage of Français program students sampled in PISA 2012 obtaining the baseline level two achievement or higher in the mathematics portion of PISA 2012 is not possible with current published results from OECD, as the focus of the published results are on mean scores. Within the two results documents analyzed for this research study, *PISA*

2012 results: What students know and can do (volume I) and *PISA 2012 results: Excellence through equity (volume II)*, there were no specific mean scores for Français program students published (OECD, 2013b; OECD, 2014).

Comparing the overall pass rate upon first attempt of grade nine mathematics for AAA students in Manitoba in 2011 and 2012 to the percentage of students with low ESCS that met the baseline level two achievement or higher in the mathematics portion of PISA 2012, for Manitoba students who identified as AAA and were registered in any program the pass rate for first attempt at completing their grade nine mathematics credit was 71.93% in 2011 and 70.85% in 2012. Although there were no published data from the OECD to address performance of Aboriginal students in the sample of students that participated in PISA 2012, there were published data based on low socio-economic status. This published data focused however on the mean score for Manitoba students with low socioeconomic status, or low ESCS, rather than the percentage of Manitoba students that met the baseline level two achievement or higher in the mathematics portion of PISA 2012 (OECD, 2013b; OECD, 2014).

Summary

This chapter provided a review of the qualitative analysis of goal related language of three OECD documents about PISA 2012 and of the qualitative analysis of OECD published PISA 2012 results for Manitoba. This review has shown that there are small sections of the PISA documents that indicate relevant goal-related language and some published results which provide some information addressing MET's goal of improving the achievement of student populations that have historically been less successful. Specifically, the PISA documents' language and the published results of PISA 2012 for EAL/ESL populations as well as low income and rural communities provide some information towards addressing this goal. In comparing the

percentage of Manitoba students who met the baseline level two achievement or higher for the mathematics portion of PISA 2012 to the percentage of students in 2011 and 2012 who earned their grade nine mathematics credit upon first attempt, published results for Manitoba students who participated in PISA 2012 focused more on mean scores for students with low socio-economic status. There were no published results in the documents analyzed for this research study that provided information on the percentage of students in English or Français programs that either met or exceeded the baseline level two achievement for the mathematics portion of the PISA 2012 assessment. There was no alignment within PISA's goal-related language or PISA 2012's published results in any form for Aboriginal or northern students, either for countries or for regions such as Manitoba. There was no alignment within PISA's goal-related language or PISA 2012's published results for Manitoba's goals of inclusion and of education for sustainable development. There were some published results from PISA 2012 that indirectly referred to student dropout patterns, providing marginal information towards addressing MET's goal of improving the graduation rate. With little to no information provided within PISA's goals and published PISA 2012 results for three of MET's four goals of education, Chapter Seven will take the comparisons made in this chapter and pose questions for further research as well as conclusions of this research study.

Chapter Seven: Questions for Further Research and Conclusions

This research study explored whether, and to what extent, the goals of PISA align with the overarching goals of Manitoba Education and Training, and whether the published results of PISA 2012 provide information to address the goals of MET. This research is an important addition to the literature which has currently focused on league tables and the ranking of Manitoba in relation to other provinces, and in relation to country-specific data from PISA 2012. There has been no explicit exploration in the literature to date as to whether participation in PISA is of value for Manitoba – whether from the perspective of whether participation in PISA has value for Manitoba Education and Training, or whether participation in PISA has value for students in Manitoba. Before research on a larger question of PISA participation and its potential value for Manitoba, it was important to explore the goals of PISA and whether there was any alignment with MET goals.

The results of this research study exploring whether, and to what extent, the goals and published results of PISA align with the overarching goals of Manitoba Education and Training within the context of mathematics show that there is very little alignment between the goals of PISA and the goals of MET. This research study has shown that there is one overarching goal of MET – education for sustainable development – that is not at all addressed by the goals and aims of PISA, nor by the published results of PISA 2012, within the context of mathematics education. The MET goal of inclusion is superficially and indirectly addressed within the framework of PISA in terms of tracking exclusion percentages and providing booklets modified for content for students with special needs, however inclusion is neither supported through explicit language in published OECD documents nor in the published results of student subgroups for countries or for regions such as Manitoba that participated in PISA 2012.

MET's goal of improving the achievement of student subgroups that have been historically less successful is addressed in small part through PISA's goal of providing a database with variables to explore contexts within participating education systems, including some immigrant student data relevant to Manitoba's EAL student subgroup, and some information relevant to MET's priority action area of low income communities and rural education. What are not addressed by PISA's database of variables, by the goal-related language of PISA, or by the published results of PISA, are Manitoba's Aboriginal and northern student subgroups, both identified by MET as priority action areas.

MET's goal of improving the provincial graduation rate is indirectly addressed through PISA's goal of providing a database with variables such as truancy, attendance, and student attitudes towards school and towards mathematics but is not specifically supported in the goal-related language of the OECD's PISA framework and results documents analyzed for this research study. As well, although there is data provided by PISA on truancy, attendance, and student attitudes towards school and towards mathematics, this data is definitely limited in terms of its scope as the data comes from students who were not truant and not absent from school during the PISA assessment process. Those students who were truant or absent are inherently left out of the PISA database and therefore the database does not provide a complete picture to allow for Manitoba Education and Training to explore reasons for truancy and absenteeism and possible connections to attitudes towards mathematics. Thus the PISA database does not provide sufficient data to explore graduation rates for Manitoba or how to improve them.

Inclusion

Further research could be done to determine whether the OECD PISA 2012 database allows for exploration of the results of students with special needs who received booklets

containing two clusters of content areas rather than the four areas included for other students participating in PISA 2012. Future research could also be done to explore whether this subgroup of data is available to researchers within the PISA 2012 data set, and to then explore through the lenses of poverty and equity the results of this subgroup of Manitoba students in comparison to other subgroups' results, and to the overall results of students for PISA 2012. A broader question of how the OECD presents PISA as inclusive, even though inclusion is not a specific goal nor do they justify exclusion, could be explored through analysis of published documents, website information, and PISA data presentations done by the OECD. How inclusive are they? How inclusive is the Rasch statistical model that is used by PISA to analyze its results? How inclusive is the committee of individuals that the OECD hired to create the assessment products under the banner of PISA?

Education for Sustainable Development

It would be interesting to perform further research on the reading and the science portions of the PISA 2012 assessment, and of the PISA framework document, to determine whether sustainability or the concept of education for sustainable development is embedded within the language of the other two areas of assessment in PISA, or whether it is embedded within the framework of those two areas of PISA itself. As one of the four main goals of Manitoba Education and Training, it is worth determining whether the other two areas of PISA assessment, reading and science, are just as lacking in reference to this goal of sustainability as the mathematics assessment portion of PISA.

Historically Less Successful Students

The language of the documents analyzed for this research study put mathematics achievement, as measured by the Programme for International Student Assessment, central to

both personal and societal economic success. Within Manitoba Education and Training's goal of improving the achievement of student populations that have been historically less successful in Manitoba, are the priority action areas of rural education, northern education, education in low income communities, and Aboriginal education. There is a dearth of information on the achievement of two of these four student subgroups within PISA, that of northern and Aboriginal students. There is also no overt or implicit language, goal-related or otherwise, that would lead the researcher to believe that Aboriginal education is a priority for the OECD as it is for MET. There is a concerted effort on the part of the OECD's published PISA results to address low socio-economic status, in turn indirectly addressing MET's priority action area of low income communities. There are also some published PISA results focused on rural school achievement results. Further research could be done to determine whether the OECD would provide in the future, on request from researchers, more detailed results for Manitoba's priority action area subgroups by adding further questions to their student and school questionnaires to identify these subgroups within the data set.

Graduation Rate

With the theme of personal and societal economic success tied to PISA achievement embedded throughout the OECD documents analyzed in this research study, there is potential for readers of these documents to assume an unwritten implication of economic downturn or failure for countries or regions experiencing declining PISA achievement in mathematics. It would be valuable to continue to follow the sample of Manitoba students who participated in PISA 2012 to determine whether this subgroup of Manitoba's population experiences differences in education, jobs, and economic success compared to the students who participated in the previous mathematics-focused PISA assessment from 2003. Further research needs to be done on PISA's

assumptions of societal economic success tied to PISA achievement success, and to determine whether there is correlation or causation between PISA achievement and Manitoba's economic success.

The OECD claims that the PISA baseline level 2 score is what is required "to achieve success in the modern ... world" (2013a, p.183). Further research could be done to determine whether they explain how this is true and how they know that achieving level 2 on PISA ensures success in life. Research could also be done to explore what the OECD means when they use the phrase "success in the modern world" - what is success? What does that look like? How does the OECD define it? Does their definition of success align with what the Manitoba Government defines as success? Does their definition of success align with what students define as success? When comparing the mathematics achievement of Manitoba students who participated in PISA 2012 to student credit achievement trends for Manitoba grade nine mathematics, further research could be done to explore the differences seen in the published PISA 2012 data versus the grade nine credit data. Why is there a difference? Does it matter that there is a difference? Does the PISA assessment, and the published results, provide crucial information that the MET data set does not?

Conclusions and Further Research Questions

The Organization for Economic Cooperation and Development has stated that PISA's "value ... is based on a constant interplay between PISA as a monitoring survey and more rigorous kinds of effectiveness research done elsewhere" (OECD, 2013a, p.172). Troubling to me, as a researcher, was the discovery through this research study of the lack of information within the goals and published results of PISA in addressing most of the goals of MET. It would be interesting to research the amount of money Manitoba has spent on participation in the PISA

assessments since their inception in 2000, and perform an analysis of value for dollars spent in terms of data and analysis provided by the OECD to support the goals of Manitoba Education and Training, and compare this to value for dollars spent on other assessments such as the Pan Canadian Assessment Program (PCAP). With this lack of alignment of the goals of PISA with the goals of MET, and the lack of information from published PISA results to provide information to address MET goals, this begs the larger question of why Manitoba Education and Training is requiring students to participate in the OECD's PISA assessment. Is the use of an assessment based on samples of students worldwide that emphasizes league tables critical for Manitoba Education and Training? Why or why not? What does Manitoba Education and Training want to assess? How does Manitoba Education and Training want to analyze data obtained from an assessment? Is everything that is valued by Manitoba Education and Training worthy of, or requiring, assessment?

There is an underlying acceptance that the published results of PISA are an accurate depiction of mathematics achievement of students in Manitoba, or in any participating region or country. This research study did not explore the validity of the Rasch statistical method that the OECD uses to analyze all of its PISA results. However, I believe this is another crucial research exploration that needs to be done within the context of Manitoba's participation. Is the Rasch statistical model a valid statistical method that provides an accurate depiction of students' mathematical abilities? Is the Rasch statistical model a valid statistical method that provides an accurate depiction of students' mathematical abilities for all subgroups that Manitoba Education and Training identifies as priority action areas? Is there validity and reliability in the results created by the Rasch statistical model for the sample of students in Manitoba? Is there more

value in exploring an assessment that is population based and does not use a statistical analysis model that calculates answers that students leave blank based on the answers they gave?

With Manitoba Education and Training focusing on improving the achievement of historically less successful populations, and with the OECD's PISA assessment providing little overlap with its exploration of equity for various student subgroups within the samples tested, further research may be done to determine what MET's purpose for participation in PISA has been over the past decade, and whether the populations that MET has identified as priority action areas – rural, northern, Aboriginal, and low income communities – believe there is purpose to participation in PISA. As disconnected as I am from immigrant and Aboriginal populations in both background and experience, I believe it is still vitally important to promote awareness of these populations' inequities, needs, and differences, and to promote conversation amongst researchers and educators regarding reducing or eliminating the inequities to ensure not just equality of access, but equality of opportunity for all students in Manitoba.

The OECD database of PISA 2012 results from student questionnaires was used to make conclusions regarding equity in mathematics performance, using only a sample of students that participated in Manitoba and in other regions and countries. None of the federally funded First Nations schools have participated in the OECD's PISA assessment. None of the territories have participated in the OECD's PISA assessment either, yet all of the Canadian provinces have participated. Why is there a difference in response to participation in PISA between provinces and territories, and between provincially and federally funded schools? Why is there a discrepancy? How much, if any, influence, does Manitoba Education and Training have on the development of future PISA assessments?

This research study has shown that the goals of PISA, and the published results of PISA 2012, provide very little information towards addressing Manitoba Education and Training's four goals of inclusion, of education for sustainable development, of improving achievement of historically less successful populations, and of improving the graduation rate, all of which in some way relate to the lens of poverty I claimed in Chapter Three. With curriculum and course choices in Manitoba secondary schools emphasizing career preparation or post-secondary study, it is worth taking the time to think critically about the power and position mathematics has been given in assessments such as PISA, in society, in education systems, and in the economy. Research could be done to determine how mathematics has ended up with this positioning, and how this compares to the positioning of other MET priority action areas such as sustainable development or Aboriginal education. Research could be done to determine how politics, economics and industry have become driving forces behind education curriculum and behind assessment tools used by the education system. Further research needs to be done on the correlation between poverty and educational achievement. This may help educators and policy makers to understand their own positions of power within society and the education system, and how current systems of education and assessment support or eliminate inequities and address socio-economic differences for specific groups of students.

References

- Aboriginal Affairs and Northern Development Canada (AANDC). (2015). *Elementary/secondary education programs*. Ottawa, ON: Author. Retrieved from <https://www.aadnc-aandc.gc.ca/eng/1100100033676/1100100033677>
- Alberta Government. (2014). *Alberta learning information service: other provinces' grade 12-level subjects acceptable for admission for 2014 - 15 admission to degree-granting institutions*. Edmonton, AB: Author. Retrieved from <http://alis.alberta.ca/pdf/transferralberta/Otherprovinces.pdf>
- Amgen Canada Inc. (2013). *Spotlight on science learning: the high cost of dropping science and math*. London, ON: Author.
- An Act to Eliminate Poverty in Canada. Bill C545.
- Atkinson, P.A. and Coffey, A. (1997). Analysing documentary realities. *Qualitative research: theory, method and practice*. Editor D. Silverman. London: Sage, 45-62.
- Brochu, P., Deussing, M., Houme, K., and Chuy, M. (2013). *Measuring up: Canadian results of the OECD PISA study*. Toronto, ON: Council of Ministers of Education Canada.
- Brownell, M., Roos, N., Fransoo, R., Roos, L. L., Guevremont, A., MacWilliam, L., and Levin, B. (2006). Is the class half empty? A population-based perspective on socioeconomic status and educational outcomes. *Institute for research on public policy choices*. 12(5), 1-30.
- Campaign 2000. (2015). *Manitoba child and family report card 2015: a crisis that has become chronic*. Winnipeg, MB: Author.
- Canadian Charter of Rights and Freedoms, § 15, Part I of the Constitution Act (1982).

- Citizens for Public Justice. (2012). *Poverty trends scorecard: Canada 2012*. Retrieved from <http://www.cpj.ca/files/docs/poverty-trends-scorecard.pdf>
- Climate Change and Emissions Reduction Act, C.C.S.M. c. C135 (2008).
- Community Living Manitoba. (2009). *Inclusive education in Manitoba: a review of progress toward appropriate education for all*. Winnipeg, MB: Author.
- Council of Ministers of Education Canada (CMEC). (2010). *PCAP-2010: report on the pan-Canadian assessment of mathematics, science, and reading*. Toronto, ON: Author.
- Craigén, R. (2013, December 4). Why does ‘fuzzy math’ persist? It’s a bonanza for consultants, publishers. *The globe and mail*. Retrieved from <http://www.theglobeandmail.com/news/national/education/why-does-fuzzy-math-persist-its-a-bonanza-for-consultants-publishers/article15763158/>
- Craigén, R. (2013, December 19). Get the ‘fuzzy’ out of Manitoba math. *Winnipeg free press*. Retrieved from <http://www.winnipegfreepress.com/opinion/analysis/get-the-fuzzy-out-of-manitoba-math-236513381.html>
- Creswell, J. W. (1999). *Research design: qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage.
- Delanty, G., & Strydom, P. (2003). *Philosophies of social science*. Maidenhead, PA: Open University Press.
- Denzin, N. K., & Lincoln, Y. S. (1998). *Collecting and interpreting qualitative materials*. Thousand Oaks, CA: Sage.
- Dubiel, M. (1997). The crisis in school mathematics content. *Canadian mathematics education study group. Proceedings. 1997 annual meeting*. Lakehead University. Thunder Bay, ON. Editor M. Pothier, Mount St. Vincent University. 67-76.

Flessa, J.J. (2007). *Poverty and education: towards effective action. A review of the literature.*

Toronto, ON: OISE.

Glaser, B. & Strauss, A. L. (1967). *The discovery of grounded theory: strategies for qualitative research.* Chicago, IL: Aldine Publishing.

Government of Manitoba. (2010). *Aboriginal education directorate.* Winnipeg, MB: Author.

Retrieved from <http://www.edu.gov.mb.ca/aed/>

Government of Manitoba. (2011). *Towards inclusion: supporting positive behaviour in Manitoba classrooms.* Winnipeg, MB: Author.

Government of Manitoba. (2013a). *Province announces new position at U of W to strengthen teacher training in math.* Retrieved from

<http://news.gov.mb.ca/news/index.html?item=19793>

Government of Manitoba. (2013b). *All aboard: Manitoba's poverty reduction and social inclusion strategy annual report 2012 - 13.* Winnipeg, MB: Author.

Government of Manitoba. (2014, January 30). *Province maintains commitment to students and families, increases education funding by two per cent.* Retrieved from

<http://news.gov.mb.ca/news/index.html?item=20230>

Government of Manitoba. (2015). *Manitoba's high school graduation rate.* Winnipeg, MB:

Author. Retrieved from http://www.edu.gov.mb.ca/k12/docs/reports/grad_rate/

Manitoba Education. (2010a). *Manitoba education annual report 2009 - 2010.* Winnipeg, MB:

Author.

Manitoba Education. (2010b). *Working together supporting students in transition: sharing student information between First Nations and provincial schools.* Winnipeg, MB:

Author.

- Manitoba Education. (2011). *Mathematics: new kindergarten to grade 12 implementation timelines*. Winnipeg, MB: Author. Retrieved from <http://www.edu.gov.mb.ca/k12/cur/math/timelines.html>
- Manitoba Education. (2013a). *Kindergarten to grade 8 mathematics: Manitoba curriculum framework of outcomes*. Winnipeg, MB: Author.
- Manitoba Education. (2013b). *Manitoba education annual report 2012 - 2013*. Winnipeg, MB: Author.
- Manitoba Education and Advanced Learning (MEAL). (n.d.). *English as an additional language funding*. Retrieved from <http://www.edu.gov.mb.ca/k12/cur/eal/funding.html>
- Manitoba Education and Advanced Learning (MEAL). (2014a). *Aboriginal identity declaration. EIS data collection*. Winnipeg, MB: Author.
- Manitoba Education and Advanced Learning (MEAL). (2014b). *Public schools enrolment and categorical grants reporting for the 2014/2015 school year*. Winnipeg, MB: Author.
- Manitoba Education and Advanced Learning (MEAL). (2015). *Education for sustainable development in Manitoba education and advanced learning*. Winnipeg, MB: Author.
- Manitoba Education and Training (MET). (2000). *Manitoba education and training annual report 1999 - 2000*. Winnipeg, MB: Author.
- Manitoba Education, Citizenship and Youth (MECY). (2009a). *Grades 9 to 12 mathematics: Manitoba curriculum framework of outcomes*. Winnipeg, MB: Author.
- Manitoba Education, Citizenship and Youth (MECY). (2009b). *Manitoba education annual report 2008 - 2009*. Winnipeg, MB: Author.
- Manitoba Education and Youth (MEY). (2003). *Diversity and equity in education: an action plan for ethnocultural equity – for consultation*. Winnipeg, MB: Author.

Manitoba Human Rights Code. C.C.S.M. c. H175. (1987)

Manitoba Immigration and Multiculturalism. (2013). *Manitoba immigration facts: 2012*

statistical report. Winnipeg, MB: Author. Retrieved from

http://www.gov.mb.ca/labour/immigration/pdf/manitoba_immigration_facts_report_2012.pdf

Manitoba Public Schools Act, C.C.S.M. c. P250 § 262 (2010).

Manitoba Teachers Society. (2014, January 30). Schools' funding announcement is welcome

news, says MTS president. *MTS news and opinion*. Retrieved from

<http://www.mbteach.org/news/news.html>

Morse, J. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing research*, 40, 120-123.

Murphy, B., Zhang, X., Dionne, C. (2012). Low income in Canada: a multi-line and multi-index perspective. Retrieved from <http://www.statcan.gc.ca/pub/75f0002m/2012001/summary-sommaire-eng.htm>

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (2004). *Perspectives on the teaching of mathematics*. 66th yearbook. Editor R.N. Rubenstein. Reston, VA: Author.

- National Council of Teachers of Mathematics. (2010). *Teaching and learning mathematics: translating research for school administrators*. Reston, VA: Author.
- Onwuegbuzie, A. J., & Leech, N. L. (2005, February). *Sampling designs in qualitative research: making the sampling process more public*. Paper presented at the annual meeting of the Southwest Educational Research Association, New Orleans, LA.
- Organization for Economic Cooperation and Development (OECD). (2005). *History*. Paris: Author. Retrieved from <http://www.oecd.org/about/history>
- Organization for Economic Cooperation and Development (OECD). (2009a). *PISA data analysis manual: SPSS and SAS, second edition*. Retrieved from <http://www.oecd.org/pisa/pisaproducts/pisadataanalysismanualspssandsassecondedition.htm>
- Organization for Economic Cooperation and Development (OECD). (2009b). *PISA technical report*. Retrieved from <http://www.oecd.org/edu/school/programmeforinternationalstudentassessmentpisa/pisa2009technicalreport.htm>
- Organization for Economic Cooperation and Development (OECD). (2012). *About PISA*. Paris: Author. Retrieved from <http://www.oecd.org/pisa/aboutpisa>
- Organization for Economic Cooperation and Development (OECD). (2013a). *PISA 2012 assessment and analytical framework: mathematics, reading, science, problem solving and financial literacy*. Paris: Author. Retrieved from <http://dx.doi.org/10.1787/9789264190511-en>

Organization for Economic Cooperation and Development (OECD). (2013b). *PISA 2012 results: excellence through equity: giving every student the chance to succeed (volume II)*. Paris:

Author. DOI: 10.1787/9789264201132-en

Organization for Economic Cooperation and Development (OECD). (2014). *PISA 2012 results: what students know and can do (volume I, revised edition)*. Paris: Author. DOI:

10.1787/9789264208780-en

Osborne, K. (1999). *Education: a guide to the Canadian school debate – or, who wants what and why?* Toronto, ON: Penguin Books Canada Ltd.

Ponticelli, D. (2013, December 3). Manitoba math scores sunk: PISA report. *Winnipeg sun*.

Retrieved from <http://www.winnipegson.com/2013/12/03/manitoba-math-scores-sunk-pisa-report>

Poverty Elimination Act. Bill C233. (2011).

Poverty Reduction Strategy Act. C.C.S.M. c. P94.7 (2011).

Progressive Conservative Caucus. (2014). *Building a prosperity blueprint: real targets – measurable results*. Winnipeg, MB: Author.

Province of Manitoba. (2014a). Mandate, mission, vision, overarching goals and priority action areas. *Education and advanced learning*. Winnipeg, MB: Author.

Province of Manitoba. (2014b). *TomorrowNow – Manitoba's green plan*. Winnipeg, MB: Author.

Social Planning Council of Winnipeg. (2010). *Manitoba child poverty report card 2010: the challenge for Manitoba's provincial government*. Winnipeg, MB: Author.

Staff Writer. (2013, November 5). 44.7 per cent of Manitoba food-bank users are children: Report. *Winnipeg free press*. Retrieved from

- <http://www.winnipegfreepress.com/local/447-per-cent-of-Manitoba-food-bank-users-are-children---230664771.html>
- Statistics Canada. (2010a). Fact sheet – urban Aboriginal population in Canada. Retrieved from <http://www.aadnc-aandc.gc.ca/eng/11001000114298/1100100014302>
- Statistics Canada. (2010b). Labour force survey for 2006.
- Statistics Canada. (2011). National household survey.
- Statistics Canada. (2015). Low income cut-offs. Retrieved from <http://www.statcan.gc.ca/pub/75f0002m/2012002/lico-sfr-eng.htm>
- Steckler, A., McLeroy, K. R., Goodman, R. M., Bird, S. T., & McCormick, L. (1992). Toward integrating qualitative & quantitative methods: An introduction. *Health education quarterly*. 19, 1-8.
- Sustainable Development Act, C.C.S.M. c. S270 (1997).
- Tashakkori, A., & Teddlie, C. (1998). *Mixed methodology: combining qualitative and quantitative approaches*. Thousand Oaks, CA: Sage.
- University of Winnipeg. (2016). *High school pre-requisites: faculty of education*. Retrieved from <http://www.uwinnipeg.ca/future-student/requirements/hs-pre-req-faculty-of-edu.html>
- Yin, R.K. (2009). *Case study research: design and methods*. 4th ed. Thousand Oaks, CA: Sage.
- Zwaagstra, M. (2013, December 5). Standardized testing is needed now. *Winnipeg free press*. Retrieved from <http://www.winnipegfreepress.com/opinion/analysis/standardized-testing-is-needed-now-234554971.html>

Appendix A: Number of Students Enrolled in Grade Nine in Manitoba

This Appendix compiles into tables of values the number of Manitoba students who were enrolled in grade nine for the years within the MET data set requested by the researcher for this thesis. It is these values which were used to obtain the percentages presented in the tables and figures provided in Chapter Five.

Table A1 Total number of first time students enrolled in grade nine in Manitoba at September 30th for 2008 - 2012.

# of students enrolled					
	2008	2009	2010	2011	2012
All programs	13368	13318	13227	12832	12949
English	11917	11870	11819	11364	11484
Immersion	1107	1109	1074	1144	1119
Français	344	339	334	324	346

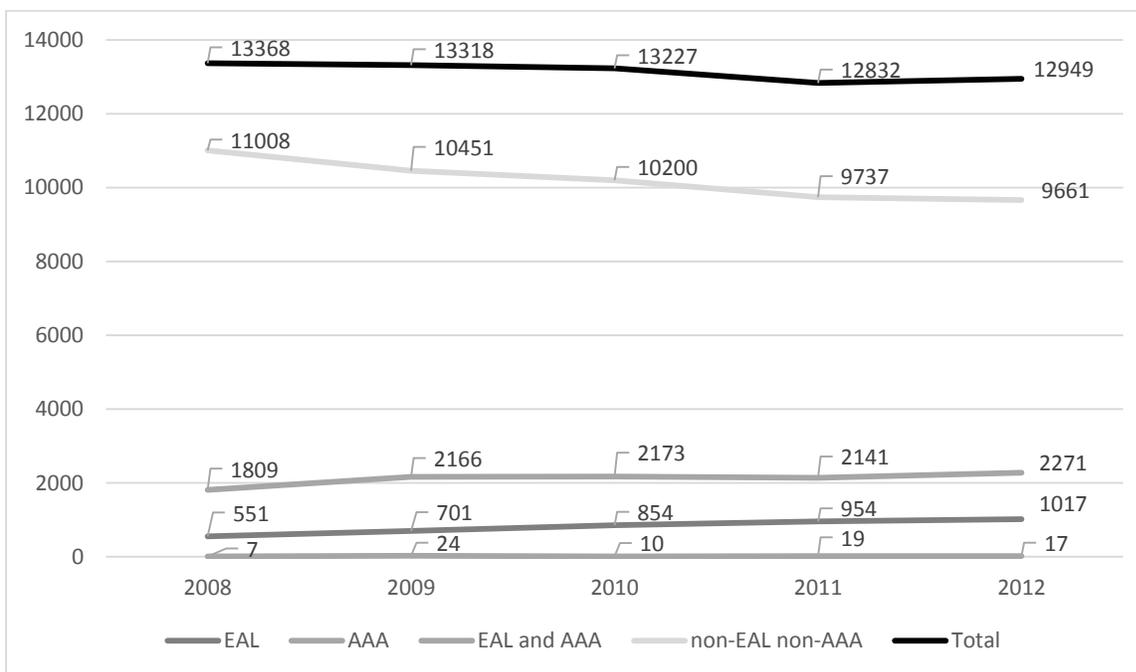


Figure A1 Number of EAL, AAA, EAL and AAA, and non-EAL non-AAA first time students enrolled in grade nine in Manitoba as of September 30th for 2008 - 2012.

Table A2 Number of EAL, AAA, EAL and AAA, and non-EAL non-AAA first time students enrolled in grade nine in Manitoba as of September 30th for 2008 - 2012.

		Number of students				
		2008	2009	2010	2011	2012
All programs	Total	13368	13318	13227	12832	12949
	EAL	551	701	854	954	1017
	AAA	1809	2166	2173	2141	2271
	EAL & AAA	7	24	10	19	17
	Non-EAL, non-AAA	11008	10451	10200	9737	9661
English	Total	11917	11870	11819	11364	11484
	EAL	540	685	840	923	973
	AAA	1599	1964	1950	1934	2030
	EAL & AAA	7	24	10	19	17
	Non-EAL, non-AAA	9778	9221	9029	8507	8481
Immersion	Total	1107	1109	1074	1144	1119
	EAL	2	10	4	21	24
	AAA	113	114	126	127	143
	EAL & AAA	-	-	-	-	1
	Non-EAL, non-AAA	992	985	944	996	952
Français	Total	344	339	334	324	346
	EAL	9	6	10	10	20
	AAA	97	88	97	80	98
	EAL & AAA	-	-	-	-	1
	Non-EAL, non-AAA	238	245	227	234	228

Appendix B: Number of Students Who Passed Grade Nine Mathematics

This Appendix compiles into tables of values the number of Manitoba students who passed grade nine mathematics for the years within the MET data set requested by the researcher for this thesis. It is these values which were used to obtain the percentages presented in the tables and figures provided in Chapter Five.

Table B1 Number of students who earned their grade nine mathematics credit upon first attempt who were enrolled in grade nine in Manitoba as of September 30th for 2008 - 2012.

	# students who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	11845	11803	11874	11470	11597
English	10478	10416	10533	10093	10202
Immersion	1056	1076	1038	1079	1067
Français	311	311	303	298	328

Table B2 Number of EAL students enrolled in grade nine in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

	# EAL students who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	489	610	789	884	941
English	481	594	778	854	907
Immersion	2	10	4	21	23
Français	6	6	7	9	11

Table B3 Number of AAA students enrolled in Manitoba as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

	# AAA students who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	1297	1550	1580	1540	1609
English	1102	1364	1378	1354	1389
Immersion	104	105	114	110	128
Français	91	81	88	76	92

Table B4 Number of students that are both EAL and AAA enrolled in Manitoba as of September 30th and earned their grade nine mathematics credit upon first attempt for 2008 - 2012.

	# students that are both EAL and AAA who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	2	13	6	7	12
English	2	13	6	7	10
Immersion	0	0	0	0	1
Français	0	0	0	0	1

Table B5 Number of Manitoba students that are neither EAL nor AAA enrolled as of September 30th who earned their grade nine mathematics credit upon first attempt for 2008 – 2012.

	# students that are neither EAL nor AAA who earned grade nine mathematics credit upon first attempt				
	2008	2009	2010	2011	2012
All programs	10059	9643	9505	9046	9047
English	8895	8458	8377	7885	7906
Immersion	950	961	920	948	916
Français	214	224	208	213	225