GRADE 3 EQAO MATHEMATICS ACHIEVEMENT TESTING: A COMPARISON OF FRENCH IMMERSION STUDENTS' RESULTS BY LANGUAGE OF TESTING

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Abstract

This study investigated the effect that language of testing had upon the Education Quality and Accountability Office mathematics assessment scores of grade 3 French Immersion students in Ontario during the 2003-2004 school year. The study also examined variables related to classroom instruction and their impact on student achievement.

When overall student achievement scores were analyzed, results demonstrated that students who completed the assessment in French achieved higher overall scores than those who wrote the assessment in English. Despite an attempt to identify a homogeneous sample of the grade 3 French Immersion population, it was not possible to acquire data that were completely comparable, and, as such, the results should be interpreted with caution.

Questionnaires were distributed to teachers of each participating class in the study. Results of the teacher questionnaires did not indicate any significant differences in classroom practice that may have accounted for the difference in student mathematics achievement.

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Permission has been granted from the Education Quality and Accountability Office to include the *2003-2004 EQAO Grade 3 mathematics assessment booklets* (French immersion and English versions) and the *Glossary of terms* in this thesis document.

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CHAPTER ONE: INTRODUCTION

During the 2002-2003 year, I was a grade 3 French Immersion (FI) teacher in Ontario. At that time, I had experienced administering the Education Quality and Accountability Office (EQAO) assessment to students over the course of several years and had had the opportunity to administer both the French and the English versions of the grade 3 mathematics assessment. Through observation and experience, I had developed some intuitive thoughts about student achievement related to the language of mathematics testing. In addition, as part of my role as grade 3 teacher, I had been involved in a FI advisory committee that looked at which language of testing would be the best option for grade 3 students within my school board. The experience of being part of that committee allowed me to discuss the issue with other teachers, administrators, parents, and the French consultant. Throughout the process, I was intrigued by the fact that many people had some very strong opinions about the appropriate language of testing for our students; however, there was not a lot of research being consulted to support a decision either way. In the end, the decision was made to conduct the testing in French within our school board.

The experiences I had as part of a FI advisory committee heightened my curiosity around research into the relationship between student achievement in mathematics and language of mathematics instruction. As a result, I joined an action research group within my board, and I undertook an action research project in my classroom. In this project, I implemented a variety of instructional strategies in an attempt to improve student achievement in mathematics and increase student achievement results on the EQAO assessments.

Following my teaching experiences, I worked in the role of French consultant for the school board in which I worked. Throughout my 5 years in the position, I had the opportunity to discuss the issue of language of testing and mathematics with consultants and teachers in other school boards as well as administrators and superintendents within my board. The position allowed me time to read existing research related to the issue of language of testing and to share some of the information I learned from this reading with stakeholders from a variety of different groups (teachers, parents, French consultants, principals, and senior administration). Once again, the senior administration of my school board was interested in exploring which option of testing would be best suited to our students. A decision was made to continue the mathematics testing in French and also to participate in the reading and writing components of the assessment.

These experiences, intuitive thoughts, and the action research results led to an interest in the relation between test language and student achievement levels, which is the focus of this study. I will begin first by outlining the background of FI.

Origins of the FI Program

In the late 1960s, English-speaking parents across Canada began a movement to see improved programming for French-as-a-second-language study for their children in publicly funded schools. The goal was to have their own children finish secondary school with a greater proficiency in French than they themselves possessed. The result was the beginning of the FI programs. The earliest implementation of the program dates back to 1965:

> 12 parents calling themselves the St. Lambert Bilingual School Study Group received permission from their very reluctant school board to begin a FI kindergarten. This

> small group believed that their children could learn French as a living language without harm to their competence in English. (Alberta Learning, 2002, p. 21)

Today the FI program has grown to include more than 300,000 students across Canada and has spread internationally, with countries such as Finland, Hong Kong, Singapore, Spain, the United States, and Australia offering second language immersion programs (Alberta Learning, p. 21).

Since the onset, FI programs have been the subject of numerous studies in educational research. A growing body of literature exists, examining a variety of topics of interest. In particular, major areas of emphasis in research discuss the impact of FI programs on: students' abilities in their first language (which is often English, but may be another language), students' abilities in the target language (French in the Canadian immersion context), and students' abilities in the content areas of the curriculum (subject areas such as mathematics, science, social studies, the arts, etc.).

Definition of FI Programs

FI (or any second language immersion program) is typically defined by six key characteristics:

1. The target language is acquired primarily by using it for meaningful communication within the school-that is, for instruction in other subjects (mathematics, social studies, science, etc.);
2. All (or a very high percentage) of the students have no or very limited experience with the target language;
3. The target language is not the prevalent language of the community;
4. The program begins with intensive instruction in and via the target language by

teachers fluent in the language, with instruction via the first language often increasing in later years;

5. Instruction of subject material is never repeated in the two languages;

6. The program is expected to take several years to achieve its objectives (in most cases these objectives are defined at the end of Grade 12). (Alberta Learning, 2002, p. 25)

These notions are reflected in the definition of FI as outlined by the Ontario Ministry of Education, as discussed later in this chapter.

FI and French First Language Programs

Provincial ministries responsible for education across Canada define requirements for FI in their respective provinces. For the purposes of this study, I will look specifically at the Ontario elementary education system in 2003-2004. It is important to note that in the province of Ontario, during the time of this study and continuing on into the current education system in 2009, students have access to schooling in English language schools, FI programs, and French First Language Programs. There is a clear distinction between FI programs and French First Language Programs, despite the fact that students in both programs receive instruction of some or all of the content areas (Mathematics, Science, the Arts, Health and Physical Education, and Social Studies) in French. French Language education is different from FI because FI students are learning French as a second Language whereas French Language schools are for students who have the right to be educated in the context of French language and culture, as identified in Section 23 of the Canadian Charter of Rights and Freedoms. According to the *Aménagement linguistique* (Ontario Ministry of Education, 2005a) policy of the Ontario Ministry of Education, in Ontario, the following

people have the right to have their children educated in French at the elementary and secondary levels in Canada:

1. Canadian citizens residing in Ontario whose first language learned and still understood is French;
2. Canadian citizens residing in Ontario who received their elementary-level education in French, here or elsewhere in Canada; and,
3. Canadian citizens who have a child who received, or who is receiving his or her education in French at the elementary or secondary level, here or elsewhere in Canada. (pp. 12-13)

It is also possible for children whose parents do not meet these criteria to be admitted to a French Language school if they receive permission from the school's admissions committee. These children may be the children of parents who have settled in Canada as immigrants or refugees and for whom French may be their first, second, or even third language, yet who feel a certain attachment to French context (p. 22). In a French Language school, all communication with parents is done in French, and English is taught as a content area subject beginning in grade 4. The expectations for English language study are different than those that are required in English Language schools (and FI programs). In French Language schools, curriculum documents outlining policy and expectations in content areas are used. These documents are written in French and reflect Franco-Canadian culture, as well as define the required content learning for students (areas such as Social Studies, Mathematics, the Arts, Sciences, and Health and Physical Education).

The Ontario Context

In 2003-2004, the parameters of FI in Ontario were outlined in *The Ontario Curriculum:French-as-a-Second Language: Extended French Grades 4-8, French Immersion Grades 1-8* (Ontario Ministry of Education, 2001a). This document continues to be the current Ministry of Education policy and guidelines for FI in 2009. In this document, FI is defined as the following:

> In the FI program, French must be the language of instruction for a minimum of 50 percent of the total instructional time at every grade level of the program. Immersion programs must include the study of French as a second language and the study of at least two other subjects taught in French. These two subjects must be selected from the following: the arts, social studies (Grades 1 to 6) or history and geography (Grades 7 and 8), mathematics, science and technology, and health and physical education. Immersion programs must provide a minimum of 3800 hours of instruction in French by the end of Grade 8. (Ontario Ministry of Education, 2001a, p. 4)

FI schools are classified as English Language schools. All communication with parents is in English, and the large majority of students enrolled in FI programs come from homes where French is not one of the languages that is spoken or understood by the parents or guardians of the child. The curriculum expectations for content areas are the same as those of students in other English language schools; however, the content of these areas may be taught in French.

Across the province of Ontario, individual school boards decide autonomously on the entry points (the grade level that students begin study in the program) for their immersion programs as well as determine what percentage of time will be taught in French and which

subject areas will be taught in French at each grade level. While 50% is the minimum amount of instructional time in French, many boards across the province of Ontario follow a delivery model that includes a higher concentration of instruction in French in the early years of the program (which may include junior kindergarten, senior kindergarten, grade 1, grade 2, and grade 3), as indicated by the Ontario Ministry of Education:

> It has been shown that a student's level of proficiency in French increases with the number of accumulated hours of instruction in French. Many FI programs thus exceed the minimum requirement of 3,800 hours of French instructional time. An immersion program starting in Grade 1 generally provides instruction in French in all subjects (i.e., for 100 percent of total instructional time) until Grade 3 or 4, when students begin to study English language arts. Instruction in English may then be gradually extended to include other subjects. By the end of Grade 8, students may receive up to 50 percent of their instruction in English. (Ontario Ministry of Education, 2001a, p. 5)

Because of this, in some schools and/or boards, half of all instruction is conducted in French, whereas a neighbouring school board (or school within the same board, in some cases) may include 100% instruction in French at any particular grade level. Within the research conducted for this study, it was found that 25 out of 37 school boards in Ontario that offered Early FI programs in 2003-2004 had a delivery model that provided for increased intensity of instruction in French during the early years of the program (Appendix A). Of those, several offered a delivery model that was within an 80% to 100% range of delivery in French throughout the primary grades. To attain this level of instruction in French, the content areas of the curriculum (mathematics, science, social studies, art, drama, and music) were taught in

French in addition to French language instruction. Each individual school board across the province of Ontario establishes which subject areas are taught in French, choosing from the arts, social studies (grades 1 to 6), history or geography (grades 7 and 8), mathematics, science and technology, and health and physical education (Ontario Ministry of Education, 2001a, p. 5). This gives individual school boards the flexibility to decide which subjects will be taught in French at each grade level, so long as two subject areas in addition to French language are chosen. This means that there will be differences between boards in terms of which subject areas are taught in French.

Amongst school boards that begin the FI program in the primary grades, the entry points are varied between junior kindergarten, senior kindergarten, and grade 1, largely due to the fact that junior and senior kindergarten programs are not mandatory years of school attendance for students in the province of Ontario (Service Ontario e-laws, n.d.).

Because of the options outlined, it is necessary to consider the delivery model that is used within each school board in order to make accurate comparisons between school boards. Specifically, an examination of the percentage of time and the subject areas that are taught in either English or French at each grade level facilitates the comparison of FI programs amongst different school boards. To further identify similar cohorts of students, an analysis of the accumulated hours of French instruction by grade level can be used to determine student experience and instruction in the target language. The accumulated hours of instruction refers to the total number of hours a student received instruction through French (including language study and the content areas of the curriculum). Once the delivery model is identified, the total number of hours of instruction can be calculated. The calculation of the accumulated hours of instruction in French is mandatory for students studying French-as-a-

Second Language in Ontario. The document *The Ontario Student Record (OSR) Guideline* (Ontario Ministry of Education, 2001b) states that:

> An individual record of accumulated instruction in French as a second language will be established and maintained for each student enrolled in an elementary school. The record will be kept on a card . . . , and will include all of the information required for each entry. An entry will be made on the record:
>
> 1. at the end of a school year, semester, or summer course; and
> 2. when a student transfers to another school, including a private, federal, or First Nation school; and
> 3. when a student retires from school. (p. 13)

If a student has had previous instruction in French but no record is available, the entries on the card must be started at least from the date of enrolment in an Ontario school. A note will be made on the first lines of the instruction card indicating what is known about a student's previous instruction in French as a second language and in other subjects taught in French. If the number of accumulated hours must be estimated, an annotation must indicate that the figure is approximate (p. 13).

For calculating the accumulated hours of instruction, the French record card requires calculations for:

1. Hours of Instruction in the subject of French;
2. Hours per year of French instruction given in subjects other than French (specify Subject(s) and Hours for each subject);
3. Total number of hours for the year; and
4. Total number of hours accumulated by the end of the school year.

For the purposes of the current study, it is assumed that even when students have studied in different delivery models, if their accumulated hours of instruction in French are the same or similar by the end of a common grade level, then their proficiency in the target language will also be comparable. Using the accumulated hours of instruction in French as an indication of proficiency is an appropriate practice for identifying FI students for the purposes of research. For example, Turnbull, Lapkin, and Hart (2001b) used the accumulated hours of instruction in English when comparing Education Quality and Accountability Office (EQAO) results of students in FI with their English counterparts. This allowed the researchers to identify program categories which grouped FI students into similar groups to form a basis for comparison, which allowed them to investigate possible links between program design and test outcomes (p. 13). The researchers note that

> in examining mathematics test results by language of testing, it is important to control for prior accumulated hours of instruction in English. Accumulated hours of instruction in English may be related independently both to mathematics test scores themselves and to the impact of language of testing (which might expect to be greater with less prior exposure to instruction in English). (Turnbull et al., p. 22)

Conversely, examining the accumulated hours of instruction in French will produce the same result, as both calculations seek to determine how much instruction was conducted in each language in order to compare similar exposure to both French and English.

EQAO Assessment Options

In each academic year since 1996, all students in grade 3 across the province of Ontario have been required to participate in the EQAO assessment. During the 2003-2004 academic year, the EQAO assessment was five days in length and comprised reading,

writing, and mathematics components. The test is used to assess Ontario students in their mathematics and English reading and writing skills. According to their website, the presence of the EQAO ensures greater accountability and better quality in Ontario's publicly funded school system.

> An arm's-length agency of the provincial government, EQAO provides parents, teachers and the public with accurate and reliable information about student achievement. EQAO also makes recommendations for improvement that educators, parents, policy-makers and others in the education community can use to improve learning and teaching. (EQAO, n.d., ¶ 1)

Given that some FI schools deliver mathematics through the French language, individual boards of education choose one of three options for testing their FI students: (a) students complete the reading, writing, and mathematics components of the assessment in English, (b) students complete the reading and writing components of the assessment in English and write the mathematics component in French or (c) students complete only the mathematics component of the assessment in French (and do not participate in any reading or writing assessment tasks). Each school board was required to select one of these options for all of its FI schools. The current study focuses on the mathematics portion of the assessment only, comparing the results of grade 3 FI students in the 2003-2004 school cohort who studied in programs that had the same or similar ranges of accumulated hours of instruction in French by the end of grade 3 and who had studied mathematics in French during their years in school.

Description of the EQAO Assessment

During the administration of the 2003-2004 EQAO mathematics assessment, teachers followed a detailed lesson plan and students then completed mathematical items related to a theme. Students completed mathematical tasks independently during the assessment and were required to demonstrate an understanding of the mathematical concepts described in the *Ontario Curriculum Mathematics: Grades 1-8* (Ontario Ministry of Education, 1997). Parallel to the prescribed mathematics curriculum, the EQAO mathematics assessment included items from the following strands: Number Sense and Numeration, Measurement, Geometry and Spatial Sense, Patterning and Algebra, and Data Management and Probability.

Problems in all areas required students to demonstrate reasoning, application, and communication skills. A limited number of multiple-choice questions were presented along with several open-ended questions and problems. All items on the assessment were developed to measure student ability within the context of the overall and specific mathematics expectations that were identified in *Ontario Curriculum Mathematics: Grades 1-8* (Ontario Ministry of Education, 1997). The expectations were homogeneous across the province for grade 3, whether instruction was in a FI setting or in an English language school. A sample of the 2003-2004 EQAO Mathematics Assessment is provided in Appendixes B (English) and C (French). During the assessment, accommodation and modification strategies were allowed for special needs students, so long as the practices were consistent with regular classroom practice. In addition, there were certain accommodations that were allowed for all students. For example, teachers were permitted to read questions aloud to students upon request but could not provide any prompting or explanations to students. Students were also allowed to use mathematics manipulatives (i.e., pattern blocks,

base 10 blocks, rulers, centicubes, etc.) during the assessment as they saw fit and could use calculators on specified portions of the assessment only. FI students were also provided with a French to English and an English to French glossary of terms for reference. An example of this glossary is provided as Appendix D.

Following the testing period, all student materials were returned to the EQAO office and were marked over the summer by teachers that had been hired and trained by EQAO. Students were assessed on a 4-point rating scale, with Level 1 being the lowest achievement and Level 4 being the highest achievement. In situations where a student's answer was blank, lacking in information, or incomprehensible, "not enough information to score" or an "I" was recorded. Level 3 was the expected level of achievement. Each question is scored individually, and the results were used to provide a single individual overall achievement level for each student.

The overall individual result in mathematics is derived by combining the results from the constructed-response section (open-ended problems) with those from the multiple-choice section. (EQAO, 2004). The student scores are converted into an overall score using a standard psychometric process. Wolfe, Childs, and Elgie (2004) describe the process as follows:

> The approach currently used to scale the Grade 3 and 6 assessment results is based on classical test theory, in which total scores are sums of item marks. . . After the marking, the numerical values of the marks assigned to the constructed response items were summed (e.g., Level 1 contributed to a score of 1). Standardized scores were created from the sum of the constructed response items and equated versions of the sum of the multiple-choice scores were weighted . . .the range of scores was

> divided into sections corresponding to Levels 1 to 4. Very low total scores received a score of Not Enough Evidence for Level 1. (p. 52)

The overall score assigned represents a range of sums that have been scaled to correspond to a discrete achievement level of 1, 2, 3, or 4. This process is used for the reading, writing, and mathematics assessments at the grade 3 and 6 levels.

In the fall of grade 4, results were shared publicly. Boards, schools, and individual student results were distributed to schools, and information was presented to the public via both the school and the media. Each student was provided with an individual summary of his or her results.

Previous Research on FI, Mathematics, and EQAO Testing

A previous study examining Grade 3 EQAO mathematics achievement results was conducted in 1998-1999 by Turnbull et al. (2001b). At that time, the EQAO testing was relatively new (in its third year), and the curriculum expectations were only in year two of implementation. After several years of experience with the testing and the curriculum, schools and teachers were required to implement improvement plans to increase student achievement on the assessments. In addition, the EQAO made modifications to the test itself and to the teaching methods and allowable accommodations utilized during the testing period. Because of the changes to the EQAO assessment and the increased familiarity with the curriculum expectations, classroom instructional practices and testing conditions may have improved, resulting in improved student achievement. This study will reexamine grade 3 achievement on the EQAO assessments in light of the changes and improvements that have occurred in both classroom practice and within the EQAO assessments themselves since the onset of the testing and since the initial study that was conducted in 1998-1999.

The Turnbull et al. (2001b) study focused on a comparison of FI and non-FI students. Within this study, the researchers examined which choices of testing options were implemented throughout Ontario for FI students. In the case of mathematics, the study found that typically, districts with full immersion programs (higher accumulated hours of instruction in French) were more likely to use the translated version of the mathematics assessment. The term *translated test* refers to the French version of the English test. Boards with partial immersion (1,400 accumulated hours of English instruction) consistently used the mathematics test in English. Boards with less than 500 hours of instruction in English tended to prefer the mathematics test in translation as well (p. 16). Despite a detailed discussion of these trends, the Turnbull et al. study did not look at the effects of the language of testing on student achievement in relationship to the accumulated hours of instruction in English. The study did indicate that:

> Among students in programs delivering less than 420 hours of instruction in English to the end of Grade 3, those taking the mathematics test in French translation did markedly worse than those doing the English version of the test. Over three quarters of students writing the test in English achieved Level 3 or 4, compared to 61% of those doing the translated version. Since these students had been taught mathematics in French, these results are sufficiently counter-intuitive to require closer examination; it seems likely that the result reflects differences among districts unrelated to the language of testing. (pp. 21-22)

Further to this, the study indicates that:

> The available data provide a limited basis for conducting this analysis at Grade 3. The results offer virtually no support for the argument that testing in English

disadvantages immersion students, at least in comparison to testing in French translation, even when instruction in mathematics up to Grade 3 was in French. (p. 22)

The current study will examine this notion in detail and will go a step further towards examining whether or not such students may be at an advantage when writing the test in English. The study will compare similar groups of FI students based on the language of testing in an attempt to offer greater insight into the most appropriate language of testing in mathematics for FI students at the grade 3 level.

Purpose of the Study

The purpose of this study is to compare the results of FI students who wrote the EQAO mathematics assessment in English with the results of FI students who wrote the EQAO mathematics assessment in French to determine if there is a significant difference in student achievement at the grade 3 level as related to the language of testing when students have been studying mathematics in French through an Early Immersion program.

The current study will focus on comparing Immersion students based on the language of testing, with the intention of offering greater insight into the most appropriate language of testing in mathematics for FI students at the grade 3 level when the language of instruction is fixed as French. For the purposes of this study, the data will include information from the Detailed Student's Report as prepared by the EQAO for each individual school. Four school boards, encompassing six elementary schools, are included as participants in this study.

Because it is recognized that "student achievement is influenced by a myriad of factors in addition to program design" (Turnbull et al., 2001b, p. 14), the study will look at additional information that may contribute to impacting student achievement. The *Early Mathematics Strategy: The Report of the Expert Panel on Early Mathematics in Ontario*

(2003a), indicated that the use of current resources aligned with the curriculum and the implementation of effective and varied instructional strategies will have a positive impact on student achievement (Ontario Ministry of Education, 2003a, pp. 25-29). The current study examined instructional strategies and resources used in instruction, as reported through a teacher questionnaire, to determine if there was a potential relationship between student achievement and classroom practices. Data on this information were collected through the completion of a questionnaire by the grade 3 teacher(s) from each school who instructed the students during the 2003-2004 school year and who administered the grade 3 EQAO mathematics assessment.

Research Hypothesis and Questions

The hypothesis to be tested is that FI students who wrote the grade 3 EQAO mathematics assessment in English will attain significantly higher overall achievement scores than their FI counterparts who wrote the assessment in French.

The research attempts to answer the following questions: (a) How do the results of FI students writing the test in French compare to the results of FI students who write the test in English? and (b) Is there a relationship between resources and instructional strategies identified by teachers and the mean achievement scores of students by cohort and language of testing?

While the current study will examine briefly trends and patterns in the classroom practices of the teachers of participating students, it is noted that there are a variety of additional variables that may affect student achievement, which may include but are not limited to socioeconomic status, gender, personality, classroom environment, relationships

with peers and teacher. An examination of these factors is beyond the scope of this study and therefore will not be addressed.

Significance of the Study

The EQAO results are of great importance to the Ontario Ministry of Education, educators, and schools boards as indicated by their use in schools and school boards across the province. Individual schools and school boards analyze their achievement test results and create system and school improvement plans. Publicly, individual school results are published in the media and are available to the general public via the EQAO website. Because of this emphasis on the EQAO assessment scores, the language of mathematics testing deemed most appropriate for grade 3 FI students is an issue that warrants consideration. Improved student achievement is crucial as outlined by the Ontario Ministry of Education in *Building the Ontario Education Advantage*:

> Ontario's 2002-2003 province-wide results indicated that 50 per cent of Ontario Grade 3 students met the provincial standard for reading, 56 per cent met the provincial standard for writing and 57 per cent met the standard for mathematics. For Grade 6, the results indicate that 56 per cent met the standard for reading, 53 per cent met the standard for writing and 53 per cent met the standard for mathematics. Hence, almost half of Ontario's students are not meeting the standard. (Ontario Ministry of Education, 2004, p. 3)

Since only half of the students were meeting the standards, improved results are required and expected.

In terms of the achievement of FI students in 2002-2003, it was noted that:

> "More than half the FI students achieved the provincial standard in reading (55% for Option A and 56% in Option B), writing (64% for Option A and 62% in Option B) and mathematics (60% for Options A and B and 75% in Option C)." (EQAO, 2003, p. 34)

While the results were slightly higher amongst the FI population, there was still 25-40% of the grade 3 FI population that were not meeting the provincial standard, which supports the notion that improved results were required.

This study may assist all interested parties in determining which language of assessment best suits the needs of their Grade 3 FI students in order to ensure greatest success both in attaining achievement Level 3 on the expectations in the Ontario Mathematics Curriculum and on the EQAO mathematics assessment, as well as providing practical information that will be useful in the everyday teaching and learning of mathematics. For administrators and teachers, the study will provide insight into teaching practice, programs, and assessment strategies that enhance student achievement in mathematics by outlining the relationship between student achievement and language of testing as well as instructional strategies.

Relevance of Findings

During the process of obtaining data for the current study, I was in the midst of professional changes which took my research in a variety of directions. I entered the role of French Consultant in December of 2004 and quickly became involved in a variety of work-related research projects which held many implications and opportunities for deeper understanding of the nature of FI programs and their impact on student learning across

Ontario, Canada, and throughout the world. These obligations brought additional perspectives for consideration within the context of the current study.

While the undertakings of the consultant role and other personal commitments have led to a delay in the completion of this project, there are several conditions of the EQAO testing that have not changed and, as such, support the continued significance of the results of the current study, despite having data that are from 2003-2004. Upon examination of conditions that have not changed from 2004 to 2009, note that:

1. In terms of the construct of the test, the 2003-2004 assessment was based in the curriculum that was in place at the time. While the mathematics curriculum has since been revised, the EQAO test continues to be based on the expectations outlined in the curriculum;
2. The 2003-2004 EQAO mathematics assessment provided in French for grade 3 was a direct translation of the English assessment. This has continued to be the case each year up to and including the current year's assessment;
3. The options outlined for school boards to choose for the grade 3 mathematics assessment continue to be the same in 2009 as they were in 2004;
4. Both FI students and English students are given the same parameters around time available to complete the assessment and in relation to accommodations or modifications that students may receive. This has remained the same since 2004 and was current for the 2009 assessment. This would include the fact that on the mathematics portion of the assessment, the teacher is permitted to read the question aloud to students upon request and that all FI students are provided with a bilingual glossary for independent consultation during the assessment; and,

5. The French-as-a-Second Language curriculum for FI has not changed since 2001. The document continues to be in place in 2009.

Because all of these conditions remain the same in the current context of EQAO testing, the results discussed through the research undertaken in this project continue to be relevant, applicable, and of significance for teachers, parents, students, boards, and other stakeholders. In the final chapter of this study I include an indication of the relevance of the findings and recommend changes that are applicable to the 2008-2009 context.

Thesis Overview

The current study begins with a review of the existing research literature that compares FI students' achievement to that of their English counterparts in a variety of curricular areas, examines the relationship between students' abilities to demonstrate learning of subject-specific content when it is taught and learned in a second language, discusses the abilities of FI students in English as compared to their cohorts in monolingual English learning settings, examines mitigating factors that intervene when one is faced with completing a task in second language, discusses the validity of translated tests, and examines issues related to instructional practices and resources in the FI setting. The current study includes a complete description of the research undertaken, including preliminary research used to determine the sample group, the data collection process, specific questions pertaining to the research, the significance of the data collected, a description of and data analysis, followed by findings of the research, future implications, and potential areas for continued research.

CHAPTER TWO: REVIEW OF THE LITERATURE

The review of the literature begins with a discussion outlining the findings of a previous study that was similar to the current study and outlines the similarities and the reasons for needing an additional study such as the current one. This is followed by a discussion of literature that concerns the relationship between the language of instruction of mathematics and the language of testing of mathematics. Third, the review outlines research that compares the English abilities of FI students with the abilities of their peers who learn in a monolingual English environment. Fourth, the review touches upon some of the specific considerations that need to be taken into account with second language (L2) learners and content knowledge. The review then examines briefly the validity of translated achievement tests. Finally, the chapter discusses resources and instructional practices used for mathematics instruction at the time of the study.

Previous EQAO Study

A previous study conducted by Turnbull et al. (2001b) in 1998-1999 compared the EQAO results of all Grade 3 FI students in Ontario with monolingually instructed students in English schools from the same cohort. The aim of that study was to examine the following research questions: (a) Do all FI programs choose the same testing option? Is this choice related to immersion program design? (b) How do FI students perform on the provincial grade 3 tests of reading, writing, and mathematics compared to regular English program students? and (c) Do FI student performances on the provincial tests differ depending on (i) the grade at which English literacy instruction is introduced and (ii) the proportion of instructional time in French? (p.11)

The sample size included between 70 and 75% of all students who participated in the EQAO assessments. Turnbull et al. (2001b) concluded that the overall achievement levels on the assessment for Grade 3 immersion students were broadly similar to those of nonimmersion students in all three areas: reading, writing, and mathematics (p. 16).

In terms of mathematics achievement, Turnbull, Lapkin, and Hart (2001a) found that:

> In the case of the regular (English monolingual) program, between 56% and 66% of students obtained ratings of 3 or 4. The range for immersion students was almost twice as broad: 49-69%. However, in contrast to literacy and, in particular, reading test results, students in total immersion at Grade 3 (with no English instruction, all instruction up until the assessment was done in French) did not appear to be at a disadvantage. Test results for mathematics did not show a systematic relationship to starting grade or accumulated hours of instruction in English. (p. 20)

Further investigation by Turnbull et al. (2001b) looked at the results by FI program type. The researchers identify six categories:

1. Grade 4 start for English
2. Grade 3 start
3. Grade 1 or 2 start with <420 hours of instruction in English
4. Grade 1 or 2 start with <500 hours of instruction in English
5. Grade 1 or 2 start with <750 hours of instruction in English
6. Grade 1 or 2 start with 1,400 hours of instruction in English

Within these groups, the researchers examined the relationship between program type and choice of testing. In the case of the EQAO testing, the assessment is first developed in English and is then translated into French for FI students. The mathematics content and tasks

that make up the EQAO test remain the same for both languages. This is consistent with the mathematics curriculum that is taught in Ontario. Both English and FI students learn the same mathematics curriculum (in terms of mathematical skills and knowledge). The difference is that some FI students learn this content in French. Turnbull et al. found that

> In the case of mathematics testing, districts with full immersion through Grade 3 were more likely to have used tests in translation. Boards that started English instruction at Grade 1 or 2, with partial (50/50) immersion resulting in 1400 accumulated hours of English instruction, consistently used mathematics tests in English. . .districts in other categories generally showed a strong preference for tests in translation, in contrast to those with partial immersion programs. Boards with programs delivering less than 500 hours of instruction in English generally preferred translated tests. (p. 16)

Further to this, the study investigated the achievement results of students by program category and language of testing. Turnbull et al. (2001a) found that FI students who began instruction in English at the grade 1 or 2 level demonstrated the weakest performance on the mathematics assessments:

> In districts with limited amount of instruction in English to the end of Grade 3, those students writing the test in French translation did markedly worse than those doing the English version of the test. In this case, more than 75% of students writing the test in English scored at Levels 3 and 4 whereas only 61% of students writing the test in French met or exceeded the provincial standard. (p. 21)

Overall, Turnbull et al. (2001b) noted that the data collected offered very little support for the argument that "testing FI students in English put them at a disadvantage, at least in comparison to testing in French translation, even when instruction in mathematics up

to Grade 3 was in French" (p. 22). This finding demonstrates that amongst results of students who had received mathematics instruction in French, the achievement results of those who wrote the mathematics test in English were at least comparable to, if not better than, the results of students who were tested in French.

Relationship to the Current Study

Within their study, Turnbull et al. (2001b) examined the results of students by program category. They identify that amongst FI students receiving 420 hours or less instruction in English prior to taking the test, those students who took the test in French translation did markedly worse than those doing the English version (p. 21). They noted further that "since these students had been taught mathematics in French, these results are sufficiently counterintuitive to require closer examination; it seems likely that the result reflects differences among districts unrelated to the language of testing" (Turnbull et al., p. 22). The current study aimed to build on this investigation by examining the results of FI students studying within this program model to determine if the student achievement results on the EQAO mathematics assessment will be similar with a different cohort of students. The current study includes an examination of some of the other factors that may influence student achievement, particularly related to classroom practice, in an attempt to determine which classroom practices, if any, had the greatest impact on student achievement.

Relationship Between First Language (L1) and Second Language (L2)

Research into the relationship between the language of instruction of mathematics and the language of testing of mathematics has been examined extensively (Baker, 2006; Barik & Swain, 1976; Bournot-Trites & Reeder, 2001; Cummins, 1981; Day & Shapson, 1996; Holster Stewart, 2005; Lindholm & Aclan, 1991; Saunders, 1998; Swain & Lapkin,

1982; Vorhaus, 1984; Walsh & Yeoman, 1999). Critical to this area of research is Cummins's theory of *interdependence* (Cummins & Swain, 1986), a hypothesis which indicates that some aspects of linguistic proficiency are cross lingual, allowing underlying skills to transfer between the two languages that are being learned, enhancing the learning of both languages. In relation to specific cognitive academic knowledge, the theory supports the notion that students are able to retrieve and express content-specific knowledge in either language and to transfer skills learned in L2 to L1 and vice versa, given adequate levels of proficiency in both languages. Several studies confirm this theory to be true (Bournot-Trites & Reeder; Day & Shapson; Lindholm & Aclan), and indicate that when students participate in mathematics assessments, they generally do equally as well when tested in either language. This research also indicates that when students have learned content knowledge in L2, they are able to retrieve it and achieve successfully when tested in L1 (Bournot-Trites & Reeder; Lindholm & Aclan; Day & Shapson). In the case of Bournot-Trites and Reeder and Day & Shapson , the studies looked at students whose L1 was English and L2 was French; however, Lindholm and Aclan found the same results with students whose L1 was English but L2 was Spanish. It is noteworthy that the majority of the studies documented above have looked at populations of language immersion students who are between grades 4 and 7. The research discussed by Day and Shapson , however, included grade 3 students. Such a distinction is important, because as students progress through the program each year, their level of proficiency in both languages increases, making their ability to process content knowledge in either language stronger. Due to discrepancies in theory (the ability to transfer language) and practice (the results of Turnbull et al., 2001b), there is a need for additional research. Furthermore, because the majority of the studies undertaken involve students

beyond the grade 3 level, there is a need to conduct further research involving students in the years up to and including grade 3 who are still developing literacy skills, particularly as it pertains to making decisions around the language of testing that is most appropriate for the EQAO mathematics assessment.

While there is limited to no evidence to indicate that achievement is hampered when learning is in L2 and assessment is in L1, a number of studies have indicated that students are able to achieve at higher levels when tested in English (L1) on content matter that was taught in French (L2), (Bournot-Trites & Reeder, 2001; Cummins & Swain, 1986; DeCourcy & Burston, 2000; Genessee, 1987; Day & Shapson, 1996; Turnbull, et al., 2001b). In fact, even when students have had limited to no formal instruction in English, they are able to achieve at levels that are on par with their English language counterparts when tested in English either on subject matter that was taught in French or on English language assessments (Baker, 2006). This ability to be at parity with their peers despite limited formal L1 content instruction gives support to the notion that content language learned in L2 is transferable to L1.

English Skills of FI Learners

The ability of FI students to perform at parity with single language peers in their use of English is substantiated in current research. Several studies confirm that while FI students may experience an initial lag in their first language skills, they perform at parity with their English counterparts after experiencing one or two years of formal instruction in English (Baker, 2006; Bournot-Trites & Reeder, 2001; Genesee, 1987). This finding provides some explanation as to why students who are taught in L2 are able to adequately complete tasks

that are performed in L1. When we shift the language of assessment, however, parity does not necessarily hold true.

Language of testing is a serious issue for many reasons, the key reason being that when students are tested on content knowledge in an L2, their achievement may be a reflection of their lack of proficiency in the language as opposed to their knowledge related to the content of the test (Benoit-Humber, 2008; Bournot-Trites & Reeder, 2001; Cummins & Swain, 1986; Hauger & Sireci, 2008). Genesee (1987) pointed out that historically, mathematical problem solving has been an area in which immersion students have not performed strongly when tested in their L2.

Additional Considerations for L2 Learners

In their examination of students learning mathematics in French in Australia, De Courcy and Burston (2000) elaborated on factors that influence students' ability to demonstrate content knowledge when performing tasks in an L2. They began by identifying factors that cause difficulty to monolingual children when faced with solving mathematical word problems such as a lack of understanding of what the problem is about, not knowing what mathematical strategy to apply, and not being able to complete the needed calculation correctly (p. 77). While these factors may influence immersion students' ability, they are also confronted with issues related to their L2 abilities when attempting mathematical problems that are written in their L2. De Courcy and Burston identified the main issue as follows:

> In order to comprehend written problems, besides world knowledge and basic knowledge of the vocabulary and mophosyntax of L2, children need familiarity with, and understanding of, text cohesion in L2: knowledge of the features of the word-

> problem genre, recognition of new/old information, mastery of co-reference (more specifically anaphora, identification of connectives). (p. 77)

Hauger and Sireci (2008) noted that "when examinees are tested in a language that is not their native language, the proficiency to read and respond to test questions may interfere with their proficiency to demonstrate their knowledge, skills, and abilities" (p. 238).

> Toplak and Wiener (2000) identified three ways in which mathematics assessments, such as those administered by the EQAO, emphasize reading and writing skills:
>
> First, questions on standardized tests often require comprehension of the text in order to make sense of the problem. Second, some questions require a more elaborated written response, which rely on skills and clarity of communication through writing. Third, some questions are word problems which require an integration of language and number concepts at every step of the problem. (¶ 16)

At the grade 3 level, one could question whether or not an immersion student's L2 abilities would be adequate to allow for the level of comprehension of the text required to comprehend the question and then to clearly communicate a written response. Cummins and Swain (1986) examined the L2 skills of immersion students and noted that it was not until grade 5 or 6 that immersion students were able to obtain achievement in the 50th percentile on standardized tests of French achievement, confirming that it takes students 6 or 7 years of study in the target language to attain an average level of performance in French. Baker (2006) also referred to this timeline. This is significant because the French EQAO mathematics assessment used at the grade 3 level in Ontario is a direct translation of the English assessment. Given this fact, it stands to reason that FI students are at a potential linguistic disadvantage when faced with reading and comprehending the language used to

communicate the mathematical tasks they are required to complete as part of the assessment. Koda (2007) explained the additional constraints that are placed on L2 readers:

> The dual language involvement implies continual interactions between the two languages as well as incessant adjustments in accommodating the disparate demands each language imposes. For this reason, L2 reading is crosslinguistic and, thus, inherently more complex than L1 reading. (p. 1)

In terms of world knowledge and vocabulary, it is important to note that, for the majority of immersion students, their out-of-classroom experience is in their first language. For most, their only experience with the target language is through classroom instruction (Baker, 2006; Day & Shapson, 1996). Given this fact, one must consider the implications for the possibilities for L2 vocabulary and language development as connected to contexts that may be presented on achievement tests. It would stand to reason that the experiences that occur through the school day alone would not be adequate to provide students with the varied knowledge base and contact with a wide enough variety of experiences to prepare them for those which they may encounter within the context of the assessment (or to possess a native-like command of the target language), putting them at a disadvantage (Samuel, 1990). In order to be able to have equivalent levels of language-related knowledge and skill levels in both languages, students would need to have had similar experiences in both languages, which is typically not the case in an immersion setting.

De Courcy and Burston (2000) discussed the fact that reading and completing a test in L2 requires a longer time period than is needed in one's first language. Because of this, extra time is required for L2 students to be able to achieve similar results to their L1

counterparts. Vorhaus (1984) gave some insight as to why this may be true by further explaining the differences between L1 and L2 readers:

> First language readers are interactors who use the author's language as a basis for developing concepts and an understanding of the author's idea while second language readers are mostly receivers who are constantly trying to develop more linguistic knowledge and insight about that particular author's language. . .The first language reader had the linguistic resources that allow enough mental flexibility to understand what the author is conveying, while the second language reader can only use the available linguistic information to understand what the author is saying. (p. 413)

De Courcy and Burston (2000) presented a hypothesis in which they predicted that the limited knowledge of French vocabulary and the higher cognitive demands of reading in French prevented some students from understanding the word problems on mathematics assessment tasks resulting in two phenomena: Students were prevented from completing the test, and they had difficulty interpreting the questions that they did have the time to attempt. Their findings indicated that overall, being tested in French could have an adverse effect on student achievement but that, by year five, FI students who completed a mathematics assessment in English did significantly better.

Validity of Using Standardized Test Results

Throughout the current literature, researchers have used data obtained through standardized mathematics assessments to measure FI student achievement (Bournot-Trites & Reeder, 2001; Cummins & Swain, 1986; Genesee, 1987; Lindholm & Aclan, 1991; Swain & Lapkin, 1982; Turnbull et al., 2001a, 2001b). The frequency of the use of standardized tests across the research literature related to measuring mathematics achievement of FI students

suggests the validity of these types of assessments is accepted as a reliable indicator of student achievement.

The EQAO has also taken steps to ensure the validity and reliability of their assessment tools. In the paper "Varieties of Assessment: Issues of Validity and Reliability," Bartley and Lawson (1999) discussed the Ontario assessments in relation to the current research and literature by looking at the purpose, comparability, appropriateness, bias, and test design (vis à vis theories of learning). They concluded that the "EQAO assessments expand upon the approaches. . . that provide authentic assessment experiences for students and their teachers, while providing the desired accountability information for parents and taxpayers" (p. 18). This supports the notion that the Ontario achievement tests are appropriate resources for both assessment and accountability, and that the EQAO assessment is a valid and reliable measure of student achievement.

Of the studies done on the mathematics achievement abilities of FI students, it is important to note that all but those conducted by Turnbull et al. (2001b) use the scores of achievement tests performed in English to measure the mathematical abilities of FI students. With the limited amount of research done using data obtained through assessments administered in French, it is difficult to ascertain the equivalence of content knowledge that is assessed through a translated test (i.e., is the mathematics content assessed equally on a test that has been developed in English and then translated into French?). This topic is an additional area of research that is related to the current study. The validity and equivalence of assessments upon being translated into an L2 is a topic that has garnered some attention through the research literature. Gierl (2000) explained that if tests are going to be translated into different languages to compare groups, then the construct measured by the test must be

equivalent across the groups in order to allow for meaningful comparisons. He indicated that "test translation is an important measurement topic since the validity of scores on any translated achievement test depends, in part, on the accuracy of test translation" (¶3). Gierl examined translated tests in mathematics and in social studies assessments that were administered to grade 6 students across Canada in three contexts: English language schools, Francophone schools, and FI schools. In both of the assessments, Gierl found that after conducting a one-factor confirmatory analysis, the assessments provided an adequate fit for all three testing contexts. However, upon completion of a multisample analysis, Gierl concluded that parameters were equivalent across groups for social studies but that the parameters were not equivalent across groups in mathematics. As a result, he concluded that group comparisons in mathematics may not be appropriate until test developers evaluate the nature of the differences.

In her study on the effects for academic achievement for immersion students, Samuel (1990) examined in depth the construct equivalence of translated tests. For the purposes of her study, Samuel used both the English and the French translation of the *Grade 6-Social Studies Achievement Test, Part A-Multiple Choice* published by Alberta Education in1985. She noted that there are two fundamental ways in which translation can alter the nature of test questions:

> First, the difficulty of items could be altered because of differences in the meaning or for presence of cues in the original and translated items. Secondly, the readability of the original items could be altered. Since readability affects how well students comprehend what is being asked by test questions, this alteration could affect the way students respond to those questions. (p. 11)

Samuel (1990) initially hypothesized that variances between original and translated tests may have an impact on student achievement based on alterations that occur to the instrument during the translation process. Following an in-depth discussion of various aspects of translation, including translation and text meaning, translation and item equivalence, translation and item cues, and translation and readability, Samuel concluded that there is insufficient evidence to prove that any differences between carefully translated assessment instruments will have an effect on student achievement or outcomes.

In addition, research has been conducted into the validity of translated versions of the Trends in International Mathematics and Science Study (TIMSS) assessment in terms of the validity of results across different translated versions of the test (Chen, Gorin, Thompson, & Tatsuoka, 2008; Hauger & Sireci, 2008). Both studies found that in the case of the TIMSS assessment, mathematics results did not seem to be hindered by students in different countries who wrote various translations of the assessment (studies looked at results from the United States, Taiwan, Singapore, and Iran). These studies support the conclusion that differences between carefully translated instruments will have little effect on student achievement.

Classroom Practices in the FI Context

Bournot-Trites and Reeder (2001) indicated that in addition to language abilities being a key factor influencing student achievement on mathematics assessments, instructional strategies and teaching resources also play an important role. They noted that "teaching materials that promote students' interactions, cooperation, and group work are probably more favorable to learning than methods or materials that place less emphasis on these learning variables" (p. 40).

In 2003, the Ontario Ministry of Education released the *Early Mathematics Strategy*, a report prepared by a panel of experts in the area of teaching and learning mathematics in the early grades. The report indicated that from 1997-2002, despite the fact that system-wide results on the EQAO mathematics assessment across Ontario demonstrated overall trends moving in the right direction, there were still large percentages of students that were not achieving the provincial standard. The report was undertaken as a response to this information and gave many recommendations for the improvement of student learning in mathematics. Included in this information is the provision of suggestions for improving mathematics teaching and learning. In the document, several instructional practices are recommended, such as:

1. Resources to support early grades of learning that are connected to the curriculum (print resources for students and teachers, literature related to mathematics, problem-solving activities, manipulative,s or concrete materials);
2. The use of computer software;
3. Investigation and guided learning;
4. Individual activities and group activities;
5. Portfolios and collections of student work;
6. Journals and logs;
7. Performance tasks; and
8. Tests, quizzes, and short-answer questions.

The current study attempts to identify some of the teaching strategies and learning resources that were used in the classrooms of the students that participated in the study to identify if there is a relationship between the strategies used among the groups and any possible differences in student achievement levels. A questionnaire was distributed to teachers in

order to gather this information. Items on the questionnaire reflected instructional practices as identified in the *Early Mathematics Strategy* (Ontario Ministry of Education, 2003) report as listed above. In addition, the titles of several print resources that were linked to the mathematics curriculum were included as specific resources that may have been in use for instruction prior to the EQAO assessment.

As Samuel (1990) indicated, there is often a limited amount of appropriate available curricular materials in the target language in FI classrooms, a fact which may inhibit student learning from both a linguistic perspective as well as a cognitive perspective. Further investigation into which of the available resources were the most effective was undertaken as part of the current study, as it was seen to be beneficial for all stakeholders in FI programs given the fact that appropriate resources for instruction were limited.

Conclusion

The purpose of this chapter was to examine the current literature related to the hypothesis that there will be significant differences in FI students' achievement scores when they are tested in French as compared to English.

Upon review, the current research has focused on student achievement through a variety of content areas, including, but not limited to mathematics. There is a strong argument supporting the notion that despite being taught in L2, students are able to retrieve content knowledge in L1 without any disadvantage. As students progress in their formal studies of L1, their ability to transfer skills between languages increases.

In terms of student achievement in content knowledge when learning and assessment take place in L2, the evidence is somewhat contradictory as to the direct impact on student achievement. The research indicates that the higher the level of proficiency in L2, the more

likely the success of achievement on content-based material when assessed in L2. The key point to note is that students are able to perform and achieve at high levels when they have adequate levels of linguistic proficiency in both languages. The question remains as to the point of study where this threshold is reached. This may vary depending on the hours of accumulated instruction in the target language that the student has experienced (which varies greatly among schools and school districts across the province of Ontario).

The majority of studies related to language of testing and student achievement have examined students beyond the grade 3 level, who are well on their way to having highly developed literacy skills in both languages. The need for examination of results through the primary years is an area of research that has not been fully explored but will benefit from the contributions of the current study.

While the body of research related to language of instruction, language of testing, and student achievement has been examined, little in this research has identified the myriad of additional factors that may influence student achievement. Some indication of the impact of teaching methodology and resources has been discussed, but with inconclusive results. The need exists to further examine the possibilities and ramifications of classroom practice and resources as they pertain to student learning in an L2 environment.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

In this chapter, the research problem, hypothesis, and theory related to the problem are presented. A description of the data gathered for analysis is included. Detailed descriptions of the process for gathering data as well as data collection procedures are included. Procedures for statistical analysis and the analysis of teacher questionnaires are discussed.

Research Problem

The primary purpose of the research in this study is to compare the results of FI students who wrote the EQAO mathematics assessment in English with the results of FI students who wrote the same assessment in French in order to determine if there is a significant difference in overall student achievement at the grade 3 level as related to the language of testing. The research presented will attempt to answer the following questions: (a) How do the results of FI students writing the test in French differ from the results of FI students who write the test in English (if there is any difference at all)? and (b) Is there a relationship between resources and instructional strategies identified by teachers and the achievement success of students?

Theory

In general, research indicates that FI students who learn content in an L2 are able to transfer that knowledge into the first language. Amongst L2 immersion students, achievement is not impacted negatively when learning is done in an L2 but assessment is done in the L1. This transfer of knowledge occurs when students have achieved adequate levels of proficiency in both languages, which may take up to 6 or 7 years of study to achieve.

Learning in an L2 creates greater cognitive demands on learners than learning in the L1. L2 learners demonstrate a more limited vocabulary acquisition in their L2 than in the L1, which affects their ability to comprehend content and to communicate their understanding of knowledge and concepts. Because of this, the acts of reading and writing in the L2 take more time than in the L1.

Hypothesis

Factors such as the increased processing demands on learning in an L2, limited vocabulary acquisition of L2 learners (as compared to that of the first language), the differences in language between the English and the French translation of the EQAO mathematics assessment, and the demands for the use of language throughout the mathematics assessment all contributed to the reasons for conducting the research of the current study. Because of these factors, it was hypothesized that FI students who wrote the grade 3 EQAO mathematics assessment in English would achieve significantly higher overall scores than their counterparts who wrote the EQAO mathematics assessment in French.

Participant Description

Participants in the study included students and teachers in FI schools in Ontario that offered a high concentration of study in French throughout the early years of study. Within the participant group, all students accumulated between 3,372 and 3,515 accumulated hours of instruction in French by the end of grade 3. Participating schools represented southern, southwestern, and northern Ontario and included both Catholic and public school boards. Eligible participants were from schools where both the overall student achievement results and at least one copy of the teacher questionnaire were returned. Table 1 outlines the characteristics of each participating group in the study.

Table 1

Participating School Boards

Description	Location	Testing Option	Hours	Number of schools	Schools
Urban Public	Southern Ontario	B	3,420	2	F_1, F_2
Rural Public	Southern Ontario	C	3,420	2	F_3, F_4
Rural Catholic	Northern Ontario	A	3,515	1	E_1
Rural Catholic	Southwestern Ontario	A	3,372	1	E_2

Note. Option A = EQAO Mathematics test is written in English and language test is written in English. Testing Option B = EQAO Mathematics test is written in French and language test is written in English. Testing Option C = EQAO Mathematics test is written in French and the language test is not written. Hours indicates the total number of accumulated hours of instruction in French that students experienced until the end of grade 3.

Mathematics Achievement Scores

The research uses the overall individual EQAO mathematics scores of participating students as the measure of student achievement for the comparison participants who wrote the test in English

and participants who wrote the test in French. The "Overall Individual Student Results" is a report that was prepared for each school by the EQAO. Each school administrator (principal) had a secure password to access this information from the EQAO website. This particular report was utilized for the research because it included a list of each student's individual overall achievement level by student bar code number. This was an important piece in assuring the anonymity of participating students.

The component of the study that involves an examination of the individual student achievement scores by language of testing constitutes nonexperimental quantitative research. The research is quantitative in nature as it involves a statistical analysis of EQAO data in order to determine a possible relationship between achieved student results and language of testing. Ary, Cheser Jacobs, and Razavieh (2002) define quantitative research as using objective measurement and statistical analysis of numeric data to understand and explain phenomena (p. 22). In the case of the current study, student achievement data in mathematics are examined for two groups of FI students: those writing the assessment in English and those writing the assessment in French.

Nonexperimental quantitative research involves the testing of variables with the intent of identifying an existing relationship between them without any manipulation of the variables (Ary et al., 2002, p. 24). In the current study, the overall individual EQAO achievement scores and the language of testing are variables that have been identified and a

relationship amongst them is sought, without any manipulation of these variables; both items are preexisting.

Teacher Questionnaire

As a secondary source of data, the grade 3 teachers in schools who participated in the study were asked to fill out a questionnaire created for the purpose of this study (Appendix E). The purpose of the questionnaire was twofold. In the first part of the questionnaire, teachers were asked to confirm their FI delivery model and the language of instruction for mathematics.

The second purpose of the questionnaire was to gather information on classroom practices related to the learning of mathematics that may have had an influence on student achievement. As previously noted the language of testing in itself may not be the only factor that influences student achievement on the EQAO assessment; therefore, the questionnaire for teachers included items that allowed them to indicate specific instructional practices, resources, and textbooks that they used in teaching mathematics as well as the frequency of their use as indicated through a Likert scale. Through this section of the questionnaire, teachers were able to indicate whether they used each item *never*, *rarely*, *sometimes*, or *often*. A list of items was provided as well as space for teachers to add additional items under the category of "other." Information pertaining to teaching strategies and resources was gathered through items 4, 5, and 6 of the questionnaire:

Item 4: Which of the following instructional strategies did you use to instruct mathematics in your classroom during the 2003-2004 school year?

Item 5: Which of the following resources did you use to instruct mathematics in your classroom during the 2003-2004 school year?

Item 6: Which mathematics textbooks and programs did you use for teaching Mathematics during the 2003-2004 school year?

The teacher questionnaire also gathered information that pertained to the amount of time each teacher used English as the language of instruction to accommodate student learning, either in classroom activities or through homework:

Item 7: During what percentage of your mathematics time did you speak English to your students to reinforce mathematics concepts taught in French in the 2003-2004 school year?

Item 8: During what percentage of time did you assign mathematical tasks in English (in class or as homework) to your students to reinforce concepts taught in French in the 2003-2004 school year?

This information helped in further identifying the degree to which the instruction in mathematics was conducted in French and allowed for further determination of whether or not the participants had experienced similar exposure to instruction in French in terms of the percentage of time that French was used as the language of instruction for each grade level up to and including grade 3.

The questionnaire completed by participating teachers also constitutes quantitative research. Survey research permits the researcher to summarize characteristics of a certain group. (Ary et al., 2002, p. 374). The group being examined is grade 3 FI teachers in Ontario who instructed mathematics in French. The information collected from this group through the teacher questionnaires was twofold. A survey of tangibles was included in order to acquire data which identified the language of instruction of mathematics as well as the FI delivery model. According to Ary et al., a census of tangibles is useful when seeking information about a small population and when the variables involved are concrete (p. 376). A survey of

tangibles is also useful when seeking information about a sample from a large population. If the sampling is well done, the inferences made about the population can be quite reliable (p. 377).

The second part of the questionnaire involved a census of intangibles in which teacher opinion was sought to identify classroom practices and resources that were in use and the frequency of their use. The relevance of these data was to provide insight into instructional practices that may influence student performance but are extraneous to the language of testing. The intangible items on the survey are variables that are difficult to measure, as these constructs are not directly observable but must be inferred by indirect measures (Ary et al., 2002, p. 376). In the context of the current study, it is unlikely that any individual participating teacher actually tabulated his or her actual frequency in using the practices or resources listed. The responses provided would likely reflect the teacher's perception of the frequency of use. Caution must be taken when interpreting these results, as participants responding to intangible items may be reluctant to reveal a choice that may appear to be based on self-interest, prejudice, or lack of knowledge about the item (Ary et al., p. 377). In the case of the current study, there is a limited possibility that these factors may have influenced participant responses; however, a guarantee of anonymity for all participants was implemented in an attempt to avoid such issues.

When examining the results of a survey of intangibles, the researcher makes inferences about the population as a whole (Ary et al., 2002, p. 378). In the case of the current study, all members of the sample group submitted questionnaire data.

For each participating class, both the individual student EQAO results and the completed teacher questionnaire encompass the data used in the study. In order for a school

board's data to be included in the study, both the individual students' results and the teacher questionnaire were required.

All results from the participant questionnaires were collated and reviewed to identify trends and patterns and any possible relationships with student achievement. This will be discussed in greater detail later in this chapter.

Ethical Review by Nipissing University

Because the data being used for the study involved human subjects (namely grade 3 FI students and teachers), approval was sought from the Nipissing University Ethics Committee to conduct the research. A copy of the written approval to involve human subjects in research is included in Appendix F. Once permission was granted to conduct the research, the process of identifying potential participants began.

Preliminary Research

Prior to beginning the study, a significant amount of preliminary research was conducted to determine school boards in Ontario that would qualify for participation in the study. The following is an overview of the steps that were followed during the preliminary research undertaken to identify school boards as potential candidates for the study, each of which will be elaborated on in the discussion that follows the list:

1. Identifying which school boards in Ontario offered French Immersion programs;
2. Identifying individual French immersion delivery models by school board;
3. Identifying EQAO testing option by board; and,
4. Identifying the geographic location of school boards.

Identifying School Boards With FI

The first step in conducting the research was to identify participating school boards. As described earlier, each school board in Ontario that offers a FI program does so voluntarily and identifies the amount of instruction in French at each grade level, ensuring that the minimum of 50% instruction in French is maintained as outlined in Ministry policy through the French-as-a-second-language: FI curriculum document (Ontario Ministry of Education, 2001a). While this document was released in 1998, many boards of education in Ontario already had well- established programs that they were able to continue to organize using a locally developed delivery model that fell within the parameters of the definition of FI by the Ministry of Education. In order to compare students from different school boards in this study, it was necessary to identify boards with similar or the same delivery models so that data used compared students with similar or the same amounts of experience and instruction in French-as-a-second language through an immersion program. The initial stages of research consisted of first identifying which of the 60 school boards in Ontario offered a FI program. A complete list of all school boards in Ontario was obtained from the Ministry of Education website. Data about FI programs was mostly obtained through individual school board websites. In a limited number of cases, contact with school board personnel via e-mail or telephone was needed to determine whether or not a FI program was in existence.

Identifying FI Delivery Models

The next step was to identify what the delivery model (the percentage of time taught in French at each grade level from junior kindergarten to Grade 8) was for each board that offered a FI program. This information proved to be very challenging and time-consuming to collate. Through a variety of preliminary contacts with school board consultants and Ministry

personnel, it was discovered that a compilation of this information did not already exist; therefore the next step in the research was to collect individual data on each board as to the delivery model of the FI program within that board. This information was collected by visiting board websites and contacting various school board personnel (which included anyone from teachers, consultants, co-ordinators, superintendents, administrative assistants, and/or the director of education where necessary). Through several months of research, a final list of school boards and individual delivery models was amassed (Appendix A). It should be noted that despite the extensive effort in collecting this data, information for some school boards was not obtained, even after a significant amount of time and numerous contact attempts.

This information brought to light a number of complicating factors in addition to the fact that the percentage of time taught in French varied across the province. Two key issues included the fact that the entry point for FI programs varied. Across the province, students were able to begin study in a FI program at any number of different grade levels. For some boards, this meant that students began their immersion studies in junior kindergarten, senior kindergarten, or grade 1, while in other school boards, the immersion program began in grade 4 or grade 5 (or, in some instances, a higher grade). Within these varying starting points, the introduction of formal instruction in English also varied. Some boards began a small amount of English instruction in the kindergarten years, while others did not provide any instruction in English until grade 4.

Because of these differences, it became apparent that finding school boards with similar delivery models for their FI programs would not be facilitated by consulting the percentage of time taught in French alone. In order to accommodate the anomalies in FI

models yet still have a valid and comparable sampling of school boards, the number of accumulated hours of instruction in French by the end of grade 3 was calculated for each school board that offered 100% instruction in French in the earliest years of entry and that introduced a small percentage of formal English instruction sometime before the end of grade 3.

In order to calculate the accumulated hours of instruction in French for each school board, first the total number of instructional hours per school year was calculated. Based on the Ontario Ministry of Education requirement of 194 instructional days per year, with 300 minutes of instruction per day, a total of 970 hours was identified as the total number of hours of instruction received by each student in each academic year. This total was then multiplied by the percentage of instruction in French for each year of FI within each individual school board. Finally, the accumulated hours of instruction in French for each year up to and including the end of grade 3 were calculated. This total was used to indicate the total number of hours of instruction in French by the end of grade 3 for the purposes of this study. It is noted that in some cases, the actual percentage of time taught in French may be slightly lower due to phenomena such as individual teacher explanations given in English or certain content areas being taught in English by non-French-speaking personnel who instruct students when covering a class for the homeroom teacher's planning time. A range between 2,930 and 3,420 accumulated hours of instruction in French was identified as the acceptable range for participation in the study, as this range identifies boards that offer early FI programs with a higher concentration of instruction in French throughout the primary grades of the program (junior kindergarten through to the end of grade 3). This narrowed down the number of eligible school boards for the study significantly. The actual numbers of

accumulated hours of instruction for boards that participated in this study are included in Table 1.

Identifying EQAO Testing Options

From there, the task of identifying which option of testing each eligible school board participated in for the 2003-2004 assessment was conducted. The EQAO office provided a list of school boards indicating the option of testing chosen for each board.

Having data about the delivery model and the option of testing for each school board facilitated moving to identifying potential school boards for participation in the study. This information was added to the table of information on FI delivery models and can be found in Appendix A.

Identifying geographic location of school boards

The final criteria for identifying school boards for participation in the study was to look for a stratification of rural and urban school boards, Catholic and public school boards, and to identify geographic locations that represented a variety of different regions of Ontario. It was also preferred to have an equal number of boards in which the assessment was written in each language (English and French) in order to compare results. When all of these factors were pulled together, out of the 43 school boards in Ontario offering some form of Early FI program, 9 school boards were identified as potential candidates for participation in the study. As the anonymity of boards was guaranteed through the Nipissing Ethics Review process, individual school boards cannot be named, however; boards eligible for participation represented northern Ontario (five school boards), southern Ontario (three school boards), and southwestern Ontario (one school board). Amongst those boards, six were Catholic and three were public, one was urban and eight were rural.

Initiation of the Study

Upon completion of the preliminary research, the process of securing participants for the study was undertaken. The process to invite participation in the study was initiated by requesting permission to conduct research from the school board. Following this, individual school administrators and grade 3 teachers were contacted respectively and invited to participate in the study.

Requesting Permission from School Boards

To secure participation in the study, permission was sought from the nine identified school boards to include their data in the study. The initial step was to identify the process for seeking permission to conduct research within the board. Each board had its own process. Some required application to a committee, others required contact with school board personnel (including, but not limited to consultants, co-ordinators, superintendents, research department personnel, or the director of education). Once the contact person and the process had been identified, a letter outlining the nature of the study and the data that was being collected was sent to each of the identified school boards. (Appendix G). Within the letter, a brief outline of the study was presented as well as a guarantee of confidentiality and an explanation of the conditions for withdrawal from the study.

Five of the original nine boards responded positively. All participating school boards provided written consent to conduct research within their school boards on the condition that consent was confirmed from both the principal and the classroom teacher. This written consent was included in part of a package that would be sent to principals seeking participation in the study.

In one of the school boards, the contact person indicated that he/she would solicit participation from interested schools. As no schools indicated interest in participation in the study, this school board was not included in the study.

While most boards provided written permission as a first response to the research request, other boards did not, and a letter reminding boards to confirm participation in writing was sent out (Appendix H). Following this request, the remaining three school boards (from the original nine) were removed from participation in the study. Two of these schools did not respond to the invitation to participate, and the third school board declined participation via a phone conversation with a representative from the board who explained the reasons why they were not interested and able to participate in the study; that included a very small number of participants in the 2003-2004 EQAO mathematics assessment, which they felt would not make a significant contribution to the study being undertaken.

Requesting Permission from School Administrators

The next step in gathering the data was to contact the school administrators (principals) of the FI schools within the participating school boards. A letter was sent to each administrator of each school which outlined the purpose of the study, the required documentation for participation, a guarantee of anonymity and an explanation of the conditions for withdrawal from the study (Appendix I). As each school board had confirmed permission to participate in writing, it was not necessary to seek written confirmation from principals. Instead, principals were directed in the letter that returning the data would be considered consent to participate in the study.

Within the package sent to principals were three copies each of the letter to participating teachers, the teacher questionnaire, and enough self-addressed, stamped

envelopes to return each teacher questionnaire, and EQAO individual results report. Principals wishing to participate were asked to give each teacher in their school who administered the 2003-2004 assessment a copy of the introductory letter, a copy of the questionnaire and a self-addressed, stamped envelope in which to return the completed questionnaire.

Requesting Participation from Grade 3 Teachers

In each participating school, the grade 3 teacher(s) who administered the grade 3 EQAO assessment and taught mathematics to the students who wrote the assessment were given a copy of an introductory letter (Appendix J), a copy of the teacher questionnaire (Appendix E), and a self-addressed, stamped envelope in which to return the questionnaire. Teacher participation was voluntary and dependent upon individual teachers completing and returning the teacher questionnaire. The letter to teachers stated that the study had been approved by the school board and indicated the name and title of the board official who had granted permission (Appendix J). In addition, the letter to teachers explained that completion and return of the questionnaire would be considered as consent to participate in the study. The letter also outlined the purpose of the study, the required documentation for participation, a guarantee of anonymity, and an explanation of the conditions for withdrawal from the study.

The purpose of the questionnaire was to verify information about the school's FI program and to identify classroom practices used for the instruction of mathematics.

On each questionnaire, the teacher identified the name of his/her school and school board as well as his/her homeroom identification code as assigned by EQAO. This code was to ensure that only one questionnaire per classroom was completed and to verify that a

questionnaire was received from each participating school. Teachers were also asked to identify the percentage of time taught in French for each grade up to and including grade 3 in his/her school. This allowed a verification of the school's FI delivery model. Finally, the questionnaire asked teachers to identify the language of instruction for mathematics. The purpose of this question was to verify that all participating students had studied mathematics in French prior to the assessment in order to validate that the sample classes were comparable in their mathematics background in terms of the language of instruction.

The remainder of the items on the questionnaire dealt with instructional practices and resources used in FI mathematics classes. A Likert scale with values from 1 (*never*) to 4 (*regularly*) was provided for teachers to identify specific instructional practices and resources used. Since it was assumed that instructional strategies and resources had an impact on student learning and achievement, the questionnaire was developed to solicit this information from participants in an attempt to determine the most beneficial instructional strategies and the most appropriate resources available to enhance the mathematical learning of FI students (Ontario Ministry of Education, 2003, pp. 25-29). For each item, a number of choices were provided as well as additional space for teachers to identify instructional strategies or resources that they had implemented in class prior to the testing.

Finally, the questionnaire included a space where teachers could indicate whether or not any amount of English was used in instruction either to reinforce concepts orally, or as the language of communication on assigned written mathematical tasks. The purpose of this information was to confirm that the instruction in mathematics occurred in French to assure that classes compared in the research had received a similar experience in and exposure to French as a second (or third or fourth) language.

Requesting Permission from EQAO

In order to use sample questions from the 2003-2004 EQAO mathematics assessment, permission was requested from the EQAO office to include copies of the mathematics assessments in entirety and to use items from the assessments as part of the discussion in the study. Permission was granted to do so.

Collection of Data

A reasonable timeline was allotted for receipt of each school's data. In some cases, either the *Detailed Students Results* report or the teacher questionnaire were received. Because the results of the study required each participating school to submit both pieces of data, it was necessary, in some cases, to send a reminder letter to principals in participating schools to assure that the missing data were sent in (Appendix K). In all cases, the missing data were provided following receipt of this reminder notice.

After 10 months of going through the process of identifying FI delivery models for all 60 school boards in Ontario, identifying school boards that met the parameters for consideration to be included in the study, requesting permission to conduct research within each qualifying school board, contacting school administrators to request school data, and following up with individual school administrators to assure the receipt of both the individual overall student mathematics achievement scores and the grade 3 teacher questionnaires, the data received included four school boards: two whose students wrote the test in English and two whose students wrote the test in French. Within those boards, eight schools (10 classes) had sent in both their Detailed Student Results reports and teacher questionnaires. Upon examination of the program data gathered through the teacher questionnaires, it was discovered that in one school board, only one of the three schools that sent in information

had a delivery model that was within the parameters of accumulated hours of instruction needed to qualify for the study; thus the data for the other two schools were not valid and could not be included in the analysis. Because of this, data from only one school in that school board have been included in the current study. In another school, one of the teacher questionnaires was incomplete thus the data could not be included in the study. EQAO data from that school is included in the study; however, the teacher questionnaire data reflect the opinion of only two teachers from that school. In that particular school, there were three teachers who administered the EQAO mathematics assessment in the 2003-2004 academic year. Table 1 outlines the data that were used for analysis in this study.

Similarly, in some participating schools, the number of grade 3 students who wrote the 2003-2004 EQAO assessment would be large enough to indicate that there was likely more than one class and more than one grade 3 teacher. However, information pertaining to the number of classes and teachers per school was not identified as part of the study. Because of this, every school that returned overall individual mathematics results and at least one teacher questionnaire was included in the data of the study. It may be the case that in some participating schools, only one of several grade 3 teachers returned the teacher questionnaire, so the questionnaire results for that particular school represent only one perspective on the learning experiences of the grade 3 participants within that school.

Within the school boards, schools, and classes with complete data, the final sample size that is included in this study encompasses 100 FI students who wrote the test in French and 56 FI students who wrote the test in English for the 2003-2004 grade 3 EQAO mathematics assessment. In the 2003-2004 assessment, 8,658 FI students representing 43 school boards participated in the EQAO mathematics assessment (EQAO, 2004). Of these 43

school boards, 22 offered an immersion program that offered a high concentration of French instruction (more that 50%) in at least one of the grades leading up to grade 3. The sample in the current study represented 1.8% of the total population of FI students who participated in the 2003-2004 assessment. However, this number represents the total number of participants from all immersion programs, not just those that had a similar range of accumulated hours of instruction in French as the participants in the current study. As individual school board numbers of grade 3 FI students were not available, it was not possible to determine what percentage of students with a range between 3,372 and 3,515 accumulated hours of instruction in French is represented by the 156 participants in the current study.

The actual accumulated hours of instruction of participants in the study ended up being between 3,372 and 3,515 hours. This was a much narrower range than the original parameters that were set at the initiation of the study (which was a range between 2,930 and 3,420), which meant that participants were quite similar in terms of their exposure to learning French-as-a-second language through an immersion program.

Analysis

The student achievement scores obtained from the EQAO mathematics assessments were examined using inferential statistics. Inferential statistics help determine how reliably researchers can infer those phenomena observed in the sample will occur in the larger population of concern (Ary et al., 2002, p. 118). To assess the validity of the overall achievement scores of participants in this study, two statistical analyses were conducted using PAWS Statistics version 17.

First, a *t* test for independent samples was conducted. The independent *t* test is used when two random samples are drawn from a population and each group is assigned a

different treatment. After exposing the two groups to the treatments, the *t* test allows the researcher to determine if the difference in results after such treatments is easily attributable to chance or if they are statistically significant (Ary et al., 2002, p. 185). The independent *t* test looks for differences in mean scores between two independent groups. In order for a *t* test to be used for statistical analysis, the data need to satisfy three assumptions: be fully independent samples, be normally distributed, and have equality of variance (Archambault, 2000; Hinton, Brownlow, McMurray, & Cozens, 2004). In the case of the data included in the current study, the data are independent; each participating group was assigned a different treatment, that being language of mathematics testing which was either French or English. A P-P (probability) plot graph was used to check for normal distribution for both sets of data (mean overall individual mathematics achievement scores for each of the group writing the assessment in English and the group writing the assessment in French). Finally, a Levene test was conducted to determine the equality of variance between the sets of data for the two participant groups. A full discussion of these analyses is included in Chapter four and will demonstrate that the three necessary conditions for using a *t* test for statistical analysis have been met and therefore the *t* test is appropriate in the current study.

The results of the teacher questionnaires were examined using descriptive statistics. Descriptive statistics make the handling of quantitative data more meaningful by allowing the researcher to organize, summarize, and describe observations. Data were organized into tables that outline the frequencies of responses for each participating school in each treatment group along with the overall achievement results (in percentage) of each school. Ary et al. (2002) indicate that complex statistical analyses are not usually required to analyze survey

data (p. 410). Once the data for the current study were collated, patterns and trends in practice were identified and discussed.

The results of the statistical analysis and the questionnaire responses will be discussed in detail in Chapter four.

CHAPTER 4: FINDINGS

Following the collection of the data, statistical analysis was conducted on the EQAO grade 3 mathematics achievement results, and the results of the teacher questionnaires were summarized. The purpose of this chapter is to present the findings of these processes in an attempt to test the hypothesis of the study and to answer the questions that the study seeks to answer.

Research Questions and Hypothesis

The hypothesis to be tested is that FI students who wrote the grade 3 EQAO mathematics assessment in English will achieve significantly higher overall achievement scores than their FI counterparts who wrote the assessment in French. According to Ary et al. (2002), a hypothesis must state the relationship between two variables, must be consistent with the current body of knowledge, and be testable (pp. 104-105). In the case of the current study, this hypothesis meets the criteria:

1. The expected relationship between variables is stated: FI students who wrote the EQAO mathematics assessment in English will achieve significantly higher overall achievement scores than their counterparts who wrote the assessment in French;
2. The hypothesis must be consistent with the current body of research: As demonstrated in Chapter two, content knowledge learned in an L2 is transferable into the first language. In addition, there are many constraints that prevent students from communicating content knowledge in their L2 that do not exist when doing so in their first language (e.g., limited vocabulary acquisition, longer processing time for reading and writing, difficulties in the readability of tests in translation when compared to the original test), and

3. the hypothesis is testable: The current study examines overall achievement scores and uses inferential statistics to test the statistical relevance of any differences in student achievement on the EQAO assessments.

Statement of Null Hypothesis

The null hypothesis for this study is that there will be no significant difference in FI students' overall achievement scores on the grade 3 EQAO mathematics assessment when FI students who wrote the assessment in French are compared with FI students who wrote the assessment in English. This constitutes an accurate null hypothesis, as the null hypothesis states that there is no relationship between the variables in the population (in this case, student achievement and language of testing); (Ary et al., 2002, p. 108).

Analysis of EQAO Achievement Data

The two groupings of students from this cohort represented samples from a designated population. The population included in this study is comprised of FI students who have experienced similar exposure to the L2, as identified by the number of hours that they have received instruction in the target language (in this case, French). For the purposes of this study a range of 2,930 and 3,420 accumulated hours of instruction in the language of French (which includes instruction of the language of French and instruction of the content areas of the curriculum conducted in French) was initially used as the measure for access into the study. Upon securing participation from amongst eligible school boards, the actual range of accumulated hours of instruction in French for participants in the study ended up being much narrower, within the range of 3,372 and 3,515 hours, meaning that the participants had experienced very similar exposure to learning French-as-a-second language in terms of the amount of time they had been learning in an immersion setting. The maximum difference in

exposure to the target language between participants is 143 hours or 4% over the course of a possible 4 years of study (junior kindergarten, senior kindergarten, grade 1, grade 2, and grade 3). Note that in all cases, the junior and senior kindergarten programs are half time programs.

While the two treatment groups were similar in terms of their exposure to instruction in French-as-a-second language, unfortunately, we do not know how similar the two treatment groups were in terms of their abilities in mathematics prior to the assessment. Data pertaining to the previous achievement in mathematics of participating students in the study were not available as part of the current study.

Within the sample group, all participants wrote the grade 3 EQAO mathematics assessment and all were FI students who had experienced a similar number of hours of instruction in an L2 immersion setting, but participants were exposed to one of two different treatments. Some students wrote the mathematics assessment in English (Group E) while the remainder of participants wrote the assessment in French (Group F).

The assignment of testing language in this study is not strictly random; however, it was not decided upon by any consideration of such predetermined criteria as student ability, socioeconomic status, gender, and so on. Each treatment group is comprised of students of varying academic abilities, socio-economic status, gender, and so on. The decision to complete the assessment in one language over another (French or English) is made by the school board for all FI students within that school board and is not done on an individual student basis. Each school board must decide annually which version of the EQAO mathematics assessment their FI students will write. All FI students within a single school board must write the same version of the assessment--individual schools may not choose for

themselves. In some cases, a school board may make a decision about language of testing based upon previous results on the EQAO achievement tests, but these decisions would be based on a cohort of students that is different from the students who wrote the current assessment. While it is possible that version of testing chosen by the school board may be based on the knowledge of the students in the program, the data collected for the current study do not attempt to identify the criteria that were used in each individual school board in deciding which version of the EQAO mathematics assessment their grade 3 FI students would write.

Within the current study, all participants are FI students with very similar exposure to instruction in the L2, and have all received mathematics instruction in French prior to the assessment. This indicates support for the notion that neither the accumulated hours of instruction in French nor the language of instruction of mathematics were factors in deciding which language would be chosen for the mathematics assessment. One might assume that in cases where students had learned mathematics in French and had experienced the majority of their education in French, the desired language of assessment for mathematics would be French. However, in the current study, we see that despite having similar learning environments (in terms of language of instruction), some school boards opted for the English assessment. This lends some support to the possible randomness of the assignment of language of testing amongst participants in the study. It does not appear that language of instruction or accumulated hours of instruction were determining factors in deciding which version of the test to write in all cases. This may have been a factor in the school boards that chose to write the assessment in French; however, the current study does not include data

that would confirm or reject this assumption, as school boards were not surveyed on this issue.

The total sample size for the study of grade 3 mathematics achievement scores is 156 participating grade 3 FI students. Of that total, the number of participants in Group F is 100 and the number of participants in Group E is 56. Note that only achievement results that scored in the Level 1-4 range were included in the study. In some instances, students scored NEI, which indicates that student response did not include enough information to be scored. This may be because the student response was incomplete, because the student did not provide a response, or because the student was not able to complete all or portions of the assessment due to an absence or other reason. Because the reason for scoring NEI is not known and may be due to absence as opposed to an inability to perform test items, this information was not included in the data of this study.

When the percentages of the number of students achieving at each level are calculated, it is interesting to note that the two groups have almost opposite results in terms of the number of students that achieved at the provincial standard or higher (Levels 3 and 4). Table 2 outlines the percentages of achievement for each treatment group and shows that 60% of Group F students met or exceeded the standards whereas only 41% of Group E students demonstrated achievement at Levels 3 or 4. While these results indicate that students who wrote the mathematics assessment in French demonstrated better achievement, further analysis is required before drawing this as a conclusion. It is important to note that when achievement scores are disaggregated by individual school, the pattern of achievement is similar across 5 of the 6 participating schools for both languages of testing. Table 3 demonstrates the overall EQAO mathematics results of participants by individual school.

Table 2

Overall Achievement Levels of Participants in Percentage by Language of Testing

Level	Group F	Group E
	n = 100	*n* = 56
1	4	9
2	36	50
3	55	41
4	5	0

Note. Option A = EQAO Mathematics test is written in English and language test is written in English. Testing Option B = EQAO Mathematics test is written in French and language test is written in English. Testing Option C = EQAO Mathematics test is written in French and the language test is not written. Hours indicates the total number of accumulated hours of instruction in French that students experienced until the end of grade 3.

Table 3

Overall Gr. 3 Mathematics Achievement Results by School in Percentage

			Achievement Level			
Group	*n*	Hours	1	2	3	4
F_1	39	3,420	8	20	63	8
F_2	20	3,420	0	40	60	0
F_3	24	3,420	6	34	54	6
F_4	17	3,420	0	41	53	6
E_1	39	3,515	12	52	32	0
E_2	17	3,372	0	41	59	0

Note. Group F = schools that administered the French version of the EQAO mathematics assessment. Group E = schools that administered the English version of the EQAO mathematics assessment. The subscript numbers beside each group are used to identify individual schools within the treatment groups. Achievement level refers to the overall individual achievement level scored on the EQAO mathematics assessment. Hours indicates the total number of accumulated hours of instruction in French students experienced until the end of grade 3.

Of the two schools in Group E, School E_1 had only 32% of students achieving at Level 3 whereas all other participating schools had between 53% and 63% of students achieving at level 3. Because the total number of participants in group E is lower than group F, the results of group E_1 decrease the overall results of Group E significantly, which may further account for the perceived negative effects on achievement for students writing the assessment in English. It is beyond the scope of the current study to discuss in detail factors that may have influenced this anomaly in achievement; however, given the fact that a myriad of factors affect student achievement, factors other than language of testing alone may account for this difference in achievement scores. These factors may include (but are not limited to) socioeconomic status, gender, environmental factors (i.e., changes in teacher, changes in mathematics achievement level, lack of instructional resources, etc.), and structure of mathematics instruction. The analysis of teacher questionnaires later in this study may account for some differences; however, the questionnaire did not ask for information on some additional factors (such as those listed) that may have negatively affected the overall achievement of this group of students.

It is worth noting that school E_1 was the school with the highest number of accumulated hours of instruction in French in the study (3,515). In this case, it would seem an intuitive conclusion that had the students participated in the French version of the assessment, perhaps their overall achievement results would have been higher. The reason for choosing the English version of the assessment is not known; however, this particular school board does offer immersion programs in at least one other school where the delivery model is 50% in English and 50% in French from the onset in the Kindergarten years. Because students in that school received only half of their instruction in French, their accumulated

hours of instruction in French would be significantly lower by the end of grade 3 than those who attended school E_1, making the French translation of the test an unsuitable option for those students. It is likely that the school board in this district (which was required to choose one testing option for all FI schools in its jurisdiction) opted for the English version of the assessment to best suit the needs of students in this school, coupled with the existing body of research that indicates that when students learn content in an L2, they are able to transfer and communicate that knowledge in their L1.

Statistical Analysis of Overall Achievement Results

To assess the validity of the overall achievement scores on the EQAO grade 3 mathematics assessment of participants in this study, a *t* test for independent samples was conducted for both groups: those who participated in the English assessment and those who participated in the French assessment.

The overall achievement results for students in both groups were used to calculate the mean achievement scores and the standard deviation for both Group F and Group E using PAWS Statistics version 17. Table 4 shows the overall achievement scores for students in both groups.

The mean score (EQAO level) for students in Group F is 2.61 and the standard deviation is 0.650. The mean score for students in Group E is 2.32 and the standard deviation is 0.636. Based on these calculations, Group F achieved at a higher level than Group E.

Further treatment of the data was undertaken to determine whether this difference was statistically relevant or attributable to chance alone, using an independent *t* test.

In order for an independent *t* test to be used for statistical analysis, the data need to satisfy three assumptions: be fully independent samples, be normally distributed, and have equality

Table 4

Individual Overall Student Achievement Scores by Number of Students and Percentage of Students for Groups F and E

Achievement Level	1	2	3	4
	Group F (n = 100)			
Number	4	36	55	5
Percentage	4	36	55	5
	Group E (n = 56)			
Number	5	28	23	0
Percentage	9	50	41	0

Note. Group F = schools that administered the French version of the EQAO mathematics assessment in 2003-2004; Group E = schools that administered the English version of the EQAO mathematics assessment in 2003-2004.

of variance (Archambault, 2000; Hinton et al., 2004). In the case of the current study, the population being examined is grade 3 FI students who wrote the 2003-2004 EQAO mathematics assessment. Two groups were included, each receiving a different treatment: One group wrote the assessment in English (Group E), and the other group wrote the assessment in French (Group F). This established the criterion of the data being independent.

A histogram and a P-P (probability) plot graph were used to check for normal distribution for both sets of data (mean overall individual mathematics achievement scores for each treatment group). Appendix L shows the results of the histograms for each treatment group. Appendix M shows the results of the normal and detrended P-P plots for Group E and Appendix N shows the results of the normal and detrended P-P plots for Group F. The results of the histogram and the P-P plots support an assumption of normality for both sets of data. As further support, Welkowitz, Ewen, and Cohen (2000) also note that the *t* test is "robust" with regard to the assumption of normality, giving "fairly accurate results even if the assumption is not satisfied" (p. 156).

In order to determine whether or not the data demonstrate an equality of variance, a Levene test was performed. When equal variances are assumed, the Levene test shows equality of variance: that there is no significant difference between the variance of the two sets of data because the "significance" (p value) is 0.835 ($\alpha = 0.05$). This satisfies the Welkowitz et al. (2000) concern that if the sample sizes are quite unequal, the population variances should not differ "markedly" (p. 156). Since all three criteria for the appropriateness of the *t* test as an analysis tool for determining statistical significance were satisfied, a *t* test was conducted.

The standard error of the difference between two means for the independent *t* test was calculated to be 0.107, indicating the difference expected through chance alone if a null hypothesis were true. The actual difference in the mean scores is 0.29, which is higher than the estimated difference due to chance. The *t* test was used to determine the statistical significance of this difference.

The results of the *t* test conducted using PAWS Statistics version 17 software are demonstrated in table 5. The resulting value of $p = 0.008$ demonstrates statistical significance at the 0.05 level, meaning that the estimated probability of the null hypothesis being true is less than 5% and the null hypothesis is rejected. The evidence is significant enough to conclude that the relationship between the variables of language of testing and student achievement is probably not a chance occurrence.

This would indicate that there is a statistically significant difference in student achievement on the Gr. 3 mathematics assessment based on the language of testing. In terms of the results of the current study, this means that the higher mean score achieved by Group F (by 0.29) represents a statistically significant difference, rejecting the null hypothesis. Therefore, when assessing FI students with similar accumulated hours of instruction in French on mathematics items, the language of testing does significantly impact on student achievement in favour of testing in the L2 (French).

These results should, however, be interpreted with caution. It is possible that this conclusion may represent a Type I error (α). A Type I error occurs when a researcher rejects a null hypothesis that is in fact true (Ary et al., 2002, p. 177). A previous study conducted by Turnbull et al. (2001b) supported the null hypothesis of the current study: that there was no significant difference in student achievement amongst immersion students who wrote the

Table 5

Independent t Test for Equality of Mean Overall Achievement Scores Between Groups E and F

					Interval of the difference[a]	
Score	*t*	*df*	*MD*	*SED*	Upper	Lower
Equal variances assumed	2.682	154.000	.289*	.108	.076	.501
Equal variances not assumed	2.699	116.121	.289*	.107	.077	.500

Note. MD = mean difference: SED = standard error difference.

[a]Values represent an interval at 95% confidence.

*p = .008 in both cases

EQAO mathematics assessment in French compared with those who wrote the assessment in English. They also found that amongst students with less than 420 accumulated hours of English, students did better when they wrote the mathematics assessment in English than in French. Because of these differences between the results of the Turnbull et al. study and the current study being undertaken, it is important to use some caution when interpreting the results.

While the effect of language of testing on student achievement has been examined to this point, it is duly noted that the language of testing represents but one variable in the plethora of factors that are related to student achievement.

Summary of Teacher Questionnaire Results

There are a variety of additional variables (including, but not limited to: classroom conditions, major instructional practices, resources, gender, socioeconomic status, etc.) that may contribute to student achievement in mathematics, regardless of the language of testing. In an attempt to identify similarities and differences in classroom settings within the FI context, information was gathered on classroom practices in the form of a questionnaire that was filled out by the teacher of each participating class. For each item on the questionnaire, the teacher identified the frequency of use in his/her classroom using a 4-point Likert scale, with values from 1 (*never*) to 4 (*regularly*). The results of each returned questionnaire are compiled in Tables 6, 7, and 8. Results were grouped by testing type (Group E and Group F). Patterns for the most common responses were identified within each group in order to compare the similarities and differences between groups. In addition, the results were examined to help identify any gaps in classroom practice that may be considered in order to

Table 6

Frequency of Use of Instructional Strategies and Achievement Data in Percentage

	Group F (n = 100)				Group E (n = 56)	
Questionnaire Item	F_1	F_2	F_3[a]	F_4	E_1	E_2
	Frequency of Use					
Textbook activities	4	3	3 3	4	4	4
Mathematics journals	2	3	3 2	2	2	1
Group work	4	3	3 3	4	3	4
Independent worksheets	3	3	4 4	4	4	4
Centres	2	3	1 1	3	2	3
Mathematics walks	2	2	1 1	2	1	3
Literature	3	2	1 2	2	1	3
Mathematics drills	2	3	3 4	1	3	4
Mathematics word wall	4	4	1 3	4	3	4
Other: mathematics games orally						4
Other: oral and written quiz						4
Other: overheads						4
n	39	20	24	17	39	17
% of students achieving Levels 3 and 4	71	60	60	59	32	59

Note. Group F = schools that administered the French version of the EQAO mathematics assessment in 2003-2004. Group E = schools that administered the English version of the EQAO mathematics assessment in 2003-2004. Within each group, individual schools are designated by the subscript numbers that accompany the letters E and F. The numerical scores for each questionnaire result are Likert scale ratings for frequency of use where: 1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *regularly*.

[a]This group includes data from two teachers in the same school.

Table 7

Frequency of Use of Resources and Achievement Data in Percentage

	Group F (n = 100)				Group E (n = 56)	
Questionnaire Item	F_1	F_2	F_3[a]	F_4	E_1	E_2
	Frequency of Use					
Manipulatives	4	4	4 3	3	4	4
Software	1	3	3 2	1	2	3
Exemplar Tasks	1	3	3 2	2	3	3
Previous EQAO Test Units	3	4	4 3	3	3	3
Sample EQAO Units	1	4	4 3	3	3	3
Other: Teacher Made				3		4
n	39	20	24	17	39	17
% of students achieving Levels 3 and 4	71	60	60	59	32	59

Note. Group F = schools that administered the French version of the EQAO mathematics assessment in 2003-2004. Group E = schools that administered the English version of the EQAO mathematics assessment in 2003-2004. Within each group, individual schools are designated by the subscript numbers that accompany the letters E and F. The numerical scores for each questionnaire result are Likert scale ratings for frequency of use where: 1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *regularly*.

[a]This group includes data from two teachers in the same school.

Table 8

Frequency of Use of Textbooks and Achievement Data in Percentage

	Group F (n = 100)				Group E (n = 56)	
Questionnaire Item	F_1	F_2	F_3[a]	F_4	E_1	E_2
	Frequency of Use					
Intéractions	1	1	1 3	4	1	2
Maths Ontario	1	1	1 1	4	1	1
Accent Mathématique	1	1	1 1	2	1	1
Connexions en Mathématique	1	1	1 1	2	1	1
Mathquest (English)	1	1	1 1	1	1	1
Quest 2000 (available in both languages)	4	4	4 1	3	4	4
Journeys in Mathematics (English)	1	1	1 1	1	1	1
Chenelière Mathématiques	1	1	1 1	1	1 4	1
Other: My Ontario Mathematics (English)						
Other: Houghton Mifflin						2
Other: Actimath						2
Other: my own program			4			
n	39	20	24	17	39	17
% of students achieving Levels 3 and 4	71	60	60	59	32	59

Note. Group F = schools that administered the French version of the EQAO mathematics assessment in 2003-2004. Group E = schools that administered the English version of the EQAO mathematics assessment in 2003-2004. Within each group, individual schools are designated by the subscript numbers that accompany the letters E and F. The numerical scores for each questionnaire result are Likert scale ratings for frequency of use where: 1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *regularly*.

[a]This group includes data from two teachers in the same school.

support future change and attempt to positively impact student learning. These will be discussed as part of the recommendations of this study.

Note that in order to participate in the study, each school needed to provide their individual student mathematics results and a completed teacher questionnaire. The number of grade 3 teachers in each school was not identified prior to the study; therefore it is not known how many classes of grade 3 students or how many Grade 3 teachers there were in each school. If the school returned one questionnaire, the data were included in the study. It is likely that schools with higher numbers of students (such as schools F_1 and E_1 that have 39 students each) had more than one grade 3 teacher; however only one teacher returned the survey.

Information pertaining to teaching strategies and resources was gathered through items 4, 5 and 6 of the questionnaire (Appendix E).

Table 6 demonstrates the results of the information pertaining to the use of instructional strategies on the questionnaire (item 4). Upon examination of instructional strategies used, there were trends in both treatment groups towards the frequent use (*regularly* or *sometimes*) of textbook activities, group work, independent worksheets, and mathematics word walls. In both groups, centres were used *sometimes* in half of the classes but were used *rarely* or *never* in the remaining half of the group. Mathematics walks, mathematics drills, and literature were used less often (*rarely* or *never*) in both groups. Generally speaking, the trends in the use of the identified instructional strategies covered the same ranges of popularity within Group E and Group F.

Item 5 of the questionnaire asked teachers to identify other available resources that were used in mathematics instruction. Table 7 shows the questionnaire results for item 5. Group E teachers indicated that exemplar tasks, previous EQAO assessments, and sample EQAO assessments, were used *sometimes*. Group F teachers had a similar trend; however; some teachers indicated more or less frequent use of these resources. In both groups, software was the least frequent used resource. Both groups indicated that mathematics manipulatives were used regularly by most teachers.

Examination of instructional strategies and resources used between the two groups does not appear to indicate a substantial difference in classroom practice between Group E and Group F, leading to the conclusion that, overall, there does not seem to be a single classroom factor that differed between groups that would help account for the student achievement results (positive or negative).

Item 6 looked at the specific textbooks that were used for mathematics instruction. Table 8 shows the results for questionnaire item 6. Given that both treatment groups instructed mathematics in French, the majority of the textbooks listed were in French; however a few English textbooks were listed due to the fact that often, when a resource is not available in French, Immersion teachers will use an English resource for instruction. In this case the instruction would be conducted in French, but the student response sheet or textbook questions would be in English. This notion will be examined further through item 8 of the questionnaire. In both treatment groups, *Quest 2000* was indicated as the most commonly used textbook. In fact, in Group E, all participants indicated using *Quest 2000 regularly* and one school used *Intéractions sometimes* in conjunction with *Quest 2000*. The results for Group F indicated that *Quest 2000* was also the most popular textbook used; however, one

school (F_4) indicated the regular use of *Intéractions* and *Mathematics Ontario* over *Quest 2000*. In all schools, there was a trend towards the frequent use of a variety of textbooks as resource materials. This could be attributed to the fact that teachers may not have class sets of all textbooks but have a few copies of each of the different titles and therefore use material from a variety of sources as they see appropriate. In addition, some textbooks do not provide enough practice on particular concepts to meet the needs of students, so teachers may include activities from a variety of resources to ensure that students have ample opportunity to master concepts. Another reason for this may be that teachers are transitioning to using new resources and are therefore implementing new textbooks by topic or chapter as opposed to fully implementing the single resource in entirety.

All participants in both treatment groups indicated *never* using any of the textbooks *Mathematicsquest*, *Journeys in Mathematics,* or *Chenelière Mathématiques*. In summary, questionnaire results indicate that *Quest 2000* was the most frequently used textbook for instruction for FI students during the 2003-2004 school year. While not indicated on the teacher questionnaire, it is likely that the French version of the textbook was the most used, as all classes were taught in French.

The teacher questionnaire gathered information that pertained to the amount of time each teacher used English as the language of instruction to accommodate student learning, either in classroom activities or through homework. Teachers were asked to identify the percentage range of time they felt that this strategy was used. Table 9 outlines the results for these items. Overall, teachers of both Group E and Group F indicated that a very limited percentage of time (0-20%) was spent using English for instruction to support learning. This strategy is not uncommon in the FI setting. When students experience difficulty

Table 9

Percentage of Time English Used as an Accommodation

	Group F (n = 100)					Group E (n = 56)	
Use of English	F_1	F_2	F_3	F_3	F_4	E_1	E_2
% of time English is spoken	0-20	0-20	0-20	0-20	0-20	0-20	0-20
% of time English tasks assigned	0-20	0-20	0-20	0-20	41-60	0-20	21-40

Note. Group F = schools that administered the French version of the EQAO mathematics assessment in 2003-2004. Group E = schools that administered the English version of the EQAO mathematics assessment in 2003-2004. Within each group, individual schools are designated by the subscript numbers that accompany the letters E and F.

understanding concepts, sometimes individual terms will be identified in English (either by the teacher or the students) to facilitate understanding.

Only one school in each treatment group identified using a higher percentage of time for English, and this was through work that was assigned in English. The questionnaire does not clarify whether or not this would include homework. It may be the case that in the two groups that indicated a higher percentage of English tasks assigned, these tasks were completed as homework and were therefore assigned in English so that the parents of the students could understand and assist their children. It may also be the case that, in some instances, when the teacher does not have any available resources in French to teach a particular concept, an English resource is used.

It would appear that the use of English as a strategy to support immersion students learning mathematics in their L2 was used judiciously by all participants in this study and does not appear to be a significant factor in student achievement.

While the general trends in the results of the information obtained through the information gathered in the teacher questionnaires are similar, further analysis of the relationship between individual class or school results in comparison to specific classroom or school practices may be beneficial in identifying the impact of classroom practice on student achievement. Such analyses are beyond the scope of the current study.

CHAPTER FIVE: CONCLUSIONS AND IMPLICATIONS

This chapter provides a summary of the conclusions that were reached in terms of the research questions that were proposed. The value of the study, implications, and areas for further study will be discussed in this chapter.

Conclusions

The research presented in this study attempted to answer the following questions:

1. How do the results of FI students writing the test in French compare to the results of FI students who write the test in English?
2. Is there a relationship between resources and instructional strategies identified by teachers and the mean achievement scores of students by cohort and language of testing?

In terms of the question of the effect of the language of testing on student achievement results, the data showed that the language of testing has a significant impact on student achievement in favour of writing the EQAO mathematics assessment in French. In the current study, focusing on students who experienced a high degree of their instruction in French, the Grade 3 FI students who wrote the mathematics assessment in French demonstrated a higher overall achievement than their counterparts who wrote the test in English. This conclusion, however, must be drawn with caution. While the mean overall individual achievement scores alone appear to indicate an advantage in favour of the group that performed the assessment in French, we do not know for sure whether this result is due solely to the language of testing. The current study cannot confirm undoubtedly that the lower achievement of the group of students who wrote the assessment in English is attributable to language of testing alone (or at all).

Additional factors may have affected the achievement of this group that have not been analyzed in the current study. These factors may include such variables as socioeconomic status, gender, personality, classroom environment, and relationships with peers and/or teacher. As such, it may be inaccurate to infer that writing the test in French would have produced increased achievement results for this group or for any other group of FI students that participated in a study such as the current one. This is particularly important in light of the research discussed in Chapter two, which indicates that students should be able to perform as well in either language when tested on concepts.

For example, in the case of participants in the current study, we do not know the prior mathematics abilities of participants. While measures were undertaken to ensure similar exposure to learning French, the study did not select participants based on prior mathematics achievement. It may be the case that the two participant groups were not homogeneous in their mathematics ability. It may be that the participants in Group F had stronger mathematical abilities and thus their higher achievement may be a result of prior knowledge as opposed to language of testing.

When comparing the results of the current study to the previous study that was conducted by Turnbull et al. (2001b), it is interesting to note that when examining the results of students with similar exposure to French with those of the current study, the results are completely opposite; students who wrote the assessment in French did markedly worse than those who wrote the test in English (p. 22). Turnbull et al. note that ". . . it seems likely that the result reflects differences among districts unrelated to language of testing" and that the issue requires further examination (p. 22). Turnbull et al. do not speculate as to what those differences might be. In addition, the Turnbull et al. study did not speak to the statistical

significance of the differences in achievement results between the FI groups on the EQAO mathematics assessment. While there was a difference in achievement in favour of those who wrote the test in English, we do not know how statistically significant the differences in achievement were. Turnbull et al. discussed the fact that

> Our Grade 3 data are too limited to draw firm conclusions about the link between language of testing and language of instruction, and student achievement. . .Even though our findings must be interpreted with caution, due to the small number of students who did the mathematics tests in English at Grade 3, our study does corroborate other research with similar findings. Future research could investigate this question more thoroughly should more school boards opt to administer the Grade 3 EQAO mathematics tests in English. (p. 24)

While the current study furthers the research in this area, the results are also to be interpreted with caution. Further investigation is required before a recommendation is made as to the most appropriate language of testing for grade 3 FI students.

In light of this conclusion, it is worth noting that the fact that the current study and the Turnbull et al. (2001b) study found differing results in the achievement of students in relation to language of testing, the coupling of these results lends support to the body of research that indicates that students should be able to perform in either language. Perhaps it is not the language of testing at all that has caused the differences in student achievement but some other variable. Further research is necessary to determine if the language of testing is a variable that affects student achievement.

In terms of classroom practice, results from the teacher questionnaires show general trends towards similar classroom practices across both treatment groups. While there were

some minor fluctuations in results, in general terms, the instructional strategies, resources and textbooks used across the population of this study appear not to have varied enough to account for any differences in student achievement. Since the 2003-2004 assessment and the release of the *Early Mathematics Strategy* (Ontario Ministry of Education, 2003a), the Ontario Mathematics curriculum has been revised. In 2005, a new mathematics curriculum document reflecting the ideas brought forth in the *Early Mathematics Strategy* report was released (Ontario Ministry of Education, 2005b). In addition, during the 2003-2004 school year, the Ministry of Education also released the first *Guide to Effective Instruction in Mathematics: Number Sense and Numeration Grades K-3* (Ontario Ministry of Education, 2003b), a document that identifies best practices in mathematics instruction. Since that time, additional guides to effective instruction in mathematics have been provided to teachers along with in-service training for teachers. Because of these changes in Ontario, the results of the teacher questionnaires may be different in the current teaching climate as teachers have had more training and time to implement additional effective instructional practices. While several of the practices examined in this study continue to be supported as best practice in mathematics instruction in Ontario elementary schools, the frequency of their use and implementation may be different than it was during the 2003-2004 school year. While data gathered in the current study did not reveal any sufficient reason to test for significant differences in practice among FI schools and classrooms, this may or may not continue to be the case in 2009. Further investigation into effective practice would provide additional information that could impact student achievement and overall scores on the EQAO assessments.

The information gathered around the use of English for mathematics in instruction in FI classrooms did not reveal any significant amounts of English being used within the program. We do not know, however, the actual observed amount of time English was used for mathematics instruction amongst participants as the data gathered reflect teachers' perceptions. As previously mentioned, with perceptual data, participants may be reluctant to reveal a choice that may appear to be based on self-interest, prejudice, or lack of knowledge about the item (Ary et al., 2002). If a higher actual percentage of English than that indicated on the questionnaire was actually being used, then this would impact any conclusions drawn about the impact of language of testing on student achievement by way of the fact that this could change the level of homogeneity within the participants in the study in two ways: by changing the accumulated hours of instruction in French and by identifying all participants as having studied mathematics exclusively in French.

Limitations of the Study

It is the nature of quantitative research, such as that undertaken in the current study, to be able to generalize the findings to the larger population (Ary et al., 2002, p. 22). As previously mentioned, however, certain caution must be undertaken when generalizing the results of the current study. As outlined in Chapter two, there are a great number of varying delivery models of FI across the province of Ontario. While the current study looks at students within a specific range of accumulated hours of instruction in French, the results may not necessarily be applicable to FI programs offering different program models that result in accumulated hours of instruction that differ from 3,372 and 3,515.

In addition, the results of the current study apply to students studying in a FI context. The results may or may not apply to students studying in a language immersion program

whereby the first language is not English and the additional language being learned is not French due to variances between linguistic and syntactical aspects of different languages.

Despite identifying subjects for this study within a similar range of accumulated hours of instruction in French, the degree of proficiency in the target language has not been measured aside from this indicator and may therefore also limit the generalizability of any findings.

In addition, it was not possible to measure the mathematics ability levels of participants in the study. Acquiring this information would have been difficult (if even possible at all). In Chapter three I outlined the extensive timelines and effort involved in identifying the parameters for participation in terms of finding grade 3 students with similar accumulated hours of instruction in French-as-a-second language. To add mathematics ability as a factor would have made the task of finding participants nearly impossible. The discussion of the data collected and the conclusions drawn from the data will address the issue of prior mathematics achievement as well as a multitude of other factors in addition to language of testing that may have impacted student achievement on the EQAO mathematics assessment.

The challenges in identifying and securing participants for this study create additional limitations for the interpretation of the results of the study. The focus of the study is on the population of FI students enrolled in early immersion programs that included a high concentration of French instruction in the early grades (within a range of 2,934 and 3,515 accumulated hours of instruction in French until the end of grade 3). This group does not represent the entire population of FI students in Ontario, which limits the representativeness of the sample to the subgroup of the FI population wherein students have studied in an

immersion setting that is defined by the identified range of hours of accumulated hours of instruction. Within this subgroup population, the sample studied (156 participants) does represent a sizeable portion of the total number of students who experienced more than 2,934 accumulated hours of instruction in French. While the randomness of the sample may be questionable for this tightly circumscribed population, the participant group does represent a sizeable portion of that population, which may mean that the results are relatively indicative overall of the population of early immersion students experiencing more than 2,934 accumulated hours of French instruction by the end of grade 3.

Despite the fact that the study briefly explores construct equivalence of translated tests in theory through the review of the literature, the actual assessment tool that was used for the 2003-2004 EQAO mathematics assessment was not analyzed for construct equivalence as part of this study and can therefore not be identified as equivalent or nonequivalent in the English to French translation.

Finally, the data in this study are from 2003-2004. In 2009, we have seen changes to the mathematics curriculum which could have implications in terms of interpreting the results of this study. The curriculum expectations that were in place at the time of this study were revised in 2005. It is important to note that the changes do not reflect a new curriculum but rather a revision of the document that was in place from 1997-2005. Amongst the revisions, there are expectations that have not been changed, expectations that have been combined, and expectations that have been revised to reflect a greater understanding of the processes associated with specific mathematical learning. The revised expectations at the grade 3 level embody a greater emphasis on skills such as: estimating through the use of benchmarks, justifying use of standard units, explaining the relationship between and among

two and three dimensional shapes, using strategies to facilitate computation of whole numbers (i.e., associative property, guess and check), and collecting data that are personally relevant to school/community issues or from the content of another subject (Ontario Ministry of Education, 2005b). Despite the fact that the nature of the expectations has changed, the fact remains that the EQAO assessment that is conducted is based on the expectations that are current for the year in which the assessment is administered. Thus the results generated from the current study will still provide valuable information about the effects of language of testing on mathematics achievement that is transferable to the current Ontario reality of mathematics instruction and learning.

Theoretical Implications

The results of the current study need to be considered in light of Cummins's (1981) interdependence theory, which indicates that some aspects of linguistic proficiency are cross-lingual and that those skills transfer between the two languages that are being learned. In relation to specific academic knowledge, Cummins's theory suggests that students are able to retrieve and express content-specific knowledge in either language and to transfer skills learned in L2 to L1 and vice versa, given adequate levels of proficiency in the first language. In the case of the current study, students who were tested on mathematics content in the same language as that of instruction (as opposed to their first language) were able to better demonstrate mathematical knowledge and understanding as measured by the EQAO achievement tests than their counterparts who completed the EQAO assessment in English. This does not necessarily reject Cummins's hypothesis. A key component of his theory is that this transfer of underlying language skills happens when there is adequate proficiency in both languages. Given the age of participants in this study, it is difficult to determine whether

they have achieved adequate proficiency in either language. Most of these students have received only 1 or 2 years of formal instruction in English, despite the fact that they have well-developed oral language skills as English is their mother tongue. In terms of their proficiency in French, it is difficult to determine if adequate proficiency has been achieved in reading, writing, or oral language by the grade 3 year. Some previous studies have indicated that adequate proficiency in the L2 is not achieved until grade 5 or 6 (Cummins & Swain, 1986), whereas other studies have indicated that proficiency is on par with monolingual counterparts after only one year of formal instruction in English (Bournot-Trites & Reeder, 2001; Genesee, 1987).

Value of the Study

The data collected in this study do raise questions about the impact of test language on students' EQAO mathematics achievement levels. Given the importance placed on EQAO testing and the culture of accountability in the Ontario educational setting, it is critical to ensure the validity and reliability of the data being used to draw general conclusions. The current study reminds us of the importance of considering a multitude of variables that affect student achievement before arriving at general conclusions about student achievement based solely on achievement test scores. The scores derived from the EQAO assessment demonstrate a limited picture of student knowledge and abilities. While the assessment is based in the curriculum that is mandated for instruction throughout the academic year, the assessment task represents a snapshot of time within that instruction. Because the timeframe is limited, the representation of student achievement that is often derived from the overall EQAO assessment scores is limited in scope.

Second, the current study demonstrates the difficulty in generalizing information about the population of students studying in FI programs across Ontario. The preliminary research conducted speaks to the many variances in delivery models that occur across the province, which, in turn, can lead to false conclusions when comparing student achievement data. When the results of FI students are made public, students from all types of immersion programs are identified together under the label of FI. As the preliminary research of this study has demonstrated (Appendix A), the term FI is applied to a variety of second learning situations where the common factor is that a minimum of 50% of the instruction is in the language of French. There are, however, many variations within the delivery models that are being provided, and, as such, significant differences in the amount of accumulated hours of instruction attained by students by the end of grade 3. Because of this, one can assume that this will also create differences in the level of proficiency among students studying in these programs, which may impact upon their ability to perform on the EQAO mathematics assessment. To place all FI results into the same category without consideration for these differences creates unfair comparisons of students. Disaggregating the data by percentage of French instruction would be a step towards providing greater insight into the effects of language of testing on student achievement.

The implications of the preliminary research conducted on program delivery models demonstrate a vast array of delivery models of FI programs across the province of Ontario. This situation can lead to difficulties in making generalizations about FI, especially in the context of reporting province-wide achievement results. The differences also bring to the forefront questions about the standardized curriculum (which includes the same expectations for language acquisition for students at the end of each grade level, regardless of the number

of accumulated hours of instruction in French) as well as concerns around the development of appropriate resources to support learning and instruction. These differences are important considerations at the Ministry, school board, and school level if systematic improvement in FI student achievement is to be attained. During the publication of this study, the information gathered in Appendix A has been shared with officials at the Ministry of Education with the hope that this information will have some positive impact on the process of the current curriculum revisions that are under way.

The results from the teacher questionnaires give some insight into the available resources for FI programming. While a variety of instructional practices, resources, and textbooks were examined, the results indicated that only a limited number of items are in use in FI programs. The question that arises as a result of this is, why is this the case? Several conclusions may be drawn, including the consideration that the number of resources available to immersion schools is more limited than those available to their English-streamed counterparts. A second possible conclusion is that in many boards, the immersion schools are much fewer in number than the English schools and are therefore more isolated and independent, meaning that their knowledge of available resources and their access to professional learning opportunities that are related specifically to their specialized teaching situation may be limited in comparison to their English counterparts. Finally, despite the myriad of comprehensive mathematics resources that have been provided by the Ministry of Education since the release of the *Early Mathematics Strategy* (2003a), there have not been any resources that directly address the issues around learning content in an L2 through a FI context. While the appendices of the *Guide to Effective Instruction in Mathematics* (2003b) have been translated into French, there remains to be any literature produced that provides

support or instructional strategies to address the specific needs of teachers and students learning mathematics in a FI context, limiting the potential for systematic changes in instruction that could benefit student achievement.

Implications of the Literature and the Study

The literature reviewed in conjunction with this study brings forth some crucial issues for consideration when interpreting EQAO data, particularly in the context of a FI setting.

Literature defining the abilities of L2 learners to demonstrate knowledge in understanding in L1 that is presented in this study clearly indicates that L2 students with little or no formal instruction are able to perform tasks in L1 at parity with their English counterparts. In fact, the research supports the notion that after 1 or 2 years of formal instruction in English, students perform as well or better that their English counterparts from the same cohort (Baker, 2006; Bournot-Trites & Reeder, 2001; Genesee, 1987). The implications of this information could have a significant influence on the future direction of FI delivery models and on decisions concerning the most appropriate language in which to assess students. Schools, school boards, teachers, parents, and other stakeholders need to take this research data under serious consideration.

The current study brings to light variables that affect student achievement that are specific to the specialized nature of the FI context. A key area for consideration is the cognitive functions required to comprehend content in an L2. The literature indicates that it takes between 6 and 7 years of instruction to develop native-like abilities in L2, and even at that, most L2 learners will require longer (Baker 2006; Cummins & Swain, 1986). This has serious implications for the demands that completing the EQAO mathematics assessment in French places on FI students, especially at the grade 3 level.

In addition, the research indicates that reading and processing information in an L2 requires longer periods of time than in first language. This is a serious consideration for FI students who are writing achievement tests in French. The FI research indicates that in order to be able to perform at parity with their monolingual counterparts, FI students may require additional time, an accommodation that is not standard on the EQAO mathematics assessment.

Finally, the body of research presented on construct equivalence of translated achievement tests brings to the forefront the need for careful consideration when comparing results of tests administered in translation. The evidence cannot emphatically rule out the possible additional complications that can occur when writing a translated version of a test, nor can they empirically state that writing a translated version of a test does not disadvantage achievement, even when the translated test is written by a subject who is a native speaker of the language. The implications of this information, specifically in relation to the EQAO assessment, should be taken seriously by all stakeholders.

Recommendations for Further Study

The current study brings to light several areas for further study that could help clarify the issues around the impact of language of testing and student achievement.

First, the current study examined overall test scores as a measure of achievement. Future studies may benefit from looking at student performance on individual test questions and compare results by category rather than overall achievement to see if there are specific areas where student achievement varies between the languages of testing. This type of research may help better identify the types of test items that are impacted by the language of testing and may also provide valuable insight for stakeholders as to specific areas for focused

instruction. This type of study could also lead to the development of targeted instructional strategies that may lead to improved mathematics achievement for FI students.

Second, it was difficult to compare students within a range of accumulated hours of instruction because, despite identifying an appropriate range, the levels of experience in the target language may still have varied, and that variance may have had an impact on student achievement. Future studies may consider using subjects from a smaller population in which all students have encountered a more homogeneous experience with the target language.

Given the importance of construct equivalence with translated tests, a study of the EQAO assessment tool itself that compared the English version of the test with its translated equivalent would be beneficial as to identifying the reliability and validity of the test in translation. Such study would need to consider the similarities and differences between the two languages in terms of word difficulty, accuracy of translation, consistency of content, format, and cultural relevance. Establishing the level of consistency between the original test and the translated test could contribute to a more accurate comparison of achievement data between tested groups.

While the general trends in the results of the information obtained through the teacher questionnaires are similar, further analysis of the relationship between individual class or school results in comparison to specific classroom or school practices may be beneficial in identifying the impact of classroom practice on student achievement. Further study could include a direct comparison between the individual student results and instructional practices within a specific classroom or school. In addition, collecting data on classroom practice by observation (instead of perception) would assist in identifying the connection between instructional practice and student achievement which could, in turn, give greater insight into

effective classroom practices that could have a positive impact on student achievement. This would be particularly beneficial in the current context of the Ontario education system that has a direct focus on data-driven instruction, professional learning communities, and school improvement planning that is based on in-depth analysis of student achievement on the EQAO assessments.

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Appendix A

FI Delivery Models by Board

SCHOOL BOARD	CENTRAL LOCATION	Entry Points Offered					Delivery Model (% in French)										EQAO Option 2003-2004
		Grade Level					Grade Level										
		JK	SK	1	4	5	JK	SK	1	2	3	4	5	6	7	8	
Algoma District School Board	Sault Ste. Marie		☑	☑				100	100	100	100	75	75	50	50	50	C
Algonquin and Lakeshore Catholic District School Board	Napanee	☑	☑					50	50	50	50	50	50	50	50	50	A
Avon Maitland District School Board	Seaforth			☑													A
Bluewater District School Board	Chesley		☑				100	100	100	100	80	50	50	50	50	50	C
Brant Haldimand Norfolk Catholic District School Board	Brantford	☑	☑	☑			100	100	100	80	80	70	70	70	50	50	A
Bruce-Grey Catholic District School Board	Hanover		☑	☑				75	75	75	75	70	70	70	50	50	B
Catholic District School Board of Eastern Ontario	Kemptville			☑					50	50	50	50	50	50	50	50	N/A
District School Board of Niagara	St. Catharines					☑	N/A -extended French only										N/A
Dufferin-Peel Catholic District School Board	Mississauga					☑	N/A -extended French only										N/A
Durham Catholic District School Board	Oshawa				☑		N/A -extended French only										N/A
Durham District School Board	Whitby			☑					100	100	100	75	50	50	50	50	C
Grand Erie District School Board	Brantford	☑	☑	☑			100	100	100	80	80	75			50	50	C
Greater Essex County District School Board	Windsor	☑	☑	☑			20	80	80	75	75	75	75	50	50	50	B
Halton Catholic District School Board	Burlington					☑	N/A -extended French only										N/A
Halton District School Board	Burlington			☑					70	50	50	50	50	50	50	50	A

SCHOOL BOARD	CENTRAL LOCATION	Entry Points Offered					Delivery Model (% in French)										EQAO Option 2003-2004
		Grade Level					Grade Level										
		JK	SK	1	4	5	JK	SK	1	2	3	4	5	6	7	8	
Halton District School Board	Burlington			☑					70	50	50	50	50	50	50	50	A
Hamilton-Wentworth Catholic District School Board	Hamilton		☑					100	50	50	50	50	50	50	50	50	N/A
Hamilton-Wentworth District School Board	Hamilton		☑	☑				100	100	90	90	80	80	50	50	50	B
Hasting & Prince Edward District School Board	Belleville					☑		N/A- extended French only									N/A
Huron Perth Catholic District School Board	Dublin								75-80	75-80	75-80	75-80	50-60	50-60	50-60	50-60	A
Huron-Superior Catholic District School Board	Sault Ste. Marie	☑															A
Kawartha Pine Ridge District School Board	Peterborough		☑	☑			100	100	100	100	80						B
Keewatin-patricia District School Board	Kenora																B
Kenora Catholic District School Board	Kenora																B
Lakehead District School Board	Thunder Bay		☑					100	100	75	75	75	75	60	60	60	B
Lambton Kent District School Board	Sarnia	☑	☑	☑			100	100	100	100	50	50	50	50	50	50	B
Limestone District School Board	Kingston	☑	☑	☑			100	100	100	100	80						B
London Catholic District School Board	London	☑	☑	☑			90	90	90	90	90						C
Near North District School Board	North Bay	☑	☑				100	100	90	90	75	75	50	50	50	50	B

SCHOOL BOARD	CENTRAL LOCATION	Entry Points Offered					Delivery Model (% in French)										EQAO Option 2003-2004
		Grade Level					Grade Level										
		JK	SK	1	4	5	JK	SK	1	2	3	4	5	6	7	8	
Niagara Catholic District School Board	Welland						N/A- extended French only										N/A
Nipissing-Parry Sound Catholic District School Board	North Bay	☑	☑				50	50	90	90	70	70	70	70	50	50	B
Northeastern Catholic District School Board	Timmins	☑	☐	☑			50	50	50	50	50	50	50	50	50	50	A
Northwest Catholic District School Board	Fort Frances			☑					70	50	50	50	50	50	50	50	A
Ottawa-Carleton Catholic District School Board	Nepean	☑			☑		50	50	25	25	80	50 for Gr. 4 entry					A
Ottawa-Carleton District School Board	Nepean		☑	☑				100	100	80	gradual decrease			50	50	50	B
Peel District School Board	Mississauga			☑					90	50	50	50	50	50	50	50	A
Peterborough Victoria Northumberland and Clarington Catholic DSB	Peterborough		☑					90	90	80	gradual decrease				50	50	B
Rainbow District School Board	Sudbury	☑	☑				25-100	100	95	80	70	70	70	60	60	60	B
Rainy River District School Board	Fort Frances																N/A
Renfrew County Catholic District School Board	Pembroke																A
Simcoe County District School Board	Midhurst					☑	N/A- extended French only										N/A
Simcoe Muskoka Catholic District School Board	Barrie																N/A
St. Clair Catholic District School Board	Wallaceburg																B
Sudbury Catholic District School Board	Sudbury	☑	☑				90	90	77	77	65	65	55	55	55	55	A

SCHOOL BOARD	CENTRAL LOCATION	Entry Points Offered					Delivery Model (% in French)										EQAO Option 2003-2004
		Grade Level					Grade Level										
		JK	SK	1	4	5	JK	SK	1	2	3	4	5	6	7	8	
Superior North Catholic District School Board	Terrace Bay	varies by school-JK-Gr. 3 100% or 50/50															
Superior-Greenstone District School Board	Marathon																C
Thames Valley District School Board	London		☑	☑			70 % French- Max. 30% English										C
Thunder Bay Catholic District School Board	Thunder Bay		☑				90	90	70	60	60						B
Toronto Catholic District School Board	Toronto		☑				100	100	100	100	75	75	50	50	50	50	C
Toronto District School Board	Toronto			☑		☑	100	100	100	100	100	decrease		50	50	50	C
Trillium Lakelands District School Board	Lindsay		☑	☑			varies across the board										C
Upper Canada District School Board	Brockville	☑	☑	☑				50	50	50	50	50	50	50	50	50	C
Upper Grand District School Board	Guelph		☑	☑				100	100	100	80	80	75	70	40	40	B
Waterloo Catholic District School Board	Kitchener	n/a-extended French only															N/A
Waterloo Region District School Board	Kitchener			☑			50	50	50	50	50	50	50	50	50	50	C
Wellington Catholic district School Board	Guelph																N/A
Windsor-Essex Catholic District School Board	Windsor	☑		☑			70	70	70	70	70	60	60	60	50	50	A
York Catholic District School Board	Aurora	no French Immersion															N/A
York Region District School Board	Aurora			☑					100	100	100	80	decrease		50	50	C

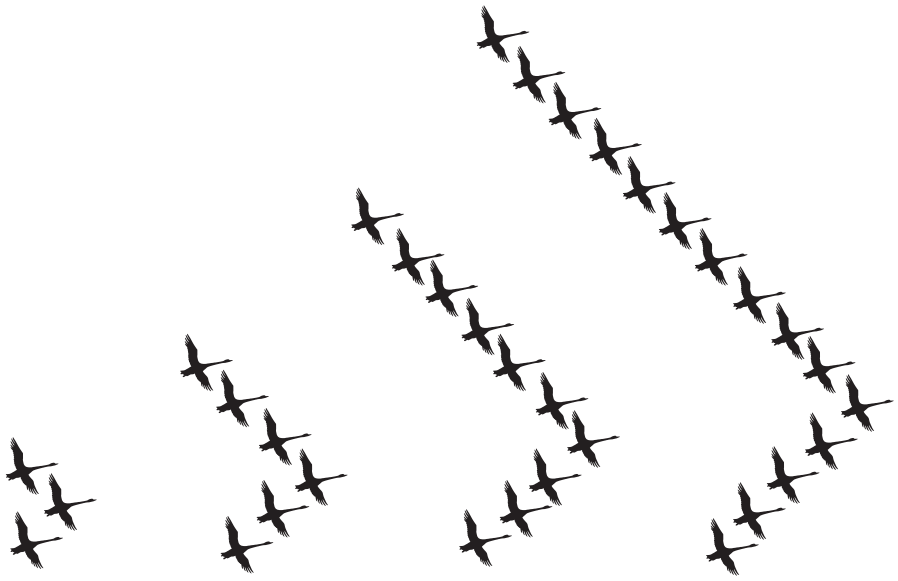
Appendix B

Sample EQAO Mathematics Investigation (English)

Investigation 2

Goose Activities

1. The students in Mrs. Cameron's class notice geese flying in V-patterns.



Flock 1 **Flock 2** **Flock 3** **Flock 4**

✷ Complete the chart below for 7 flocks of geese.

Flock	Number of Geese in Each Flock
1	
2	
3	
4	
5	
6	
7	

Look back at the drawing and the chart on page 10.

Describe all the patterns that you see.

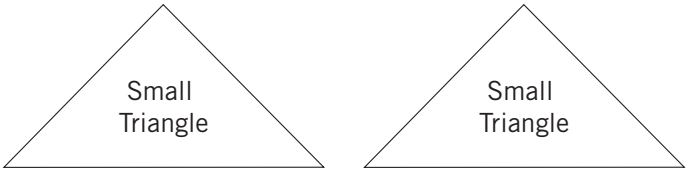
2. Jake wonders how tall a real goose is.

He thinks a goose is about 200 cm tall.

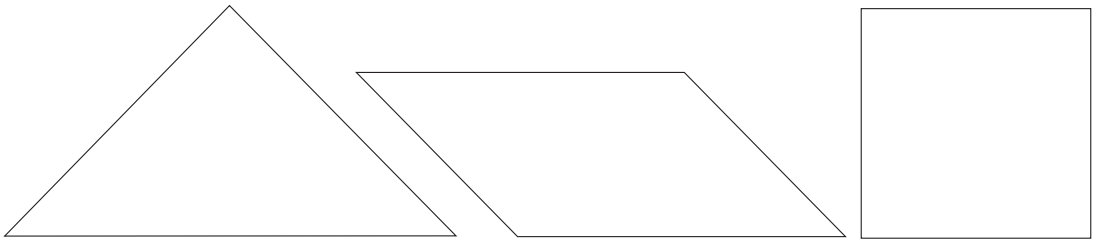
✷ Is this a reasonable estimate?

Explain your thinking.

3. The students are using tangrams to learn about symmetry.



✷ Make the shapes below using the two small triangles.



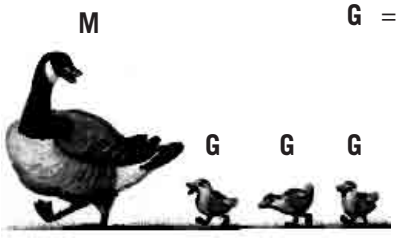
Mai Lin thinks that by tracing the small triangles inside the medium shapes above she can show that they all have a line of symmetry.

✷ Is she right?

Explain the strategy you used to solve this problem.

4. The mother geese and their goslings are out for a walk.

M = Mother
G = Gosling

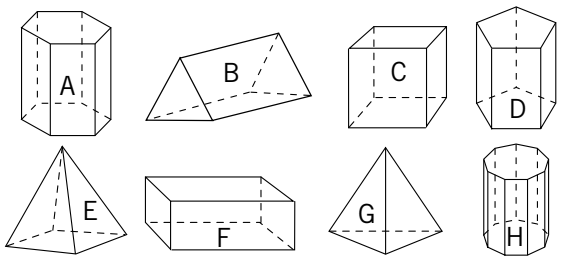


✷ There are 7 mothers (M), each with the same number of goslings. How many goslings (G) will there be altogether?

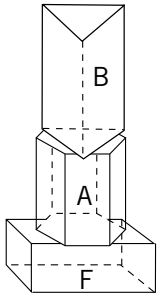
Show your work.

There will be _____ goslings (G) altogether.

5. The students like to sort 3-D solids. Here are some of the solids they use.



The students sort some of the 3-D solids into a group.



Their group is **B, A, F.** These shapes have 2 attributes in common.

Their sorting rule is _____ and

_____ .

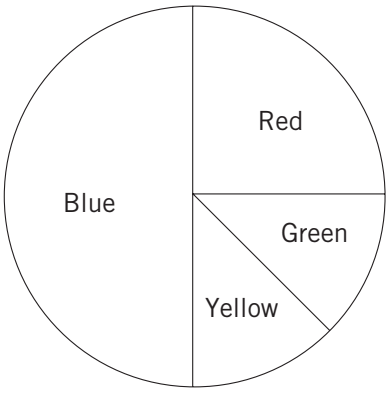
✷ Choose a **different** group of shapes that have at least 2 attributes in common.

My group is _____.

My sorting rule is _____ and

_____.

6. Here is a spinner for a game the students play.



✷ If you spin the spinner **8** times, how many times is it likely to land on **each** colour?

Explain how you solved this problem.

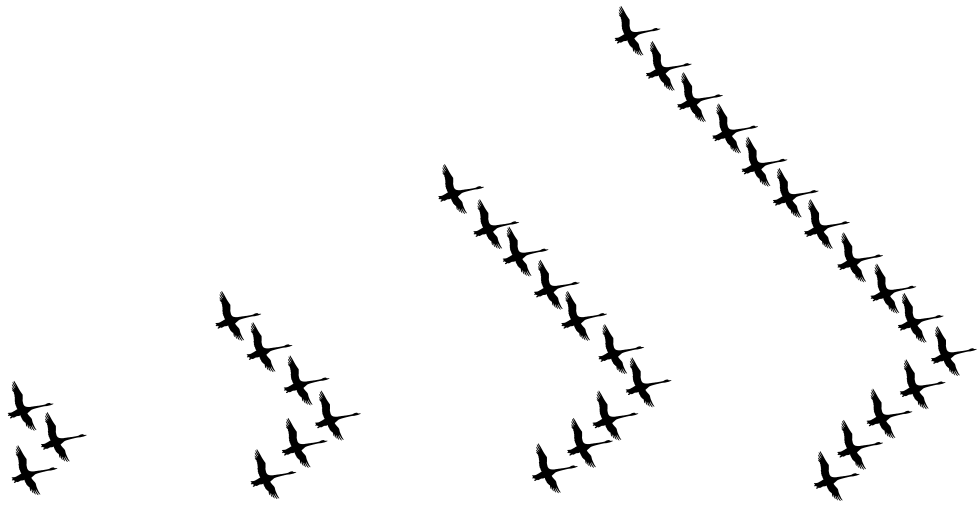
Appendix C

Sample EQAO Mathematics Investigation (French)

Investigation nº 2

Les activités des oies

1. Les élèves de la classe de M^me^ Cameron remarquent des oies qui volent en V.



Volée 1 **Volée 2** **Volée 3** **Volée 4**

✷ Complète le tableau ci-dessous pour 7 volées d'oies.

Volée	Nombre d'oies dans chaque volée
1	
2	
3	
4	
5	
6	
7	

Regarde le dessin et le tableau à la page 10.

Décris toutes les suites que tu vois.

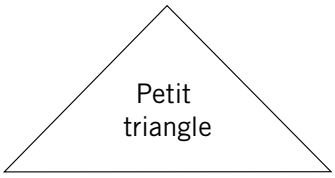
2. Jake se demande quelle est la grandeur réelle d'une oie.

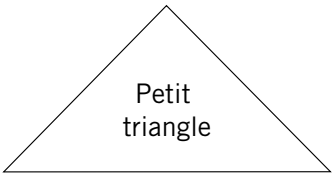
Il pense qu'une oie mesure à peu près 200 cm.

✷ Est-ce que c'est une estimation raisonnable?

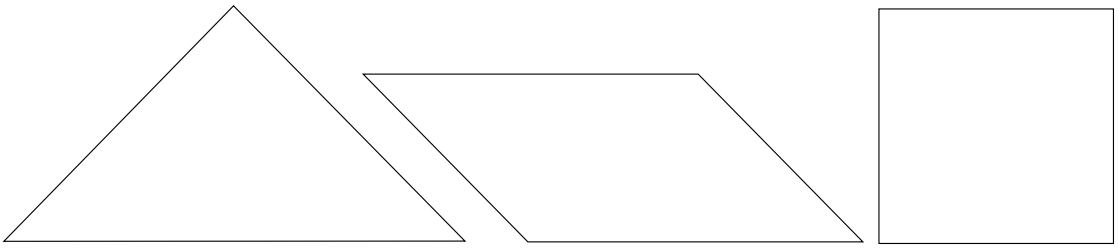
Explique ta réponse.

3. Les élèves utilisent des tangrams pour apprendre la symétrie.





✷ Construis les formes ci-dessous en utilisant les deux petits triangles.



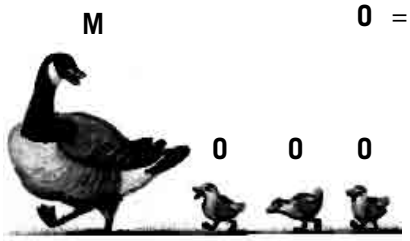
Mai Lin pense qu'en traçant les petits triangles dans les formes de taille moyenne ci-dessus, elle peut montrer que toutes les formes ont un axe de symétrie.

✷ Est-ce qu'elle a raison?

Explique la stratégie que tu as utilisée pour résoudre ce problème.

4. Les mamans oies et leurs oisons se promènent.

M = maman
O = oison

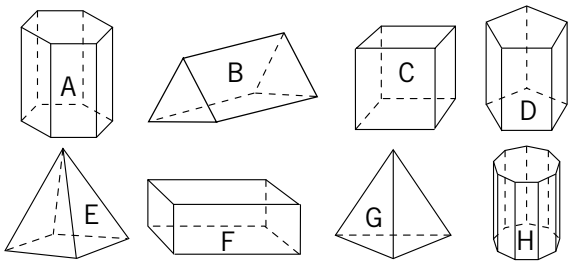


✷ Il y a 7 mamans (M) et chacune d'elles a le même nombre d'oisons. Combien d'oisons (O) y a-t-il en tout?

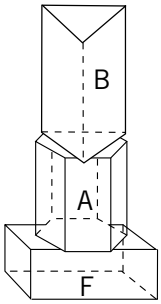
Montre ton travail.

Il y aura _____ oisons (O) en tout.

5. Les élèves aiment classer des solides. Voici quelques-uns des solides qu'ils utilisent.



Les élèves classent quelques solides dans un groupe.



Leur groupe est **<u>B, A, F</u>.** Ces formes ont 2 attributs en commun.

Leur règle de classement est _____ et

_____.

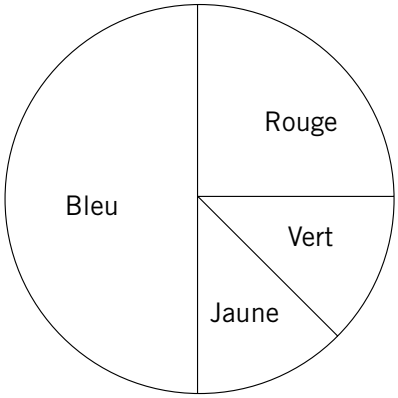
✷ Choisis un groupe **différent** de formes qui ont au moins 2 attributs en commun.

Mon groupe est _____.

Ma règle de classement est _____ et

_____.

6. Voici une roulette avec laquelle les élèves jouent.



✷ Si tu fais tourner la roulette **8** fois, combien de fois est-il probable que la roulette s'arrête sur **chaque** couleur?

Explique comment tu as résolu ce problème.

Appendix D

Glossary of Terms

Glossaire de termes mathématiques anglais à français – 3e année

(Veuiller noter que ceci n'est pas une liste exhaustive)

A

addition.....une addition
area.....une aire, l'aire
arrow (on a spinner) .....une aiguille, une roulette

B

bar graph .....un diagramme à bandes
base .....la base

C

calculator.....la calculatrice
centre.....le centre
change.....la monnaie
chart.....un tableau
check.....vérifier
circle .....un cercle, encercler
circular .....circulaire
classify.....classifier
coin .....une pièce de monnaie
column.....une colonne
congruent.....congruent(e)
count .....compter
counters.....des jetons

D

data.....des données
diagonal .....une diagonale
diagram .....un diagramme
digit .....un chiffre

E

edge.....une arête
end point .....une extrémité
equilateral triangle.....un triangle équilatéral
(an) estimate .....une estimation
(to) estimate.....estimer
even number.....un nombre pair

F

fair.....juste
fewer .....moins de
flip.....une réflexion, un rabattement

G

geometric shape .....une figure géométrique
graph.....un diagramme
greater than (>) .....plus grand que (>)
grid.....une grille
growing pattern .....une suite croissante

H

height .....la hauteur
hundreds.....des centaines

L

label.....étiqueter
length .....la longueur
less than (<).....plus petit que (<) moins de (<)
line of symmetry .....un axe de symétrie

M

make change.....rendre la monnaie
mass..... la masse
measurement .....les mesures, les dimensions

N

number ..... un nombre
number line.....une droite numérique
number sentence.....une expression numérique

O

odd number .....un nombre impair
ones .....des unités

P

pattern.....une suite, une régularité
  growing pattern .....une suite croissante
pattern blocks .....des blocs logiques
patterning.....faire une suite
perimeter.....le périmètre
predict .....prédire

R

rectangular prism .....un prisme rectangulaire
result.....un résultat
rotation .....une rotation
rough .....rugueux
row .....une rangée

S

shape ..... une forme, une figure géométrique
slide.....une translation, un glissement
sort.....classer, classifier, trier
spinner.....une roulette
square .....un carré
square-based pyramid .....une pyramide à base carrée
subtraction..... une soustraction
survey.....un sondage

T

tally chart .....un tableau de pointage
tens.....des dizaines
thickness.....une épaisseur
triangular-based pyramid.....une pyramide à base triangulaire
triangular prism .....un prisme triangulaire
turn.....une rotation

U

unit of measurement.....une unité de mesure

V

Venn diagram.....un diagramme de Venn

W

weighs .....pèse
whole number .....un nombre entier
width.....la largeur

Glossaire de termes mathématiques français à anglais – 3e année

(Veuiller noter que ceci n'est pas une liste exhaustive)

A

une addition.....addition
une aiguille.....arrow (on a spinner)
une aire, l'aire.....area
une arête.....edge
un axe de symétrie.....line of symmetry

B

la base.....base
des blocs logiques.....pattern blocks

C

la calculatrice.....calculator
un carré.....square
des centaines.....hundreds
le centre.....centre
un cercle.....circle
un chiffre.....digit
circulaire.....circular
classer.....sort
classifier.....classify
une colonne.....column
compter.....count
congruent(e).....congruent

D

une diagonale.....diagonal
un diagramme.....diagram, graph
un diagramme à bandes.....bar graph
un diagramme de Venn.....Venn diagram
les dimensions.....measurement
des dizaines.....tens
des données.....data
une droite numérique.....number line

E

encercler.....circle
une épaisseur.....thickness
une estimation.....an estimate
estimer.....to estimate
étiqueter.....label
une expression numérique.....number sentence
une extrémité.....end point

F

faire une suite.....patterning
une figure géométrique.....geometric shape
une forme.....shape

G

un glissement.....slide
une grille.....grid

H

la hauteur.....height

J

des jetons.....counters
juste.....fair

L

la largeur.....width
la longueur.....length

M

la masse ..... mass
les mesures ..... measurement
moins de ..... fewer
la monnaie ..... change

N

un nombre ..... number
un nombre entier ..... whole number
un nombre impair ..... odd number
un nombre pair ..... even number

P

le périmètre ..... perimeter
pèse ..... weighs
une pièce de monnaie ..... coin
plus grand que (>) ..... greater than (>)
plus petit que (<) ..... less than (<)
prédire ..... predict
un prisme rectangulaire ..... rectangular prism
un prisme triangulaire ..... triangular prism
une pyramide à base carrée ..... square-based pyramid
une pyramide à base triangulaire ..... triangular-based pyramid

R

un rabattement ..... flip
une rangée ..... row
une réflexion ..... flip
une régularité ..... pattern
rendre la monnaie ..... make change
un résultat ..... result
une rotation ..... rotation, turn
une roulette ..... spinner
rugueux ..... rough

S

un sondage ..... survey
une soustraction ..... subtraction
une suite ..... pattern
une suite croissante ..... growing pattern

T

un tableau ..... chart
un tableau de pointage ..... tally chart
une translation ..... slide
un triangle équilatéral ..... equilateral triangle
trier ..... sort

U

une unité de mesure ..... unit of measurement
des unités ..... ones

V

vérifier ..... check

Appendix E

Teacher Questionnaire

Questionnaire for Grade 3 Teachers

This study is designed to compare the EQAO mathematics results of students in Grade 3 and to look at teaching methods and programs that are utilized to instruct mathematics. Please answer all applicable questions and return the questionnaire in the enclosed self-addressed stamped envelope. The anonymity of all respondents will be guaranteed. Completion and return of this survey will be considered consent to participate in the study.

BACKGROUND INFORMATION:

1. School name:_____

   Board of Education name:_____

   Please indicate your 2-digit homeroom identification number from the 2004 Assessment (these are the 8th and 9th digits in the student bar codes as listed on the Detailed Student Results Report)._____

2. Please outline your delivery model for each grade level, as set by your school board:

	Percentage of time taught in French	Percentage of time taught in English
Junior Kindergarten	_____	_____
Kindergarten	_____	_____
Grade 1	_____	_____
Grade 2	_____	_____
Grade 3	_____	_____

3. Please list the language of instruction for mathematics in each grade (circle E for English or F for French):

	JK	K	Gr.1	Gr.2	Gr.3
Mathematics	E F	E F	E F	E F	E F

TEACHING STRATEGIES AND RESOURCES

4. Which of the following instructional strategies did you use to instruct mathematics in your classroom during the 2003-2004 school year? (Please circle the most appropriate response for each item)

Strategy	Frequency of Use			
	Never	Rarely	Sometimes	Regularly
Textbook Activities	1	2	3	4
Math Journals	1	2	3	4
Group Work	1	2	3	4
Independent worksheets	1	2	3	4
Centres	1	2	3	4
Math Walks	1	2	3	4
Literature	1	2	3	4
Math Drills	1	2	3	4
Math Word Wall	1	2	3	4
Other (specify):				
_____	1	2	3	4
_____	1	2	3	4
_____	1	2	3	4

5. Which of the following resources did you use to instruct mathematics in your classroom during the 2003-2004 school year?

Resource	Frequency of Use			
	Never	Rarely	Sometimes	Regularly
Manipulatives	1	2	3	4
Software	1	2	3	4
Exemplar tasks	1	2	3	4
Previous EQAO test units	1	2	3	4
Sample EQAO test unit	1	2	3	4
Other (specify):				
_____	1	2	3	4
_____	1	2	3	4
_____	1	2	3	4

6. Which Math textbooks and programs did you use for teaching Mathematics during the 2003-2004 school year?

Title	Frequency of Use			
	Never	Rarely	Sometimes	Regularly
Intéractions	1	2	3	4
Maths Ontario	1	2	3	4
Accent Mathématiques	1	2	3	4

Connexions en Mathématiques	1	2	3	4
Mathquest	1	2	3	4
Quest 2000	1	2	3	4
Journeys in Math	1	2	3	4
Chenelière Mathématiques	1	2	3	4
Other (specify):				
_____	1	2	3	4
_____	1	2	3	4
_____	1	2	3	4

7. During what percentage of your math time did you speak English to your students to reinforce math concepts taught in French in the 2003-2004 school year? (Circle one)

0-20% 21-40% 41-60% 61-80% 81-100%

8. During what percentage of time do you assign mathematical tasks in English (in class or as homework) to your students to reinforce concepts taught in French in the 2003-2004 school year? (Circle one)

0-20% 21-40% 41-60% 61-80% 81-100%

Many thanks for your time and co-operation. If you would like a copy of this study to be sent to your school upon completion, please include your school address here:

_____

_____

_____

_____

Thank you for your time and assistance. You are assured that no board, school, teacher or student names will be included in the final report.

Appendix F

Permission to Involve Human Subjects in Research

NIPISSING UNIVERSITY ETHICS COMMITTEE

ETHICAL REVIEW DECISION

Title: "Grade 3 EQAO Mathematics Achievement Testing: A Comparison of French Immersion Student's Results by Language of Testing "

Principal Researcher: **Dr. Doug Franks /Andrea Smith**

Faculty/Department: **Masters of Education**

Date of Review Decision: **September 24, 2004**

The Ethical Review Committee has completed the examination of your research proposal. As Chair, it is my pleasure to inform you that your proposal meets all the requirements of the ethical review.

Best Wishes with your research

Sincerely,

Dr. Steven High, Chair

100 College Drive, Box 5002, North Bay, ON P1B 8L7
tel: (705) 474-3450 . fax: (705) 474-1947 . tty: (705) 474-8797
internet: www.nipissingu.ca

Appendix G

Letter to School Boards (Permission to Do Research)

Dear Member(s) of the Research Approval Committee;

I am currently a Master of Education student at Nipissing University (Wilfred Laurier Campus, Brantford, Ontario). As part of the requirement for my degree, I have chosen to undertake a research study that will lead to the completion of a thesis.

My proposed topic of research is "Grade 3 EQAO Mathematics Achievement Testing: A Comparison of French Immersion Students' Results by Language of Testing." I am writing to ask permission to seek information from the French Immersion schools within your board. Please find attached a copy of Ethical Approval from Nipissing University. Within that information, you will find a copy of the introductory letter and survey questionnaire that will be provided to each participating administrator and Grade 3 teacher.

Purpose of the Study

The purpose of the study is to compare the results of Grade 3 French Immersion students who wrote the test in English with the results of Grade 3 French Immersion students who wrote the test in French to determine if there is a significant difference in student achievement on the EQAO Mathematics assessments at the Grade 3 level as related to the language of classroom mathematics instruction and the language of testing. The study will also look at classroom instructional practices and resources and their relation to student achievement on the EQAO Mathematics assessment.

Procedures

To participate in this study, each French Immersion teacher who administered the 2003-2004 Grade 3 assessment in your board will be asked to complete the attached questionnaire, which will take approximately 30-45 minutes, and return it. Each participating administrator (principal or vice-principal) will be asked to return a copy of the Detailed Students Results report of Grade 3 student individual achievement levels in mathematics for the May 2004 assessment. If this report is not available, any EQAO report that lists the Grade 3 individual overall mathematics achievement may be substituted. Student names must **not** appear on the report. A copy of the letters for teachers and administrators has been included in this package.

Potential Benefits to Subjects and/or Society
The study will discuss any significant differences in student achievement in relation to the language of testing, classroom resources and instructional practices and will make recommendations based on findings that may help improve student achievement on the Grade 3 EQAO mathematics assessment.

Participation and Withdrawal
Participation in the study will be on a voluntary basis, as no compensation will be provided to participants.
Participants may withdraw at any time without consequences of any kind and may exercise the option of removing their data from the study. They may also refuse to answer any question they don't want to answer and still remain in the study.

Confidentiality
Board names, school names, teacher names and student names will not be identified in the study. All information collected will be analyzed and viewed by the researcher only and will be stored in a locked filing cabinet for the duration of the research. Final disposal of questionnaires and student achievement reports will include shredding of documents and submission for confidential waste within the researcher's school board upon completion of the final report.

Upon completion of the research, a copy of this report will be provided to each participating school board, and individual schools will receive a copy on a per request basis.

I thank you in advance for your time and consideration. Please do not hesitate to contact my supervisor or me should you require any additional information.

Andrea Smith (researcher)
M. Ed. Candidate
Nipissing University
École Dufferin School
106 Chestnut Ave
Brantford, ON N3T 4C6
(519) 752-8232

Dr. Doug Franks (Thesis Supervisor)
Faculty of Education
Nipissing University
100 College Drive, Box 5002
North Bay, ON Canada P1B 8L7
(705) 474 3461 Ext. 4457

Appendix H

Reminder Letter to Participating School Boards

Dear Principal:

You are asked to participate in a research study entitled "Grade 3 EQAO Mathematics Achievement Testing: A Comparison of French Immersion Students' Results by Language of Testing," being conducted by Andrea Smith, a graduate student from the Faculty of Education at Nipissing University, as a requirement for a Master of Education thesis. This study has been approved by the Nipissing University Ethics Committee and (insert name of board official and title) from your school board, as per the attached information. (A copy of the Board Approval will be attached)

•Purpose of the Study

The purpose of the study is to compare the results of Grade 3 French Immersion students who wrote the test in English with the results of Grade 3 French Immersion students who wrote the test in French to determine if there is a significant difference in student achievement on the EQAO Mathematics assessments at the Grade 3 level as related to the language of classroom mathematics instruction and the language of testing. The study will also look at classroom instructional practices and resources and their relation to student achievement on the EQAO Mathematics assessment.

•Procedures

To participate in this study, please forward the Detailed Students Results report of Grade 3 EQAO student individual achievement levels in mathematics for the 2003-2004 testing year in the enclosed return envelope. This report is available by http://eqaoweb.eqao.com, using your user ID and password. If this report is not available, any EQAO report that lists your Grade 3 individual overall mathematics achievement may be substituted. Student names must **not** appear on the report. Please make sure that your school name appears on the report. While this information will be necessary for the statistical analysis of results in the study, your school name will not appear in the final report.

Please distribute one copy of each of the enclosed letter to teachers, teacher questionnaires and self-addressed stamped envelopes to each teacher that administered the Grade 3 EQAO assessment in May of 2004. Each participating teacher is asked to complete a questionnaire, which will take approximately 30-45 minutes, and to return it to the researcher in the enclosed self-addressed stamped envelope.

•Potential Benefits to Subjects and/or Society

The study will discuss any significant differences in student achievement in relation to the language of testing, classroom resources and instructional practices and will make

recommendations based on findings that may help improve student achievement on the Grade 3 EQAO mathematics assessment.

•Payment for Participation
Participation in this study is on a volunteer basis, as no monetary compensation will be provided.

•Confidentiality
Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. School names, teacher names, student names and board names will not be identified in the study. All information collected will be analyzed and viewed by the researcher only and will be stored in a locked filing cabinet for the duration of the research. Final disposal of questionnaires and student achievement reports will include shredding of documents and submission for confidential waste within the researcher's school board upon completion of the final report.

•Participation and Withdrawal
If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study.

•Rights of Research Subjects
You may withdraw your consent at any time and discontinue participation without penalty. This study has been reviewed and received ethics clearance through Nipissing University's Research Ethics Committee. If you have questions regarding your rights as a research participant, contact:

Research Ethics Co-ordinator
Nipissing University
North Bay, ON
P1B 8L7

Telephone: 705-474-3461 #4558
E-mail: ethics@nipissingu.ca

A copy of the final report will be provided at your request. If you would like to receive a copy, please include a note of request and your address in the envelope with the students' results. The report will be sent attention principal.

Once again, be assured that no board, school, teacher or student names will be included in the final report.

If you have any questions or concerns about the research, please feel free to contact:

Andrea Smith (researcher)
M. Ed. Candidate
Nipissing University
École Dufferin School
106 Chestnut Ave
Brantford, ON N3T 4C6
(519) 752-8232

Dr. Doug Franks (Thesis Supervisor)
Faculty of Education
Nipissing University
100 College Drive, Box 5002
North Bay, ON Canada P1B 8L7
(705) 474 3461 Ext. 4457

Appendix I

Letter to Principals (Participation in Research)

Dear Principal:

You are asked to participate in a research study entitled "Grade 3 EQAO Mathematics Achievement Testing: A Comparison of French Immersion Students' Results by Language of Testing," being conducted by Andrea Smith, a graduate student from the Faculty of Education at Nipissing University, as a requirement for a Master of Education thesis. This study has been approved by the Nipissing University Ethics Committee and (insert name of board official and title) from your school board, as per the attached information. (A copy of the Board Approval will be attached)

•Purpose of the Study

The purpose of the study is to compare the results of Grade 3 French Immersion students who wrote the test in English with the results of Grade 3 French Immersion students who wrote the test in French to determine if there is a significant difference in student achievement on the EQAO Mathematics assessments at the Grade 3 level as related to the language of classroom mathematics instruction and the language of testing. The study will also look at classroom instructional practices and resources and their relation to student achievement on the EQAO Mathematics assessment.

•Procedures

To participate in this study, please forward the Detailed Students Results report of Grade 3 EQAO student individual achievement levels in mathematics for the 2003-2004 testing year in the enclosed return envelope. This report is available by http://eqaoweb.eqao.com, using your user ID and password. If this report is not available, any EQAO report that lists your Grade 3 individual overall mathematics achievement may be substituted. Student names must **not** appear on the report. Please make sure that your school name appears on the report. While this information will be necessary for the statistical analysis of results in the study, your school name will not appear in the final report.

Please distribute one copy of each of the enclosed letter to teachers, teacher questionnaires and self-addressed stamped envelopes to each teacher that administered the Grade 3 EQAO assessment in May of 2004. Each participating teacher is asked to complete a questionnaire, which will take approximately 30-45 minutes, and to return it to the researcher in the enclosed self-addressed stamped envelope.

•Potential Benefits to Subjects and/or Society

The study will discuss any significant differences in student achievement in relation to the language of testing, classroom resources and instructional practices and will make recommendations based on findings that may help improve student achievement on the Grade 3 EQAO mathematics assessment.

•Payment for Participation
Participation in this study is on a volunteer basis, as no monetary compensation will be provided.

•Confidentiality
Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. School names, teacher names, student names and board names will not be identified in the study. All information collected will be analyzed and viewed by the researcher only and will be stored in a locked filing cabinet for the duration of the research. Final disposal of questionnaires and student achievement reports will include shredding of documents and submission for confidential waste within the researcher's school board upon completion of the final report.

•Participation and Withdrawal
If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study.

•Rights of Research Subjects
You may withdraw your consent at any time and discontinue participation without penalty. This study has been reviewed and received ethics clearance through Nipissing University's Research Ethics Committee. If you have questions regarding your rights as a research participant, contact:

Research Ethics Co-ordinator
Nipissing University
North Bay, ON
P1B 8L7

Telephone: 705-474-3461 #4558
E-mail: ethics@nipissingu.ca

A copy of the final report will be provided at your request. If you would like to receive a copy, please include a note of request and your address in the envelope with the students' results. The report will be sent attention principal.

Once again, be assured that no board, school, teacher or student names will be included in the final report.

If you have any questions or concerns about the research, please feel free to contact:

Andrea Smith (researcher)
M. Ed. Candidate
Nipissing University
École Dufferin School
106 Chestnut Ave
Brantford, ON N3T 4C6
(519) 752-8232

Dr. Doug Franks (Thesis Supervisor)
Faculty of Education
Nipissing University
100 College Drive, Box 5002
North Bay, ON Canada P1B 8L7.
(705) 474 3461 Ext. 4457

Appendix J

Letter to Teachers (Participation in Research)

Dear Grade 3 Teacher;

You are asked to participate in a research study entitled "Grade 3 EQAO Mathematics Achievement Testing: A Comparison of French Immersion Students' Results by Language of Testing," being conducted by Andrea Smith, a graduate student from the Faculty of Education at Nipissing University, as a requirement for a Master of Education thesis. This study has been approved by the Nipissing University Ethics Committee and (insert name of board official and title) from your school board, as per the attached information. (A copy of board approval will be attached)

•Purpose of the Study

The purpose of the study is to compare the results of Grade 3 French Immersion students who wrote the test in English with the results of Grade 3 French Immersion students who wrote the test in French to determine if there is a significant difference in student achievement on the EQAO Mathematics assessments at the Grade 3 level as related to the language of classroom mathematics instruction and the language of testing. The study will also look at classroom instructional practices and resources and their relation to student achievement on the EQAO Mathematics assessment.

•Procedures

To participate in this study, each teacher who administered the 2003-2004 Grade 3 assessment in your school will be asked to complete the attached questionnaire, which will take approximately 30-45 minutes, and return it in the enclosed envelope. Note that completion and return of the questionnaire indicate consent of the teacher to participate in the research.

•Potential Benefits to Subjects and/or Society

The study will discuss any significant differences in student achievement in relation to the language of testing, classroom resources and instructional practices and will make recommendations based on findings that may help improve student achievement on the Grade 3 EQAO mathematics assessment.

•Payment for Participation

Participation in this study is on a volunteer basis, as no monetary compensation will be provided.

Confidentiality

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. School names, teacher names, student names and board names will not be identified in the study. Board names, school names, teacher names and student names will not be identified in the study. All information collected will be analyzed and viewed by the researcher only and will be stored in a locked filing cabinet for the duration of the research. Final disposal of questionnaires and student achievement reports will include shredding of documents and submission for confidential waste within the researcher's school board upon completion of the final report.

- Participation and Withdrawal

If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any question you don't want to answer and still remain in the study.

•Rights of Research Subjects

You may withdraw your consent at any time and discontinue participation without penalty. This study has been reviewed and received ethics clearance through Nipissing University's Research Ethics Committee. If you have questions regarding your rights as a research participant, contact:

Research Ethics Co-ordinator
Nipissing University
North Bay, ON
P1B 8L7

Telephone: 705-474-3461 #4558
E-mail: ethics@nipissingu.ca

A copy of the final report will be provided at your request. If you would like a copy, please indicate so in the appropriate space on the teacher questionnaire. The report will be sent attention grade 3 teacher.

Once again, be assured that no board, school, teacher or student names will be included in the final report.

If you have any questions or concerns about the research, please feel free to contact:

Andrea Smith (researcher)
M. Ed. Candidate
Nipissing University
École Dufferin School
106 Chestnut Ave
Brantford, ON N3T 4C6
(519) 752-8232

Dr. Doug Franks (Thesis Supervisor)
Faculty of Education
Nipissing University
100 College Drive, Box 5002
North Bay ON Canada P1B 8L7
(705) 474 3461 Ext. 4457

Appendix K

Reminder Letter to Principals (Request for Questionnaire)

Dear (Principal's name):
Thank you for sending me your EQAO individual student results for the study "Grade 3 EQAO Mathematics Achievement Testing: A Comparison of French Immersion Students' Results by Language of Testing", that I am conducting as a requirement for a Master of Education thesis at the Faculty of Education at Nipissing University. To date, I have not received any teacher questionnaires from your school. In order to include your school's data in my research, I need at least one teacher questionnaire to be completed and returned. I realize that this is a very busy time of the year; however, I would appreciate it if you could ask you Grade 3 teachers to forward a completed copy of the questionnaire (see enclosed for additional copies and self-addressed, stamped envelopes) at their earliest convenience.

I would again like to thank you in advance for your participation in this study. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. School names, teacher names, student names and board names will not be identified in the study. All information collected will be analyzed and viewed by the researcher only. Final disposal of questionnaires and student achievement reports will include shredding of documents and submission for confidential waste within the researcher's school board upon completion of the final report.

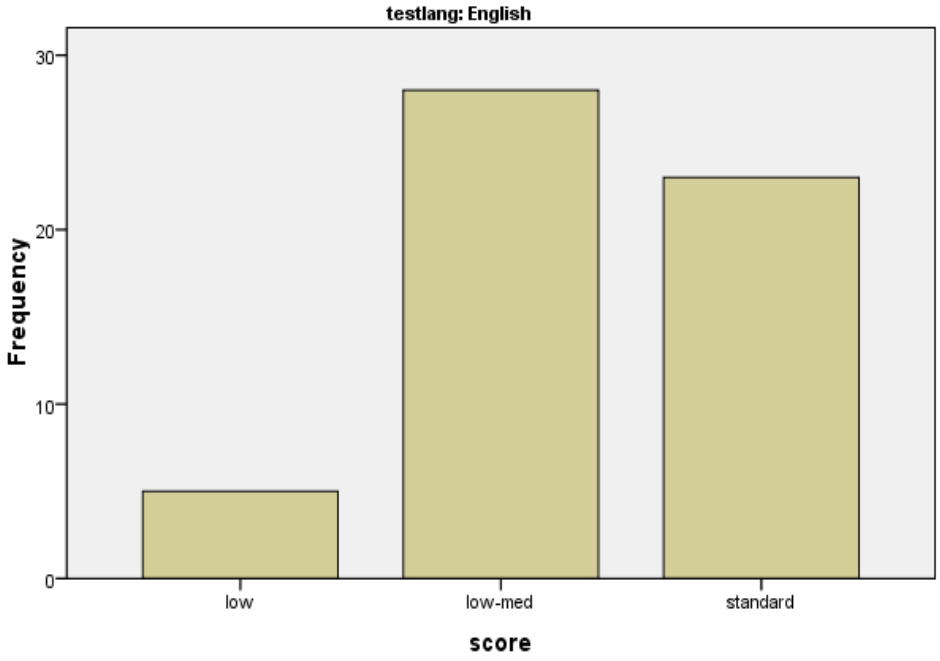
Sincerely,

Andrea Smith (researcher)
M. Ed. Candidate
Nipissing University
École Dufferin School
106 Chestnut Ave
Brantford, ON N3T 4C6
(519) 752-8232

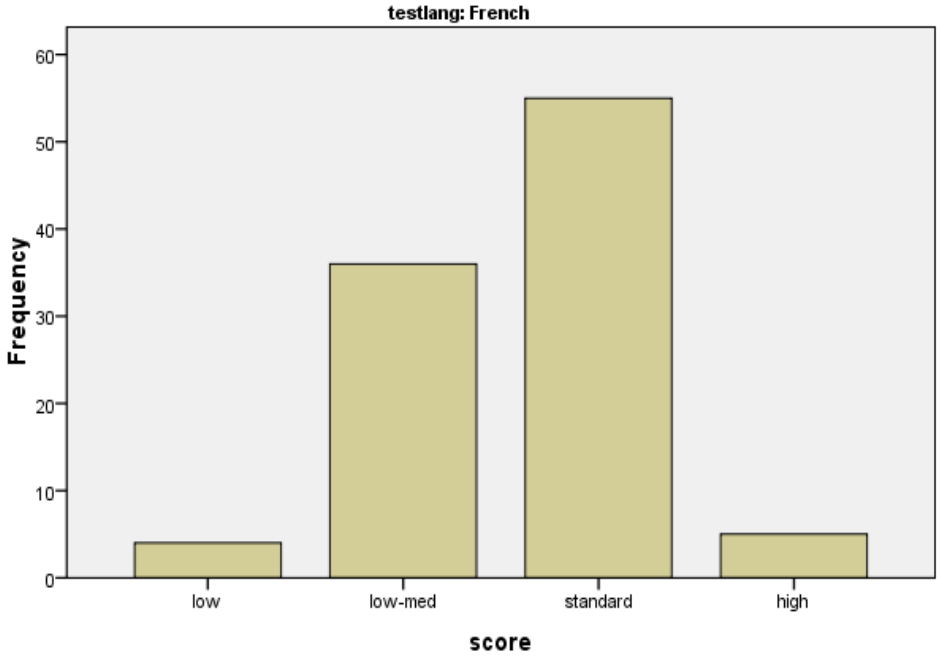
Appendix L

Histograms of Mean Achievement Scores

score

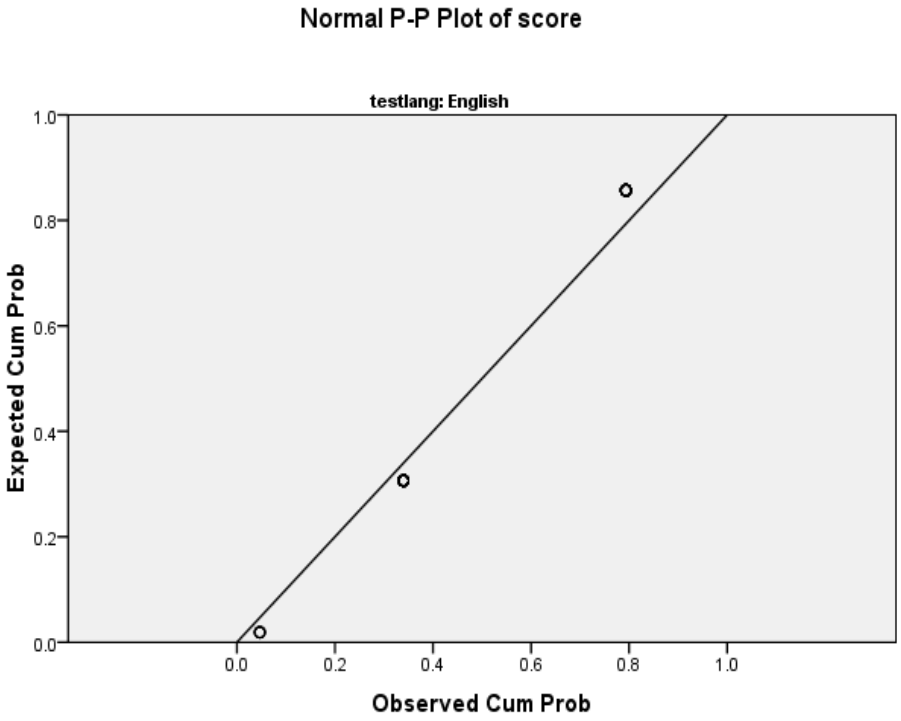

testlang: English
Frequency
30
20
10
0
low
low-med
standard
score

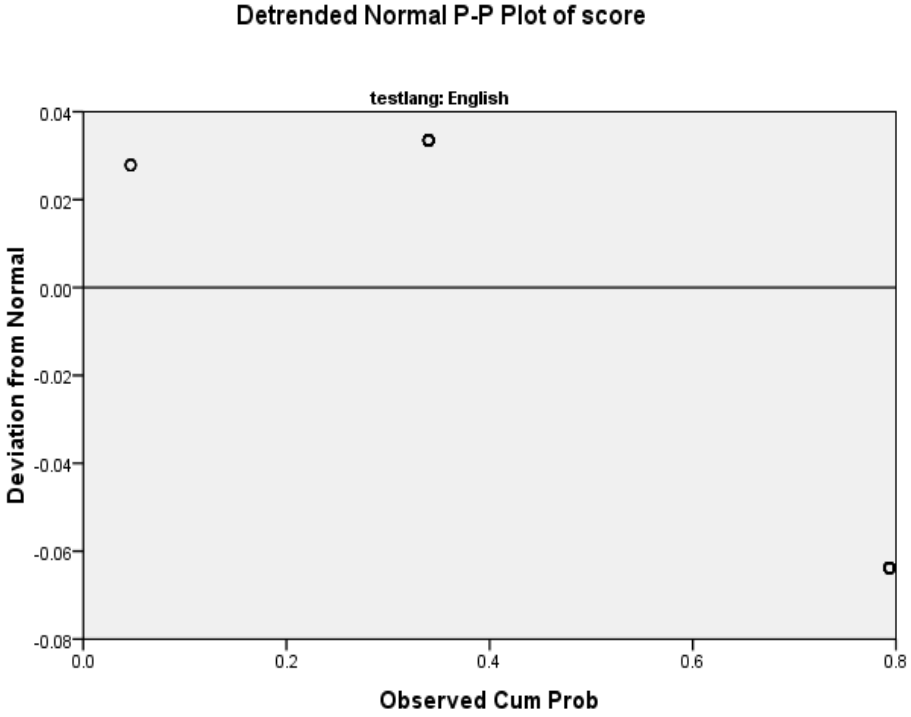
score


testlang: French
Frequency
60
50
40
30
20
10
0
low
low-med
standard
high
score

Appendix M

Normal and Detrended P-P Plot Scores for Group E

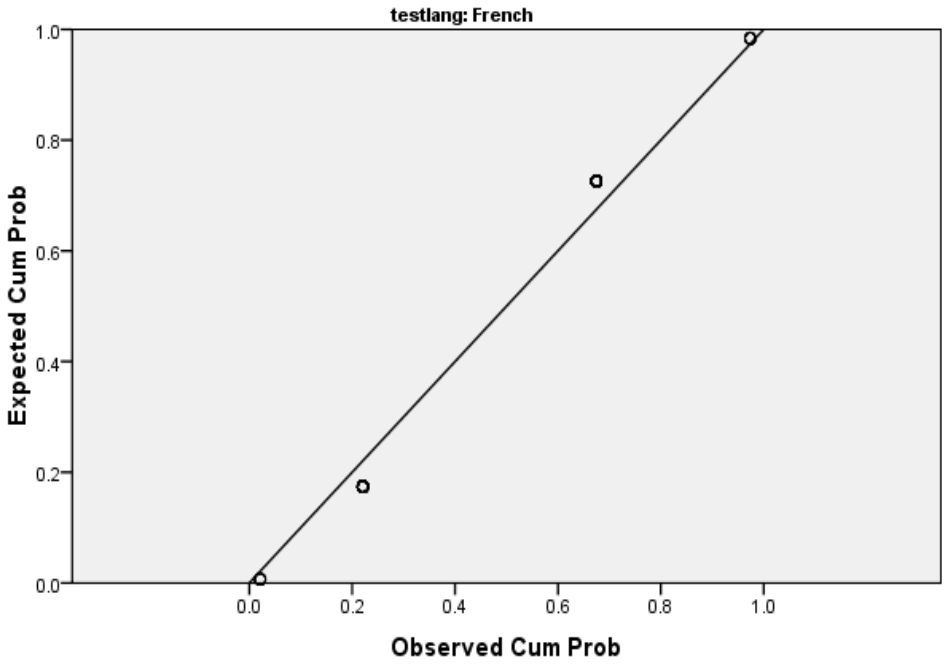

Normal P-P Plot of score
testlang: English
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of score
testlang: English
Deviation from Normal
Observed Cum Prob
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
0.0
0.2
0.4
0.6
0.8

Appendix N

Normal and Detrended P-P Plot Scores for Group F

Normal P-P Plot of score



Detrended Normal P-P Plot of score