LARGE-SCALE ASSESSMENT AND MATHEMATICS TEACHER PRACTICE: A CASE STUDY WITH ONTARIO GRADE 9 APPLIED TEACHERS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This qualitative study examines the connections between teachers' views of large-scale assessment and their classroom practice, based on a case study of Ontario teachers and the Ontario Education Quality and Accountability Office [EQAO] Grade 9 Applied Assessment of Mathematics. Large-scale assessments are a prominent aspect of the Ontario education system; given that they are also mandatory, it is imperative that their impact on teaching be documented. This study enriches the existing literature on the topic of the Grade 9 EQAO Assessment of Mathematics, and provides a more-recent portrayal of the teachers' views of this assessment and the potential impact of these views on classroom teaching by highlighting teacher attitudes, concerns, and classroom practices.

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CHAPTER 1: INTRODUCTION

Brief description

This study examines connections between teachers' views of a large-scale assessment and their classroom practices through a case study of a professional learning community. This case study involved Ontario teachers and examined Grade 9 mathematics teachers' views of the Grade 9 Applied Education Quality and Accountability Office [EQAO] mathematics assessment, and if and how these views interact with classroom teaching practices. Large-scale assessments are a prominent aspect of the Ontario education system. Although various research studies discuss the relationship between large-scale assessment and teaching practices in general, little research on this topic has been conducted within the context of Ontario specifically (Volante, 2007). Since the EQAO assessments are mandatory, and since they are an external influence to the classroom, I believe it is beneficial to see what connections might exist between teachers' views about the EQAO assessments, and their teaching practices. While some research that looks at teacher views of the Grade 9 EQAO Assessment of Mathematics exists, it consists of research that was conducted in 2002, 2006, and 2010 respectively –the last one being 8 years ago. Thus, by conducting my research on this topic, and building on the work of previous researchers, I hoped not only to enrich the existing literature on the topic of the Grade 9 EQAO Assessment of Mathematics, but more importantly, to provide a more-recent portrayal of the teachers' opinion of this assessment, and the possible impact on classroom teaching.

Personal interest

As a high school teacher of English and Mathematics, I am very interested in the topic of large-scale assessment. During my Teacher Education program, my thinking about large-scale assessment was challenged. As I became familiar with concepts of differentiated instruction and the use of a variety of assessments in the classroom, I also became more hesitant to acknowledge the benefits and necessity of large-scale pen-and paper assessments that test students on specific skills and subjects. Thus, I am using my research in hopes to help me better understand other perspectives about large-scale assessment, and the implications that large-scale assessment have on teaching practices.

In my teaching experience, I have assisted with the EQAO assessments in a variety of roles. Specifically, I acted as a scribe for the Grade 3 and 6 reading, writing, and mathematics

assessments. As a scribe, I was responsible for working one-on-one with a student during the assessment and my sole responsibility was to write, word for word, whatever the student instructed me to write. In a different school, I acted as a facilitator for the Grade 10 Ontario Secondary School Literacy Test. My responsibilities included not only distributing and collecting the assessments to and from the students, but also counting all the assessments within the school and locking them away safely, to ensure that no assessments were misplaced or mishandled, before they were sent for marking by EQAO.

As an initiation to my research and as part of my qualitative research course work, I conducted a small research project examining teachers' perceptions of the EQAO assessments; specifically, the participants of this research included one Grade 3 elementary teacher, four Grade 9 mathematics teachers, and one Grade 10 English teacher. The teachers interviewed during this initial study held generally negative views about the EQAO assessments and the effects of these assessments on students. When asked to describe the assessments, teachers used terms such as "stressful", "restricting", "irrelevant", and "inconsistent". Some of the participants also admitted that in the weeks prior to the assessment, they spent entire days doing test preparation and practice questions with their students, mimicking EQAO structure and administration process. When asked if they have ever prioritized EQAO material over other classroom activities, one elementary teacher responded: "Of course! After March other subjects that are not tested on, tend to get pushed to the back burner (Science and Social Studies). The classroom takes a language and math focus with the plan on catching up on the other subjects in June" (JL, Grade 3 teacher, email response).

The findings of this small research project led me to think about the relationships that may exist between teachers' opinions of the EQAO and their teaching practices in the classroom; it also persuaded me to dig deeper into this topic. For this reason, I constructed my thesis study to include a larger sample of participants and more-focused research questions.

Purpose of the study and research questions

This study provides insight into Grade 9 mathematics teachers' views regarding the mandatory Grade 9 EQAO Assessment of Mathematics and helps to fill a gap in the research literature. Furthermore, this study investigates the ways in which teachers' views of this assessment influence and/or interact with their teaching practices in the classroom. The study was guided by the following research questions:

1) How do Grade 9 mathematics teachers view the Grade 9 EQAO Assessment of Mathematics?

- What do teachers perceive to be some of the benefits and concerns of this assessment?

2) In what ways, if any, do teachers' views of the mandatory Grade 9 EQAO mathematics assessment interact with their teaching practices in the classroom?

Overview of the dissertation

My thesis consists of 8 chapters. In the first chapter, I discuss the purpose of the study, my personal interest, and reveal the research questions guiding my study. In the second chapter, I discuss the Grade 9 EQAO Assessment of Mathematics by first providing a history of EQAO and then discussing the Grade 9 assessment specifically, and issues concerning its validity. In Chapter 3, I present a review of the existing literature pertinent to my study; this chapter is divided into two sections, one that explores teacher views of large-scale assessment and the other that explores the impact of large-scale assessment. My theoretical framework and the guiding principles for my study are presented in Chapter 4. Chapter 5 discusses the research design for my study; specifically, I discuss the ways I selected the data to work with, and describe my journey through data analysis. My findings are discussed in Chapter 6, while Chapter 7 consists of a discussion of my findings and answers my research questions; this chapter also connects my research to the existing literature. Lastly, Chapter 8, consists of some personal wonderings, as well as a discussion of the limitations, contributions and implications, and suggested future research.

CHAPTER 2: THE CONTEXT OF EQAO

This chapter provides an overview of the Education Quality and Accountability Office (EQAO), before it digs more deeply in to the Grade 9 EQAO Assessment of Mathematics. I begin this chapter with a history of the EQAO assessments, from their creation, to the way that they are implemented today. Then, I proceed to discuss the Grade 9 EQAO assessment specifically, and the way that the assessment is created, administered, and marked. Lastly, I discuss the validity of the Grade 9 EQAO Assessment of Mathematics by drawing on studies conducted on this topic.

EQAO: A brief history

A little over twenty years ago, large-scale assessments were introduced in the Ontario classrooms as an attempt to create an improved education system (Volante, 2007). In 1996, due to an increased demand from parents and public "for more accountability and clearer and better information about the quality and effectiveness of the province's publicly funded education system" (EQAO, 2013, p. 5)**,** the Government of Ontario established the Education Quality and Accountability Office [EQAO], an independent agency with a mandate to "support and guide student improvement by providing credible information about the quality of the province's publicly funded elementary and secondary education system" (EQAO, 2013, p. 5).

Since EQAO was created, four large-scale assessments have been developed; these assessments test students on curriculum-based content according to their grade level (EQAO, 2013). The testing is mandatory for all publicly-funded schools, and very few students are exempt from participating. The province-wide testing in Ontario consists of the following assessments: Grades 3 and 6 in Reading, Writing, and Mathematics, Grade 9 in Mathematics (Applied and Academic courses only), and in Grade 10 the Ontario Secondary School Literary Test (OSSLT), a high-stakes assessment which is a requirement for high school graduation. The Grades 3, 6, and 9 assessments are considered relatively low-stakes since the results of these assessments are considered to have "no official influence on individual student achievement" (Klinger & Luce-Kapler, 2007, p. 31).

With the exception of the field test questions, all students in Grades 3, 6 and 10 receive the same assessment, while students in Grade 9 receive either the Academic or Applied version of the mathematics assessment, based on the mathematics course they take. Different versions of

all of these assessments exist for English and French language schools, and a process is in place for students who require accommodations when writing any of the EQAO assessments. The assessments vary in format but generally consist of multiple choice as well as open-ended questions. EQAO also administers a questionnaire collecting additional data from students, teachers, and principals respectively. The student questionnaire is specific to each student and generally poses questions related to students' personal feelings and thoughts towards mathematics, their perceived mathematical abilities, and their extracurricular activities –to name a few. The teacher and principal questionnaires are more broad and cover different topics; some of the questions refer to how often teaching and administrative staff may have met to discuss various school-wide topics, including EQAO, while other questions refer to the students' attitude towards the school and their peers, etc. The questions, as well as the responses to these questionnaires are readily available on the EQAO website.

EQAO provides the results of the assessments several months into the school year that follows the year in which they were administered. Individual student scores are received by teachers and schools, as well as students and their families; school and school board results are made public on the EQAO website (EQAO, 2013). Since the school and school board results are available for public access, the media often use these reports for comparison and ranking purposes (Cowley & Easton, 2008b, as cited in Koch, 2010; Neill, 2008). In addition to assessment results, EQAO provides teachers and school administrators with a summary of the questionnaire data from students and teachers as well as an online EQAO Reporting tool, both of which serve to assist with school and school board improvement plans (EQAO, 2005; EQAO, 2013). Teachers have access to an EQAO Reporting tool to track their students' achievement on the EQAO assessments across Grades 3, 6, and 9 at an individual level; teachers can also use this tool to look at students' "attitudinal and behavioral information" (EQAO, 2017, p.2) from the EQAO student-administered questionnaires –although it is not made explicit whether this specific information is reported on an individual level or a school-wide level. Therefore with the use of the EQAO Reporting tool, and other reports provided by the EQAO, teachers can look at EQAO data and use it to make informed decisions about how to more proactively teach their students.

Context: The Grade 9 EQAO Assessment of Mathematics

The Grade 9 EQAO Assessment of Mathematics was designed to assess students on knowledge and skills in accordance with certain overall and specific expectations of the Grade 9 mathematics curriculum (EQAO, 2009). In Ontario, Grade 9 and 10 mathematics courses are divided into 3 streams, namely Academic, Applied, and Locally Developed. The curriculum suggests that Academic-level courses focus more on theory and abstract concepts of mathematics, whereas the Applied-level courses focus on practical applications of mathematics (Ontario Ministry of Education, 2005). Locally Developed courses are specifically designed to accommodate students whose needs cannot be met through the Applied or Academic courses; these courses are developed at the school board level, and are offered in some but not all schools (Ontario Ministry of Education, 2005). Both Academic and Applied courses are implemented based on the overall and specific expectations as outlined in the curriculum documents, which differ to various extents between the two streams (see Ontario Ministry of Education, 2005). Since the Grade 9 Applied and Academic mathematics courses differ in their curriculum, there are two versions of the Grade 9 EQAO assessment: one for students in the Applied course, and another for students in the Academic course. Although students enrolled in Locally Developed courses do not participate in the assessment (EQAO, 2009; Koch, 2010), students with special education needs who are working towards a Grade 9 mathematics credit in the Applied or Academic course may be provided with accommodations for the assessment (EQAO, 2016b). Accommodations as defined by EQAO refer to any "changes in the way the assessment is administered or the way in which a student with special education needs responds to its components," and some examples of accommodations include changes to setting, increased time to respond to the assessment, presentation and response format of the assessment (EQAO, 2016b). EQAO provides schools with a guide for Accommodations and Special Provisions.

Both the Academic and Applied current versions of the Grade 9 mathematics assessment consist of 24 multiple-choice and 7 open-response questions, as well as 3 multiple-choice and 1 open-response questions that are being field-tested for future assessments (EQAO, 2009; Koch, 2010); it is not made explicit which questions are being field-tested in the assessment (Koch, 2010). All of the questions on the EQAO assess "key aspects of mathematics across the strands in the Grade 9 mathematics curriculum" (EQAO, 2009, p. 12), however not all specific expectations are addressed, and the specific expectations that are addressed differ somewhat

from year to year (EQAO, 2009). EQAO uses a blueprint to create and match questions based on the expectations of the Grade 9 Academic and Applied courses respectively, matching the questions to the strands of the Grade 9 mathematics curriculum, namely, Number Sense and Algebra, Linear Relations, Measurement and Geometry, and Analytic Geometry (Grade 9 Academic only) (EQAO, 2009). The blueprint is available for download on the EQAO website.

Each student writing the Grade 9 Assessment of Mathematics also receives a Formula Sheet **(Appendix A)**; as described on the Grade 9 EQAO website, "mathematical formulas are provided on the Formula Sheets for student reference during the assessment" (EQAO Website); this document accompanies the Grade 9 EQAO assessment booklets, and there are also two versions of the Formula Sheet, for the Academic level and for the Applied level respectively. Students are not allowed to bring a personal formula sheet to use on the assessment.

EQAO is responsible for the official scoring of the assessment (EQAO, 2013). Although individual schools and school boards are not responsible for marking the EQAO assessment, all schools and school boards are permitted to allow their teachers to mark students' work on the Grade 9 Mathematics EQAO assessment, and to incorporate their results into the students' course mark. In this case, teachers may mark all or part of the EQAO assessment for the purpose of allocating a grade contributing a maximum of 30% towards the students' final grade in the course (EQAO, 2014; Macaulay, 2015). The decision to grade the assessment, as well as the total percentage designated for this purpose may differ between schools or school boards **(**Koch, 2010**)**.

EQAO provides specific rules regarding the handling of the assessment materials by all teachers, including those who opt to include the Grade 9 EQAO assessment as part of their students' final mark. For example, teachers are forbidden from removing the assessment from the school grounds, or making copies of student work on the assessment –all with the exception of student answer sheets for the multiple choice questions which may be photocopied but not removed from the school grounds (EQAO, n.d.). No item-specific scoring guidelines are provided by EQAO to teachers marking parts of the assessment for use as part of student grades.

The EQAO website contains materials which students, parents, and teachers can use as preparation for the assessment. This material includes assessment booklets with questions and scoring guides from previous years, as well as informational brochures. The EQAO website also contains a Framework for each of the EQAO assessments. This Framework includes detailed

information about the assessment, as well as the blueprint that maps the curriculum to the assessment questions. In addition to the Framework, EQAO provides annual Technical Reports for the assessments, which contain detailed descriptions and in-depth analysis of the following aspects of the assessments: design and development, test administration and participation, scoring, equating, reporting results, statistical and psychometric summaries, and validity evidence (EQAO, 2016c). Due to the detailed information that the Framework and Technical Reports provide, these documents are valuable when considering the validity aspect of the EQAO assessments (Koch, 2010).

Validity of the Grade 9 EQAO Assessment of Mathematics

Although I did not conduct a validity study as part of my research, I would like to briefly discuss validity in relation to the Grade 9 Assessment of Mathematics since the perceived validity of the assessment may influence teachers' views and practices and vice versa. Brualdi (1999) describes "test validity" as the assurance that "test scores are meaningful, useful and appropriate". The traditional concept of validity, as discussed in Brualdi (1999) includes 3 components: criterion-related, content-related, and construct-related validity evidence. I will briefly discuss these 3 components and provide some examples from literature that address each respective component within the context of the Grade 9 Assessment of Mathematics. Criterion-related validity describes the relationship between assessment scores and the criteria that are being assessed; this form of validity can also be used to compare scores between internal and external assessments (Brualdi, 1999). Ross and Gray (2005) discuss criterion-related validity of the Grade 9 EQAO through a study comparing students' classroom scores with students' EQAO scores. In their examination of the alignment between internal (classroom grades) and external (EQAO assessment) scores of the same students over the course of 2 years, Ross and Gray (2005) conclude that overall, the "EQAO assessments and report card grades [are] reasonably well-aligned" (p. 17). However, when each of the two Grade 9 assessments (Applied and Academic) are viewed individually, the study found that for students in the Applied course, the EQAO assessment yielded higher scores than the grades allocated by the teacher, while for the Academic course, the EQAO assessment yielded lower scores than those allocated by the teacher. This discrepancy between classroom grades and the Grade 9 EQAO scores in the Applied course raises some issues with the criterion validity of this assessment (Koch, 2010; Ross & Gray, 2005). Possible reasons for this discrepancy may reflect teachers' views of student

abilities in the Grade 9 Applied versus the Grade 9 Academic course; more specifically, the results of the Ross and Gray (2005) study might suggest that teachers under-evaluate students' mathematical abilities in the Grade 9 Applied course and therefore allocate lower grades to those students; as such, student scores on the Grade 9 Applied EQAO assessment may in fact be more indicative of actual students' abilities and skills in the course, as outlined in the Grade 9 Applied curriculum. A second component of validity, content-related validity, refers to the relationship that exists between the assessment questions and the skills that the questions are testing (Brualdi, 1999). This form of validity is briefly discussed by Volante (2007) who argues that because the EQAO assessments "are closely aligned with the provincial curriculum, [the EQAO] tests likely have acceptable levels of content validity" (p. 6). Volante's argument however is not based on empirical research, but rather drawn from some EQAO commissioned studies, discussed below. Lastly, construct-related validity refers to the degree to which a test measures what is intended to measure (Brualdi, 1999). In an independent research study, Suurtamm, Lawson and Koch (2008) explored the construct-related validity of the Grade 9 Assessment of Mathematics by matching the questions on the assessment with the curriculum expectations for the Grade 9 course. Their findings include a number of concerns regarding this form of validity, notably "the lack of definition of important mathematics content, the undervaluing of the investigative nature of the curriculum, the isolation of mathematical processes, and the misrepresentation of the richness of problem solving" raises issues regarding the extent to which the assessment is measuring what it is intended to measure (Suurtamm et al., 2008, p. 41). These issues and concerns are an important piece in our interpretation of the validity of the Grade 9 EQAO assessment as they may have potential impact on teachers and teaching practices.

In discussing validity, we should also consider Messick's (1989, 1996) expanded concept of validity, a more-comprehensive model that includes implications related to testing and score interpretation (Brualdi, 1999). This concept of validity includes 6 forms of validity, namely: content, substantive, structure, generalizability, external factors, and consequential aspects of validity. These forms of validity are described as "interdependent and complementary [rather than]...separate and substitutable validity types" (Brualdi, 1999). However, of these, consequential validity may be most significant in my research due to its possible implication on the interpretation of the Grade 9 EQAO assessment scores. Among other consequences, the

value that teachers, students, parents, and the educational system attribute to the EQAO scores may have the consequence of prompting teachers to make changes to their classroom practice.

In order to affirm the validity of the Grade 9 Assessment of Mathematics, EQAO commissioned various studies (see Koch, 2010, p.113). While the majority of these studies validate the content-related validity aspect of the Grade 9 assessment and its alignment with the curriculum (Koch, 2010), they exclude other important forms of validity, such as the consequential aspects of validity (Koch, 2010; Volante, 2007). For this reason, a number of authors call for more research on the validity of the EQAO assessments (e.g., Koch, 2010; Volante, 2007) in particular the Grade 9 assessments, which may have higher implications for students, teachers and teaching practices due to the option to include portions of the assessment as part of students' final marks (Koch, 2010).

CHAPTER 3: LITERATURE REVIEW

In this literature review, I look at studies that focus on various aspects of large-scale assessment. The literature review is divided and discussed in two parts, namely *Views of large-scale assessment* and *Impact of large-scale assessment*. In the first part, *Views of large-scale assessment* I begin by discussing large-scale assessments, and then proceed to look at teacher views of large-scale assessment. In the second part, *Impact of large-scale assessment*, I begin by discussing the difference between low-stakes and high-stakes large-scale assessments and then proceed to discuss the impact of large-scale assessment, as well as the teacher perceived impact of large-scale assessment on classroom practice. Within each section, I first discuss some of the literature in general, and then I look at literature specific to Ontario and the EQAO context.

Views of large-scale assessment

Although there is a range of views regarding large-scale assessments among various stakeholder groups, for the purpose of this research, I will focus strictly on teachers' views of large-scale assessment and the factors that may influence these views. In this section of my literature review, I begin by describing the term "large-scale assessment" and providing some general information about these kinds of assessments. Following, I discuss the various views that teachers have towards large-scale assessments, before I proceed to look at the impact that large-scale assessments have on classroom practice.

What is large-scale assessment?

Generally, "large-scale educational assessment consists of those tests administered to sizable numbers of people for such purposes as placement, course credit, graduation, educational admissions and school accountability" (Bennett, 1998, as cited in de Lange, 2007 p. 1113). "In many countries, large-scale [assessments] are quite often identified with exit-examinations, which are often very closely related to the curriculum" (de Lange, 2007, p. 1113).

Large-scale assessments are a predominant form of assessment in North America, as well as in other countries –such as the United Kingdom, Germany, France, countries in Northern Europe, or Japan. In the United States specifically, the *No Child Left Behind (NCLB) Act* of 2001 prompted each state to create their own large-scale assessment and evaluate students in primary school, in an effort to "measure progress" and to help all students reach a certain "proficiency level" in reading and mathematics (Kloosterman & Burkhardt, 2017, p. 920). Not only are many

of the large-scale assessments in education mandatory, but researchers foresee that large-scale assessments will continue to exist and be used as means to report on accountability (Kloosterman & Burkhardt, 2017). Furthermore, large-scale assessments have become increasingly popular and used, especially in Canada and the United states (Anrig, 1992; Klinger, DeLuca, & Miller, 2008; Wilson, 1999, as cited in Lock, 2002). Although the large-scale assessment movement has met with both skepticism and criticism, large-scale assessments continue to be used.

Teacher views of large-scale assessments

Thinking about teacher views of large-scale assessment, one may have preconceived notions about what those views may be. However, when looking at the big picture of what teacher views of large-scale assessments indicate, we find out that views about this topic are in fact mixed, and that the situation is not a simple black or white. So what do teacher views reveal about these often mandatory, government regulated large-scale assessments?

Although a first glance at the literature on teachers' views of large-scale assessment indicates that the majority of teachers report negative views towards large-scale assessments, a closer look reveals that teachers also report some positive aspects of these assessments. In a 2008 article, Ballard and Bates (2008) discuss stakeholder views of mandated large-scale testing using data collected from a survey from students, parents, and teachers from Midwestern United States. The data gathered through the teacher survey indicate that teachers in these states believe large-scale assessments provide "data, trends, patterns and comparison between students, classes and schools" (p. 571) but that some of the assessment questions are biased and hence the tests "cause pressure and have unrealistic expectations for some students" (p. 571). These teachers also believe that large-scale assessments do not reflect student ability, and regardless of the amount of time spent on test-preparation, the assessments do not reflect actual and accurate student performance (Ballard & Bates, 2008). In a study conducted by Skwarchuk (2005) with 133 teachers in the province of Manitoba, the large majority of teachers surveyed are reported to hold "very negative" (p. 269) views towards mandated testing, with only a few supporting large-scale assessments as means to "[increase] standards and [improve] uniformity in teaching practices across the province" (p.267).

In Ontario, teachers' views of large-scale assessment and specifically the EQAO are also mixed. As previously mentioned, the EQAO assessments are administered, developed, tested and marked by teachers and educators within the province of Ontario (Gambell & Hunter, 2004;

Macaulay, 2015; Volante, 2006a). Thus, given the close relationship that exists between teachers and these assessments, examining connections between teachers' views of the EQAO assessments and classroom practice may provide us with interesting insights. In an article dedicated specifically to the EQAO and its implications to the Ontario educational system, Volante (2007) suggests that many Ontario educators are hesitant to believe that the EQAO assessments can better the educational system; instead, Volante reports, many Ontario teachers consider that the money invested in provincial large-scale assessments should be spent on improving class-instruction.

Teacher views of the Grade 9 EQAO Assessment of Mathematics

Some key pieces of literature that discuss teachers' views of the Grade 9 EQAO Assessment of Mathematics consist of research by Lock (2002), Kitto (2006), and Koch (2010). I will discuss the findings of each of these empirical studies below, reporting on teachers' views of the Grade 9 assessment. In a subsequent section, I will revisit these studies, this time looking at teachers' perceptions of the impact of the Grade 9 EQAO on their classroom teaching. Although there exists a more recent study that looks at Grade 9 Applied mathematics classrooms (Chapman, 2017), this study does not discuss teachers' views of the Grade 9 EQAO; hence, I have excluded this study from this section of my literature review.

Lock (2002) looks at the influence of the Grade 9 EQAO on classroom practice, a year after the assessment was first implemented as a pilot in the Ontario school system. At the time of Lock's research, little research had been done in the area of assessment and its influence on classroom teaching (Alderson & Wall, 1993, as cited in Lock, 2002), and, in particular about the connection between large-scale assessments and classroom instruction (Mehrens, 1998, as cited in Lock, 2002; Messick, 1989). Lock collected her data through "teacher questionnaires, classroom observations, discussions, and interviews" (Lock, 2002, p 67). More specifically, her sample sizes consisted of (n=634) for a pre EQAO assessment questionnaire, (n=548) for a post EQAO assessment questionnaire, and four participants for interviews. Overall, Lock's research reports that teachers have mostly negative views of the EQAO assessment due to the fact that these teachers did not consider that the assessment would "provide useful information to [them]… about classroom teaching and learning" (Lock, 2002, p.212), and thus they did not consider it would have a positive effect on their practice. More specifically, Lock found that nearly 57% of teachers did not consider that the EQAO assessment would help improve

classroom teaching, while 51% of teachers also did not consider the assessment to be a "useful tool … for positive changes in instruction" (Lock, 2002, p. 151); 23% of teachers remained neutral in their opinion as to whether "the EQAO assessment is a useful tool for helping [them] to make positive changes in instruction" (p.151). Furthermore, when discussing the assessment, teachers reported that the test was "unfair", "difficult", and that "students did not have enough time to complete the test" (Lock, 2002, p 213). Lock considers that "teachers' beliefs about teaching, learning and mathematics" (p. 243) and the Grade 9 assessment may have been a factor that influenced teachers' classroom practices.

Kitto's (2006) research further builds on the ideas discussed by Lock (2002), while also considering the validity of the Grade 9 EQAO Assessment of Mathematics. Kitto's data, collected through surveys (n=70) and interviews (n=10) reveals a few interesting things: although the teachers' views were fairly mixed about various issues related to the Grade 9 EQAO, Kitto reports the overall tone of the teachers' views was mostly negative. For example, teachers considered the assessment to be "unfair to students with poorer linguistic or social backgrounds, or who [are] not motivated to try hard" (p. 252-253). Teachers also identified issues of validity such as the fact that the assessment is inconsistent when compared to classroom practices. However, in considering the validity of the assessment, teachers also discussed that EQAO consists of appropriate and valid questions that are aligned with the curriculum content. Thus, teachers reported using these questions as "models for their own classroom assessments" (p. 257). Although teachers considered that the EQAO assessment was matched to the curriculum, they also considered that EQAO scores were much higher than their classroom scores and therefore, due to this discrepancy, EQAO scores could not be used to "provide meaningful information to teachers, students and parents" (p. 196). Overall, Kitto reported that since the assessment was first introduced, teachers' views became a lot more negative –he considers this in contrast with Lock's research (2002). In reviewing Kitto's research, the following statement interested me: "the interview findings suggest that teachers who are more familiar with how the assessments are generated and marked are more sympathetic to them. It appears that having more knowledge and understanding of the process leads to more acceptance" (p. 253). The statement struck me as it may have implications for my own study.

In her doctoral dissertation, Koch (2010) discusses the specific case of the Grade 9 EQAO Assessment of Mathematics, by drawing on data collected using a province-wide

questionnaire (n=272), as well as interviews with ten Grade 9 mathematics teachers. In discussing teacher views, Koch found that Ontario teachers hold a range of views about the Grade 9 EQAO assessment. Most importantly, Koch found that teachers "ascribe a different meaning to the Academic assessment than they do to the Applied assessment" (p. 218); specifically, teachers reported that in comparison with the Academic courses, the Applied-level students spend class time, as described by one teacher, doing more "activity-based, a lot of manipulatives, and a lot of hands-on stuff" (p.218). Thus, since the EQAO assessment does not assess using any of these methods, teachers consider that there is a disconnect in the way that material is taught in class, and the way that same material is assessed on the Grade 9 Applied EQAO (Koch, 2010). This has further implications for the assessment results, which could indicate that Applied-level scores on the EQAO assessment may be a less-accurate depiction of classroom performance and students' final mark in the Grade 9 Applied course –especially in comparison to the Academic level course. This same argument was evident in Ross and Gray's (2005) discussion of the validity of EQAO scores when compared to classroom marks, as discussed in Chapter 2. In looking at Koch's research, it is important to note that the teachers interviewed by Koch expressed their views of the Grade 9 assessment in relation to the option to include the assessment as part of the students' final mark in the mathematics course, a practice discussed in Chapter 2 as well. Overall, the teachers interviewed for Koch's study addressed both benefits and disadvantages of the practice of using EQAO marks as part of a student's final mark. For example as a positive influence of this practice, teachers reported that students take the assessment more seriously since it is used towards their final mark in the course, and thus teachers get a more-accurate idea of their students' mathematical skills and abilities. In addition, similar to Kitto's study, many participants in Koch's study found the EQAO items to be well developed and indicated that they used them in their classroom practice. Teachers interviewed by Koch also discussed some tensions related to using the EQAO as part of students' Grade 9 course marks. Specifically, the lack of scoring guidelines for EQAO items such as information on which items to score, and what weight to allocate to each item, as well as the inability to provide feedback to students on the items marked on the EQAO, since teachers are not permitted to keep copies of student work on the assessment. Teachers interviewed by Koch also identified tensions specifically related to the Applied-level assessment, and revealed concerns about the

appropriateness of the Grade 9 assessment, especially when compared to the way that students are taught in class.

In discussing the three empirical studies and their findings mentioned above, it is necessary to point out that these three studies were conducted in 2002, 2006 and 2010, respectively. The findings from these studies suggest that teachers' views of the Grade 9 EQAO assessment have changed over time, and will perhaps continue to change. Since the last empirical study related to this topic was conducted 8 years ago, examining how teachers' views of the Grade 9 Assessment of Mathematics may have shifted in the recent years is relevant.

Impact of large-scale assessment

This section examines the impact of large-scale assessments. I begin by looking at impact in relation to the stakes of the assessment –low-stakes vs. high-stakes. Following, I discuss the documented impact of large-scale assessment on teaching practices with a specific focus on mathematics teaching and learning. Lastly, I look at the teacher perceptions of the impact of large-scale assessment in order to set the stage for the analysis of my data.

Stakes of large-scale assessments

Large-scale assessments affect various stakeholders, such as students, teachers, school administrators, policymakers, and parents (Abu-Alhija, 2007; Ryan 2002). The impact of large-scale assessment however, is often related to whether the assessment is high-stakes or low-stakes. In the context of this project, I use the term *high-stakes* to refer to any large-scale assessment that has serious consequences; for example, assessments that serve as a grade promotion, graduation requirement, or admission to post-secondary institutions (Gambell & Hunter, 2004; Klinger & Luce-Kapler, 2007; Koch & DeLuca, 2012; Monsaas & Engelhard Jr, 1994; Ryan 2002). The high-stakes may have implications for students, teachers, or schools. For instance, teachers may be held accountable for student performance and they may be sanctioned or rewarded based on student achievement (Abu-Alhija, 2007). Similarly, depending on the circumstance, some schools may receive funding as a recompense for high results on large-scale assessments, others may receive funding as a means to support school improvement plans, while others may lose funding due to low student performance on the assessments **(**Klinger & Luce-Kapler, 2007).

In order to define the term *low-stakes* assessment, I refer to a definition by Gambell and Hunter (2004) which describes low-stakes assessments as examinations that provide "provincial, national, or international trends and profiles, but no individual marks for promotion or graduation purposes" (p. 698). Low-stakes assessments are presumed to have no direct consequences on teachers, such as sanctions or salary recommendations, and they are also perceived to put less pressure on teachers and students (Gambell & Hunter, 2004; Klinger & Rogers, 2011; Volante & Ben Jaafar, 2008). However, despite their deemed low-stake nature, some of these assessments could have high-stakes implications for policy makers or the government, and even for schools and districts. Within the Canadian context, and Ontario specifically, there is little research about the impact of low-stakes assessments on teachers (Gambell & Hunter, 2004).

Despite the set criteria that define *low-stakes* and *high-stakes* assessments, most assessments do not actually fit neatly into one of these two categories; instead, assessments fall somewhere on the spectrum between the two extremes, and their stakes may vary based on different stakeholders. For example, the same assessment could be considered as low-stakes for the students who do not depend on the assessment results as a graduation requirement, but high-stakes for the teachers who may nonetheless get sanctioned for poor student performance on the assessment.

Within the education system, large-scale assessments are generally mandated by the government, and vary in their characteristics. In the United Sates for example, many of the large-scale assessments that take place in the public school system are individually mandated by each state (Sloane & Kelly, 2003, as cited in Mertler, 2010). Given the circumstances in which these assessments were created and are administered, as a direct result of the *NCLB Act*, many of these assessments are considered to be high-stakes assessments with serious consequences for teachers and students (Abrams, Pedulla & Madaus, 2003).

In Canada, large-scale assessments and their stakes, as well as the grades in which the assessments are administered, differ from province to province (Klinger, DeLuca & Miller, 2008). Within the Ontario secondary school context, the successful completion of the Ontario Secondary School Literacy Test (OSSLT) is required for graduation, therefore deeming the OSSLT a high-stakes assessment for students. The Grade 9 EQAO Assessment of Mathematics on the other hand is not directly used for grade promotion or required for graduation, and for this

reason, the Grade 9 EQAO Assessment of Mathematics is not considered to be a high-stakes assessment (Klinger & Rogers, 2011; Koch, 2010). However, as mentioned, teachers may opt to include portions of the Grade 9 assessment as part of the students' final grade in the Grade 9 mathematics course. As a result, the stakes of the Grade 9 assessment can be deemed higher, as the assessment would consequently have more implications for students, as well as teachers particularly in places where the assessment contributes more heavily to the students' course grade. Several authors suggest that in Canada, and Ontario specifically, teachers are not held directly accountable for student performance on large-scale assessments, regardless of the stake of the assessment (Klinger & Rogers, 2011; Volante, 2006a; Rogers, 2014). For instance, Volante, Cherubini and Drake (2008) report that Ontario teachers are neither "rewarded with merit pay or officially sanctioned based on high or low test scores at any level within the system" (p. 3). However, despite the lack of teacher recompense or punishment reported, research indicates that many teachers and school administrators feel pressured to have their students perform well on these assessments (Neil, 2003; Nezavdal, 2003; Wright, 2002, as cited in Volante 2006b). If teachers feel pressured by large-scale assessments, then the question must be raised: How do large-scale assessments affect teaching practices?

Impact of large-scale assessment on teaching practices

The impact of large-scale assessment on teaching practices is a complex topic, as it consists of multiple elements and factors (Cimbricz, 2002). Research indicates that generally, large-scale assessments have implications such as "the narrowing of the curriculum, reduction of instructional time in favour of test preparation activities, use of more test-like teaching practices, and increased cheating" (Darling-Hammond, Ancess, & Falk, 1994, as cited in Klinger & Rogers, 2011, p 123). In his article, Volante (2006a) presents some positive and negative aspects of large-scale assessments, as they are found in the broad literature. He reports that large-scale assessment is believed to "[narrow] and [distort] the curriculum by encouraging 'teaching to the test' techniques which take valuable time away from non-tested subjects (Kohn, 2002; Smith & Fey, 2000; Volante, 2004)", and "[provide] information that is of relatively little use to improving classroom practice (Stiggins, 2002; Falk, 1998)" (p. 7). On the other hand, large-scale assessments are reported to have the potential to "identify the most successful teaching practices and proficient teachers (Cizek et al., 2011; Sanders & Horn, 1998)", "enhance teachers' reflective and critical thinking when planning instruction (Goldberg & Roswell, 2000)", and

"improve teachers' assessment and instructional practices, particularly when they are involved in marking these assessments (Gambell & Hunter, 2004; Green, 1999)" (Volante, 2006a, p. 8).

Within the Ontario context, the literature indicates somewhat mixed reviews of the impact of the EQAO large-scale assessments. For example, Volante (2007) criticizes some aspects of the EQAO assessments by describing that some Ontario teachers report "spending a disproportionate amount of time on tested subjects" (p. 8), and also "adapt inappropriate test preparation strategies" (p. 11). Test preparation practices target content covered on the assessment and focus heavily on teaching students the skills needed for a pen and paper assessment; these test preparation practices also exclude the hands-on, explorative and investigative nature of the Grade 9 mathematics curriculum (Volante, 2007). In the same article, Volante (2007) also discusses evidence of improved student learning as a result of the EQAO assessments; he notes however, that these examples are pertinent specifically to the elementary level, and for low-stakes assessments. One such example is Wideman's (2002) article which discusses that the improved student learning associated with the EQAO assessments are directly related to teacher willingness to improve their own teaching, and consequently their students' learning, as well as the teacher's willingness for action research within their school.

One important aspect of large-scale assessment that must be addressed in this section is the practice of 'teaching to the test'. Teaching to the test is generally defined as "practices [that] do not promote learning-oriented activities, but rather [practices that] focus on coaching students on question types represented on the test" (Higgins, Miller & Wegmann, 2006, as cited in Gebril, 2018). The topic of teaching to the test is often discussed in relation to the impact that it has on teaching, as teaching to the test is generally perceived as an unfavourable teaching practice adopted by teachers, due to the fact that teachers who teach to the test are reported to spend more time on the test content compared to the rest of the curriculum (Abu-Alhija, 2007; Volante, 2007). Pressure to raise test scores in their schools may prompt teachers to teach to the test. However, inflated assessment scores that result from teaching to the test "provide invalid interpretations about the students' actual mastery of the content" (Popham, 2001, p. 18). Not only do these scores not depict an accurate picture of student learning, but they can have quite an adverse effect in a situation in which the assessment at hand is deemed to be a high-stakes assessment –for example, schools may be unfairly rewarded financially for inflated student scores on said assessment (Gebril, 2018).

Despite the negative connotations attached to the practice of teaching to the test, some researchers describe teaching to the test to be a "positive practice" if the large-scale assessment is "well designed and aligns with the curriculum goals" (Swan & Burkhardt, 2012, as cited in Suurtamm et al., 2016, p. 21). However, Swan & Burkhardt (2012) further make the argument that in order to "implement the intended curriculum, the tests must cover its goals in a balanced way" (p. 4-5). This argument is further supported by Suurtamm et al. (2016), who, in discussing *Examples of Positive Interaction Between Large-Scale Assessment and Classrooms,* note that "if the enacted curriculum of the classroom and the assessed curriculum are to inform each other and to enhance student learning in positive and productive ways, then large-scale external assessments cannot operate in isolation from the classroom" (p. 22). That being said, the large-scale assessments that the teachers are 'teaching to' must be aligned with the course curriculum, the classroom content taught, and the classroom assessments. As discussed earlier, multiple authors (e.g. Kitto, 2006; Volante, 2007) make the argument that the EQAO Grade 9 Assessment of mathematics is in fact well-aligned with the Ontario mathematics curriculum. For this reason, if teachers adapt the practice of teaching to the test when preparing students for the Grade 9 EQAO, they may consequently be teaching students many aspects of the Grade 9 mathematics curriculum (Lock, 2002). On the other hand, since EQAO does not assess all aspects of the Grade 9 curriculum despite its alignment with the curriculum, teaching to the test may result in some important concepts and mathematical ideas being left out (Lock, 2002; Koch, 2010). An example of this includes the investigative nature of the curriculum and its importance in student learning.

Despite the mixed opinions regarding the possible positive and negative outcomes of teaching to the test, there are many benefits that can be associated with preparing students for a large-scale assessment in general –for example, equipping students with specific test-taking skills reduces test anxiety (Gebril, 2018). I will further discuss the topic of teaching to the test and other assessment preparation practices in Chapter 7.

Teacher-perceived impact of large-scale assessment on teaching practices

Within the broad context, the teacher-perceived impact of large-scale assessments on teaching practices varies within context as the perceived impact is often reported to be directly related to the stakes of the assessments (Lock, 2002). For example, a large survey-based research study from various states in the United States conducted by Abrams et al. (2003) revealed that

compared to teachers in low-stakes assessment situations, teachers in high-stakes assessment situations are reported to reduce the amount of time they spend on teaching subjects and materials that are not tested. Abrams et al. (2003) also state that "regardless of the rewards and/or sanctions, associated with test results, the implementation of state-testing programs has changed teaching in ways that many teachers feel negatively impacts the quality of instruction students receive" (p. 23). In a similar study, Mertler (2010) interviewed 1,543 teachers in the state of Ohio. The participants in this study report that state-mandated high-stakes testing has "negative impacts on both instructional and curricular practices of teachers" (p. 25), and further reaffirms the idea that teachers spend less time on material which is not tested, and significantly change their teaching methods in order to align their teaching with these testing practices.

Interestingly enough, within the Ontario context, teacher reports show similar concerns about the impact of large-scale assessment on classroom practices. McAdie and Dawson (2006) discuss that some teachers believe that classroom instruction time is focused mostly on areas that are assessed on the EQAO, whereas other curriculum content and material is rushed through or sometimes completely ignored. They explain that "some [teachers] feel pressure to complete the entire curriculum before the administration of the EQAO assessment and therefore have decreased time for student exploration, investigation, and focus on teaching for deeper understanding as they rush to complete all the expectations in language and mathematics before the middle of May" (McAdie & Dawson, 2006, p. 31). A later study by Klinger and Rogers (2011) consisting of a sample of 228 Grade 3 teachers, 257 Grade 6 teachers, and 274 Grade 9 teachers, reports that when surveyed about their perceptions of low-stakes large-scale assessments, Ontario teachers "were at best neutral" (p. 139) as to whether these large-scale assessments actually improve teaching practices. While some secondary teachers seem unsure, a report from the Elementary Teachers' Federation of Ontario (ETFO, 2000) about EQAO assessments revealed that "56% [of teachers] indicated that the [EQAO] tests have had a negative impact on the performance of their role as teachers" (p. 32, as cited in McAdie & Dawson, 2006).

Teacher-perceived impact of the Grade 9 EQAO on teaching practices

Reporting specifically on the impact of the Grade 9 EQAO assessment on classroom teaching a year after its introduction in Ontario classrooms, Lock (2002) discusses that overall, teachers hold negative views about the implementation of this assessment as they do not consider

that the assessment is beneficial to or aiding classroom instruction. Her survey revealed that 57% of teachers did not consider EQAO to be a tool that is useful in "ensuring that the Grade 9 mathematics curriculum is implemented" (p.151). Furthermore, when asked prior to the administration of the assessment, 54.4% of teachers did not agree with the statement that "Having the EQAO assessment made me fully implement the Grade 9 mathematics curriculum" (p. 152); interestingly enough, the number of teachers who disagreed with the same statement, increased to 69.4% following the administration of the assessment. Lock also interviewed teachers about their means of preparing students for the Grade 9 EQAO assessment. In this, Lock found that 63% of teachers provided students with practice questions similar to those on the EQAO assessment, and 59.5% of teachers also provided their students with instructions on "test-taking skills" as a means to prepare them for the assessment (p. 155 – 156). Furthermore, some of the ways that teachers wanted to prepare students were by assigning questions similar to EQAO and making references to the assessment and its components throughout the course (p. 156). Teachers also reported rushing through curriculum before the assessment, and 89.3% indicated that they strongly agreed "there is not enough time in the course to cover the curriculum" (p. 158). Lastly, teachers reported feeling pressured for time, in that they felt limited in the time they had to teach classroom content and the curriculum to prepare students for the assessment; as such, teachers reported limiting classroom activities and the use of technology in the classroom. Overall, the teachers interviewed by Lock reported that they did not consider EQAO as an important or positive tool for classroom practice; furthermore, they did not agree that the assessment would ensure that the Grade 9 curriculum was taught.

Although Kitto's (2006)'s research does not discuss in-depth the teacher-perceived impact of the Grade 9 mathematics assessment on classroom practice, some of his findings were related to the impact of the assessment on practice. For example, teachers were reported to use questions similar to EQAO questions as a means to prepare students for EQAO; furthermore, teachers considered EQAO questions to be well-designed, and even reported using the EQAO questions to create similar questions for use on classroom assessments. Although teachers regarded EQAO questions as valuable for classroom practice, they did not assign the same value to assessment scores. Specifically, when discussing the use of the EQAO assessment as part of a students' final mark in the Grade 9 course, teachers reported using this practice only when mandated by their school board. As means to prepare students for the EQAO assessments, some

teachers reported teaching "EQAO test-taking skills" (p. 254) to their students. Overall, although the teachers interviewed by Kitto presented both positive and negative assessments of the impact of EQAO on practice, they considered that the negative aspects outweigh the positive ones, especially for the Applied-level students (p. 254).

Koch's (2010) research also discussed teacher-perceived impact of the Grade 9 EQAO on their classroom practice, in relation to teachers' option to use portions of the EQAO assessment for classroom marks. As mentioned, teachers discussed both benefits and drawbacks of using this practice. For example, teachers reported that by looking at student work on EQAO, teachers were able to become more familiar with the kinds of questions asked on the EQAO, and use these questions to inform the questions they asked on classroom assessments –teachers considered that some of the EQAO questions were well constructed. Teachers also reported that by looking at the student feedback on EQAO, they were able to improve their own practice and make changes to their teaching style in a timely-manner, before the beginning of a new semester, as opposed to otherwise waiting until the official EQAO report comes out, well-after the new school semester has already started. Teachers also identified some tensions related to the use of the EQAO assessment as part of students' final mark in the Grade 9 course; more specifically, these tensions were related to the items that are assessed on the EQAO but not taught in class such as certain items that teachers "felt were not part of the mathematics curriculum" (p. 229) but had been assessed on the Grade 9 EQAO. Teachers also identified concerns in the form of having little time to mark the assessments before they were sent back to EQAO.

A more recent study by Chapman (2017) briefly discusses some aspects of the Grade 9 EQAO. Although more recent, Chapman's research findings reiterate some of the findings of the previous researchers, in relation to the teacher-perceived impact of EQAO on practice. Specifically, teachers are reported to include "released or inspired EQAO questions in worksheets, activities, and unit tests to ensure students' familiarity with the format and style of EQAO questions" (p. 100). Chapman also reported that students in the Grade 9 Applied Mathematics courses performed below the provincial standards.

Conclusion

In this review, I focused on literature relating to teacher views and the impact of large-scale assessment on teaching practice. In looking at teacher views of large-scale assessment, I found that teachers have both positive and negative views about large-scale assessments. On the

one hand, some teachers consider that large-scale assessments provide some useful data about student learning but on the other hand teachers are skeptical about the effectiveness of large-scale assessments. In looking at the literature pertinent to the Grade 9 EQAO Assessment of Mathematics, teachers' views about this large-scale assessment are reported to have changed over time. A year after the assessment was first introduced in Ontario schools, teachers were hesitant to believe that the assessment would have positive effects on classroom practice as the information it provided was not relevant to classroom teaching (Lock, 2002). Teachers interviewed several years after the assessment was first implemented reported similar views, and further identified discrepancies between students' results on classroom assessments and students' results on the EQAO; these teachers also expressed some positive views of the assessment such as the fact that EQAO questions were well-designed and aligned with curriculum content (Kitto, 2006). Koch's study (2010) revealed concerns related to the discrepancies reported to exist between classroom content and activities and the EQAO assessment, more specifically at the Applied-level. Teachers further identified some concerns with the lack of scoring guidelines provided by EQAO for teachers who opt to use portions of the Grade 9 assessment as part of students' Grade 9 course marks (Koch, 2010).

In discussing the impact of large-scale assessment, a number of implications of large-scale assessment on teaching practice were identified by researchers and teachers alike; namely, a focus on material and skills assessed on large-scale assessments, alteration of classroom teaching practices, and 'teaching to the test'. Specifically, teachers were reported to spend more time teaching skills and knowledge that they knew would be assessed on large-scale assessments; in this, teachers also adapted their classroom teaching and assessment strategies to fit models similar to those presented on the assessment. Teachers were also reported to 'teach to the test', a practice which, as discussed, can have both positive and negative connotations depending on its use. Overall, teachers reported feeling pressured to have their students perform well on large-scale assessments, regardless of the stake associated with the assessment. In reporting their perceived impact of the Grade 9 EQAO on classroom practice, Ontario Grade 9 Mathematics teachers also reported an increased use of sample EQAO questions and specifically spending classroom time preparing students for the Grade 9 EQAO assessment, and also sometimes rushing through the curriculum before the assessment period.

CHAPTER 4: THEORETICAL FRAMEWORK

I begin this chapter by discussing the connection between teacher beliefs and teaching practices. Then, I go into more detail about the relationship between beliefs and practice and discuss a particular model by Ernest (1989) that I leaned on when creating the theoretical framework for my study. Lastly, I discuss the ways I adapted Ernest's model to suit the needs of my study and help me present my findings and address my research questions.

Teacher beliefs and teaching practices

A link between teacher beliefs and teaching practices has been long established in literature (Ernest, 1989b). Within the mathematics context specifically, many researchers have studied teacher beliefs and the influence of these beliefs on classroom practice (Ernest, 1989a). Ernest (1989a) describes "the key belief components of the mathematics teacher [to be] the teacher's: view or conception of the nature of mathematics, their model or view of the nature of mathematics teaching, [and] their model or view of the process of learning mathematics" (p. 250). It appears that Ernest (1989a) uses the terms 'beliefs' and 'views' interchangeably. Since I am leaning on Ernest's model, I also use these terms interchangeably. In reading the literature for my study, I was however aware of the way that other authors use the terms 'beliefs' and 'views' and considered whether they are used in a similar way as described by Ernest.

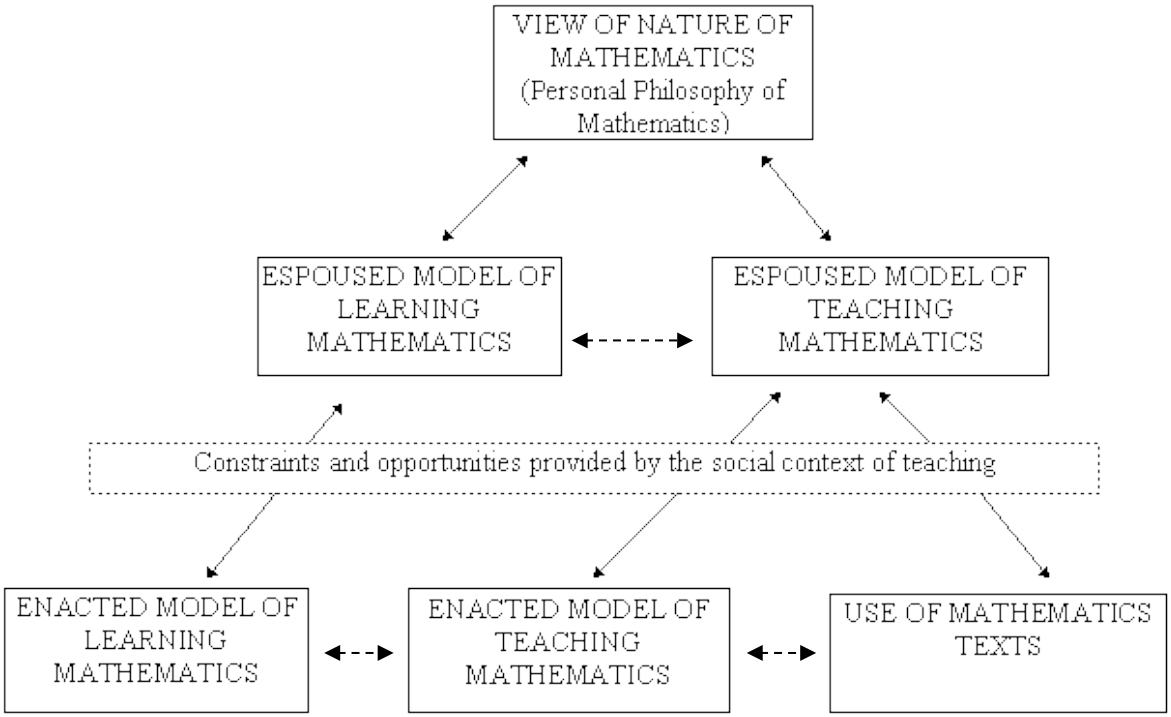
Since I am interested to see what beliefs teachers hold about large-scale assessments and if these beliefs influence their teaching practices, I first explore the nature of the relationship between teacher beliefs and teaching practices. The literature on the relationship between teacher beliefs and practice within mathematics reveals that teaching practices are influenced by teacher beliefs (e.g. Aguire & Speer, 2000; Handal, 2003; Speer, 2008; Thompson, 1984). Yet, in order to understand how views may influence the way that mathematics teachers teach, it is helpful first to look at teacher views of the nature of mathematics.

Ernest's model: The relationship between beliefs and practice

Ernest (1989a) explains that mathematics teachers have views not only about teaching mathematics, but also about mathematics itself. He describes teachers' views of the nature of mathematics in three categories: instrumentalist, Platonist, and problem solving. Ernest contends that each of these three views of the nature of mathematics in turn prompts a particular model of teaching, as depicted in **Table 2**, discussed in **Appendix B**. For example, a teacher holding a

problem-solving view would facilitate "learning as an active construction of understanding, possibly even as autonomous problem-posing and problem-solving" (Ernest, 1989a, p. 252), while a teacher holding a Platonist view would facilitate "learning as the reception of knowledge" (Ernest, 1989a, p. 251). The general relationship between teachers' views of mathematics and their teaching practices can be depicted by Ernest's model (1989a) represented in **Figure 1** below. This model connects teachers' views of mathematics (philosophy) to the way they intend to teach mathematics (espoused model), and then further to the way that they actually teach mathematics (enacted model) once faced with the constraints and opportunities provided by the social context of teaching.

Figure 1: Relationships between beliefs, and their impact on practice



Reprinted from Ernest, P. (1989a). The impact of beliefs on the teaching of mathematics. In P. Ernest (Ed.), *Mathematics teaching: The state of the art*. New York: Falmer Press. p. 252

At the top of Ernest's model are teachers' views of mathematics; from these views stream the teachers' espoused model of teaching and learning which in an ideal situation, becomes the teachers' enacted model of teaching and learning mathematics. However, in some instances, inconsistencies between teachers' beliefs and their enacted model of practice are reported to exist

(Handal, 2003; Thompson, 1984); Ernest (1989a) provides two possible reasons for these inconsistencies.

The first reason for such an inconsistency is referred to by Ernest as "constraints and opportunities provided by the social context of teaching" (p. 252); these constraints and or opportunities, Ernest further describes, act as an additional layer between teachers' espoused and enacted models. Constraints and opportunities are outside factors or circumstances where teachers feel pressured to teach in a way opposing or different from their beliefs; some examples of outside factors include time allotted for classroom preparation, opportunities for collaboration, available materials, classroom funding (Handal, 2003), and external assessment (Ernest 1989a). Depending on the circumstance, and depending on teachers' views, the examples above could present themselves as a constraint for one teacher but an opportunity for another. A textbook for example, can present itself as a constraint to a teacher who prefers to use worksheets or workbooks, but on the other hand it could be an opportunity for a teacher whose school does not usually have textbooks available for students. This can also be applied to large-scale assessments: for example, as a result of the need to prepare students for a mandatory large-scale assessment, a teacher holding a problem-solving view who might usually teach an 'active construction of understanding' may instead adapt an instrumentalist model of teaching and settle for 'compliant behavior and mastery of skills' (Ernest 1989a) from their students as they might perceive that the preparation for the assessment requires solely the mastery and replication of specific mathematical skills.

A second reason that Ernest (1989a) suggests for the existence of inconsistencies between teachers' espoused and enacted models of teaching and learning refers to "the teachers' level of consciousness of his or her own beliefs, and the extent to which the teacher reflects on his or her practice of teaching mathematics" (p. 254). Ernest argues that in order for a teacher to become a problem-solver kind of teacher (a teacher of the highest order in the hierarchy**, Appendix B),** he/she would have to reflect the "roles of the teacher and learner" (p. 254), and to consider the way their beliefs may influence their teaching practices.

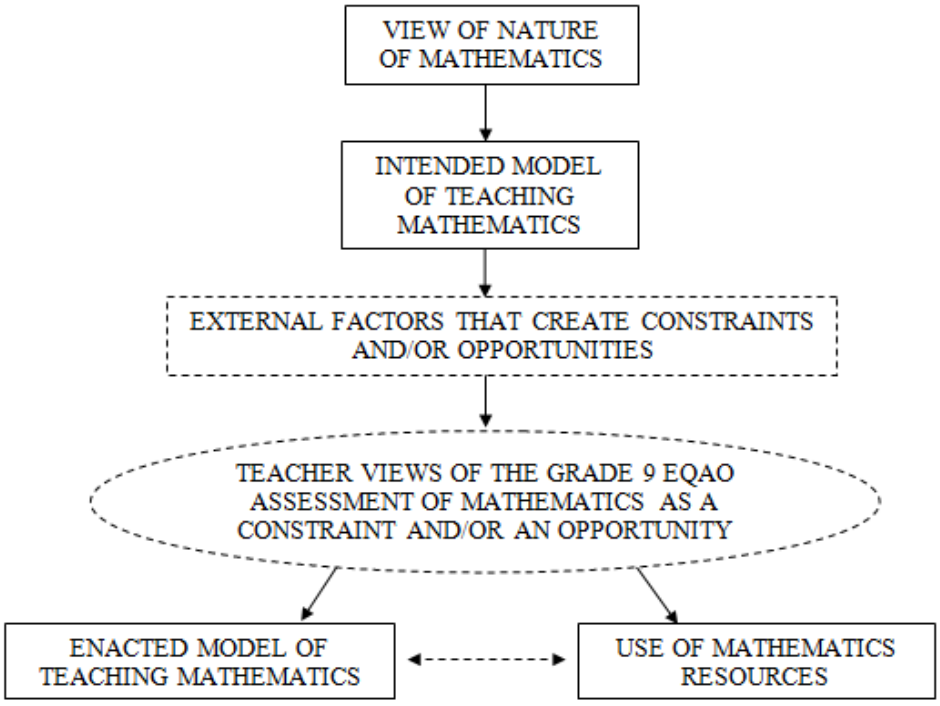
Ernest's adapted model: EQAO as a constraint and/or opportunity

In considering a theoretical framework for my research, I found Ernest's (1989a) model, presented in **Figure 1,** to be the most helpful when describing the connection between teachers' beliefs and classroom practice. Initially, I had also considered a model by Renne (1992) that

connects teacher beliefs and teaching practices, as described and cited in an article by Handal (2003). However, upon reading Renne's original paper, I did not find his model of the connection between teacher beliefs and teaching to be as explicit as Ernest's (1989a).

Ernest's model depicts "constraints and opportunities" as a potential filter or influence that may create a difference between one's intended model of teaching and his or her enacted model of teaching. When external factors are present, they present possible constraints and/or opportunities which interact with the personal beliefs and views of the teacher (Cohen & Ball, 1990; Ernest 1989a). For this reason, I have adapted Ernest's (1989a) model to include teacher views of external factors, in this case the Grade 9 EQAO Assessment of Mathematics as presenting possible constraints and/or opportunities for their enacted model of teaching. The adapted framework is presented in **Figure 2**, and it includes solely the "teaching" branch of Ernest's model in **Figure 1.** I am focusing mostly on the "teaching" portion of the model as it is specific to my research study. I have also adapted the "Use of Mathematics Texts" box to include multiple mathematical resources, mathematics texts and EQAO materials as this helps look at what materials teachers may use to prepare students for the Grade 9 EQAO.

Figure 2: **Adapted model of "Relationships between beliefs, and their impact on practice"**



Adapted from Ernest, P. (1989a). The impact of beliefs on the teaching of mathematics. In P. Ernest (Ed.), *Mathematics Teaching: The state of the art*. New York: Falmer Press. p. 252

Applying the adapted model to my study

Teachers' views of a particular external factor are an important element in the connection between teacher beliefs, their intended model of teaching, and their enacted classroom practice. As such, I considered it was not only important but also necessary to include another layer to Ernest's original model; in this case, the model includes an extra section that looks at teacher views of the Grade 9 EQAO Assessment of Mathematics.

Originally, I planned to focus more heavily on the latter portion of the model in **Figure 2**, and to look solely at teacher views of the Grade 9 EQAO Assessment of Mathematics to determine in what ways teachers consider this large-scale assessment to be a constraint and/or an opportunity, and further to determine how these views may influence teaching practice. I had also planned to explore if teacher views of the Grade 9 EQAO as a constraint and/or an opportunity lead the teachers to use certain mathematical resources which in turn may also influence their teaching practices, all the while keeping in mind the fact that teachers may simultaneously view, to various degrees, the EQAO as both a constraint and an opportunity, rather than choose one extreme or the other.

However, when I began data analysis I decided to organize my data and present my findings according to the sections presented in the adapted model above. As such, in my findings, I first discuss teacher views of the nature of mathematics and their intended model of teaching. Then, I look at teacher views of the Grade 9 EQAO Assessment of Mathematics as an 'external factor that [may] create constraints and/or opportunities', before discussing teachers' enacted model of teaching mathematics and their use of mathematics resources.

CHAPTER 5: RESEARCH DESIGN

This chapter discusses the nature of my study. I begin by discussing the research method that I used and describing the data that I worked with. Following, I discuss my role as a researcher, and proceed to talk about how I went about selecting my data. In this chapter I also describe the case and the participants, and I discuss ethical considerations and the ways that I ensured the trustworthiness of the study. Lastly, I describe how I conducted the data analysis.

Qualitative study: Secondary Analysis of Data (SAD)

In order to examine Grade 9 mathematics teachers' views regarding the Grade 9 EQAO mathematics assessment and to explore if and how these views influence teaching practices, I selected a qualitative research approach. Specifically, I conducted a secondary analysis of data that was collected during a two-year research project funded by the Ontario Ministry of Education [OME] through the Ontario Association for Mathematics Education [OAME].

Simply put, secondary analysis of data (SAD) "is a method in which data collected in another study is used to answer new research questions" (Coyer & Agatha, 2005, p.1). In addition to the obvious benefits of cost and time-efficiency, secondary analysis of data may reveal rich results. I chose to conduct a secondary analysis of the OAME project data for various reasons. In this case specifically, the original data was not only a sample of convenience, but it allowed me to access data from a large sample of participants that I may have otherwise not had a chance to interview. Conducting secondary data analysis can be a tricky task, especially if the researcher is unfamiliar with the data he/she is analyzing. However, as I will discuss below, my involvement with the original research project gave me an advantage in this regard, and ultimately helped me better understand, analyze, and report on the data. Thus, for my study, conducting a secondary data analysis of this sample was not only a matter of convenience, but also it involved many other benefits. The proper ethics procedures were followed in obtaining permission to use this data for my research. I will discuss the original data and my role in the OAME research project below.

Original data: The OAME project case studies

The goal of this OAME project was to support several school-based Professional Learning Communities (PLCs) across Ontario in their efforts to "focus on enhancing their understanding of the Grade 9 Applied mathematics curriculum, and to focus on implementing the

curriculum in ways that will best meet the needs of their students" (Suurtamm, 2015, p. 1). This research project was teacher-focused and provided the participating PLCs with the opportunity to concentrate on a particular problem of practice of their choice, related to the Grade 9 Applied mathematics course (Suurtamm, 2015). Ten PLCs were chosen to participate in the project the first year; nine of those PLCs chose to continue into the second year. Each PLC consisted of the mathematics department head, Grade 9 Applied mathematics teachers, resource staff from the school and school board, and an administrator (principal or vice-principal). Each PLC was treated and discussed as its own case study in the overall project.

The data was collected through observations and audio recordings of monthly full-day meetings with each of the participating PLCs, with a Research Assistant (RA) present. Specifically the data was collected during conversations between teachers of Grade 9 mathematics and other personnel who directly support students in Grade 9 mathematics classes – including the principal or vice-principal. During the meetings, the participants discussed various aspects of classroom practice, such as challenges and successes encountered, the types of assessment used and examples of questions posed, connections to the curriculum, as well as what influenced and/or constrained classroom practice. For example some cases worked on improving student's algebra skills, others on increasing technology use in the classroom or creating more engaging mathematical activities. Multiple cases worked on creating and incorporating more rich tasks into their classroom teaching by leaning on the work of Smith and Stein (2011) presented in the *Five Practices for Orchestrating Mathematical Discussion*, and on creating growth mindset among their Grade 9 Applied students (Suurtamm, 2017). Some cases also incorporated ways to address the EQAO assessment in their classroom teaching.

As well as recording the full-day monthly meetings, individual interviews were conducted with participants at the end of each of the two years of the project. All of this data was audio recorded and transcribed. For the analysis purposes of my research project, I had access to multiple sources of data such as audio files and transcripts of monthly meetings and individual interviews. Given that my research began after the completion of the OAME project, I also had access to the research reports published as part of the findings of the OAME project. An extensive list of all of data available is attached in **Appendix C**.

My role as a researcher in the OAME project

In the second year of the project, I participated as a Research Assistant for one of the PLCs. During this time, I not only assisted at all of the monthly meetings with the PLC, but I was also responsible for the transcription of these meetings as well as drafting monthly research reports on the data collected. For this reason, I was familiar with the participants, the type of data collected and the nature of the conversations that took place during data collection. More importantly, when I chose the OAME project to conduct a secondary analysis of data, I was aware that the topics of the EQAO assessment and classroom practice were addressed by members of PLCs on multiple occasions. Thus, I hoped that a secondary analysis of this data would allow me to answer the research questions proposed for this study, all the while giving me access to a more-extensive pool of participants to select from.

Data selection

The data collected over the two years of the project was extensive and required careful examination in order for me to select the data most pertinent to my research. Having been part of the research team and having read the research reports for the larger OAME research project, I had a pretty good idea of which PLCs had discussed the Grade 9 EQAO and/or had reported using the assessment in any way in their practice. As planned, I began my data selection with a preliminary word search through all of the transcripts of all of the PLCs; I used keywords such as "EQAO", "provincial test[ing]", "mandatory assessment", "evaluation" and "test preparation", to name a few. I hoped that this initial word search would allow me to determine the extent to which individual PLC had discussed the topic of the Grade 9 EQAO Assessment of Mathematics, and I further hoped it would guide my selection of PLC data to work with. The word search revealed many hits and reaffirmed which cases I should begin with. Thus, I selected some PLCs for more careful reading and began by looking over the transcripts that contained the words from my search. Although I was hoping this strategy would help me determine the extent to which EQAO was used in the PLCs' conversations, this was not the case. Because I was unfamiliar with the data from all but one of the PLCs, I had a hard time getting an accurate grasp of the PLCs' conversations and the context in which EQAO was used. Therefore, I had to come up with a new plan.

Since I decided to change my strategy, I considered that reading the transcripts in chronological order would perhaps give me the best idea of how each group may have used

EQAO in their conversations, all the while helping become familiar with the PLC and its members. My original plan was to discuss and analyze three different PLCs; however, choosing which one to begin with was not an easy task due to the vast amount of data available for analysis. I decided to refocus my attention on one of the PLCs that I considered might begin to help me address the research questions guiding this study. Thus, I began with the PLC that I was most familiar with: the PLC for which I was previously a Research Assistant. Being familiar with the data from this PLC, I was aware of the nature of conversations that participants from this PLC had, and I was aware that the EQAO had been discussed by the participants several times during their meetings. After carefully reviewing all of the transcripts of this PLC in chronological order, I began coding the data. As I progressed though my coding and began the data analysis, I realized that there was much more to the data than what I had originally expected. Thus, I allowed myself to dig deeper into the data from this PLC. My analysis of the data revealed that the extent of this PLC's conversations about EQAO and their model of teaching was sufficient to help me address the research questions intended for my study. Because of this, and given my timeline for completion of this research, I decided to focus my findings around this particular case. Using one case study for analysis and discussion has its own benefits such as being able to provide an in-depth analysis and discussion of this particular group of teachers, their views and classroom practices.

The PLC: The data I worked with

The PLC's participants consisted of various teaching and administrative school personnel from a high school of approximately 1500 students. The team's members are as follows:

- Ruth, Department Chair / Grade 9 Applied Mathematics Teacher
- Tony, Assistant Department Chair / Grade 9 Applied Mathematics Teacher
- Natasha, Grade 9 Applied Mathematics Teacher
- Molly, Grade 9 and 10 Applied Mathematics Teacher
- Beatrix, Grade 10 Applied Mathematics Teacher (Year 2 only)
- Dean, Mathematics Board Lead
- Edna, Special Education Resource Teacher
- Celia, Vice-Principal.

For the purpose of my research study, I used solely audio recordings and the transcript of these recordings from both years. No other personal notes, or notes shared with me by the participants at the time have been used in my data analysis. More specifically, the data I used for my analysis included solely monthly interviews from the first and second year of the research project, as well as individual interviews with some of the participants, conducted at the end of the second year of the project.

There were 5 PLC meetings conducted in the first year of the project, and 6 PLC meetings in the second year of the project. These meetings varied in length and number of participants present. However, most PLC members were present. Although the administrator (in this case a vice-principal) was present at nearly all of the meetings, she attended the meetings for only a portion of the day, usually due to other school-related engagements. The department head was present at all of the meetings, but on two instances joined the team later in the day.

The agenda for the monthly meetings was created collaboratively by the participants who brought forth items for discussion. Meetings consisted of collaborative work, and the team often worked together to develop lessons, and to review and create materials and classroom assessments. Team members also reviewed student work, discussed student progress and engagement, made further action plans, and shared personal experiences from the classroom.

In addition to the monthly meetings, individual interviews were organized with four of the participants: the department head, the assistant department head, a Grade 9 teacher, and the vice- principal. A list containing more details about each PLC meeting and individual interview is presented in **Appendix D.**

How other PLCs incorporated EQAO in their practice

This PLC was not the only PLC that incorporated practices to address the Grade 9 EQAO assessment. Other PLCs addressed the EQAO assessment in their practice in various ways. For instance, different PLCs looked at "student results on the Grades 3 and 6 assessments, considered ways to prepare students for the EQAO assessment, modeled EQAO questions in classroom assessments, and used data or questions from student attitude surveys to get an understanding of students' views" (Suurtamm et al., 2017, p. 145). Of these different practices, two were most common. Multiple PLCs used EQAO results mostly to track student progress across grades and to create learning experiences that would target the specific needs of the students, as identified in previous EQAO results. PLCs also dedicated classroom time to familiarize their students with

the EQAO assessment, such as by presenting students with sample EQAO questions or discussing the format of the assessment. The practice of familiarizing students with the EQAO assessment was modeled by many of the PLCs, and teachers were reported to wish that their students be prepared for the EQAO assessment (Suurtamm et al., 2017).

Although multiple PLCs incorporated classroom practices to address the Grade 9 EQAO Assessment of Mathematics, I chose to focus and analyze one particular PLC, as discussed above, for a few reasons. First, as mentioned, I was familiar with the PLC and its members, having worked as a Research Assistant and having participated in their PLC meetings during the second year of the project. This, I considered, would give me an advantage when analyzing the data, as I already had an understanding of how the team worked and what were some of the practices that the PLC members had engaged in. Second, I chose this particular PLC because as I re-read the transcripts, I realized that this PLC had incorporated multiple aspects of the EQAO assessment in their classroom teaching. Therefore, I considered that using this PLC would allow me to present a more comprehensive and overall deeper analysis of one particular case of teachers.

Ethical considerations

Pseudonyms were used for the participants in the original project; however, in order to further protect the confidentiality of the participants, I used new pseudonyms for each of the speakers, as well as their school and school board; student and teacher names were also excluded from any transcripts. Furthermore, in my analysis, I did not include any descriptors that could compromise the confidentiality of the participants or the school.

Trustworthiness

As I used secondary data analysis and did not have contact with the study participants for the purpose of verifying the data, I relied on other means to assure the trustworthiness of my results and reduce the errors in my analysis. For example, in addition to coding some of the data together with my supervisor who was also familiar with the data, I had cross-referenced my interpretation of the data with the data found in the final reports of the study by Suurtamm (2015) and Suurtamm et al. (2017).

Data analysis and interpretation

My data analysis was designed to answer the following research questions:

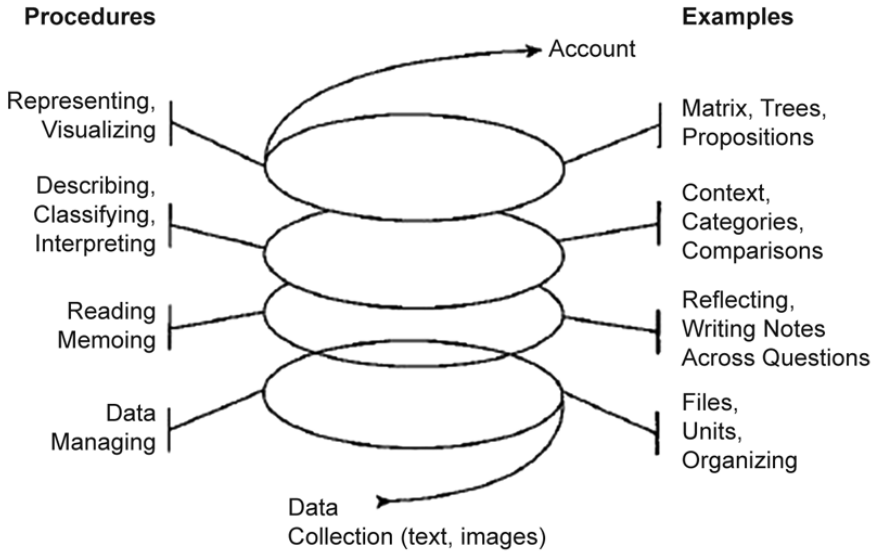
1) How do Grade 9 mathematics teachers view the Grade 9 EQAO Assessment of Mathematics?

- What do teachers perceive to be some of the benefits and concerns of this assessment?

2) In what ways, if any, do teachers' views of the mandatory Grade 9 EQAO mathematics assessment interact with their teaching practices in the classroom?

Originally, I planned to conduct my data analysis by using the Data Analysis Spiral (**Figure 3**) and following the steps presented in **Table 1** (both models adapted from Creswell, 2013).

Figure 3: Data Analysis Spiral



Reprinted from Creswell, J. W. (2013). *Qualitative inquiry & research design: choosing among five approaches* (Third edition.). Los Angeles: SAGE Publications. p. 183

Table 1: Data Analysis and Representation

Data Analysis and Representation	*Specific Actions (as originally planned in the Proposal)*
Data organization	-Selecting the data to be used for further reading -Transcribing any missing relevant passages -Organizing data chronologically within each applicable case
Reading, memoing	-Multiple readings of the selected transcripts for familiarity purposes -Taking marginal notes and writing reflecting passages -Identifying key ideas and concepts

	-Identifying the big picture ideas -Using the big ideas to create initial categories
Describing the data into codes and themes	-Providing a detailed description of the data -Creating an extensive list of codes and themes
Classifying the data into codes and themes	-Grouping codes into themes
Interpreting the data	-Interpreting the data using the Theoretical Framework and the Literature Review
Representing, visualizing the data	-Presenting an in-depth description of the cases using various means of representation, as required

Adapted from Creswell, J. W. (2013). *Qualitative inquiry & research design: choosing among five approaches* (Third edition.). Los Angeles: SAGE Publications. p. 190-191

When I was writing my thesis proposal, I came across the Data Analysis Spiral figure and its step by step visually more simple linear process presented in the Data Analysis and Representation table above. I then used this table to determine the specific actions which I had anticipated I would go though in my data analysis process. However, as I began the process of data analysis, I discovered that in reality, the process was less linear than the step-by-step progression presented in the table; instead, the process, was more-accurately depicted by a spiral, a series of recurring steps, that got deeper and more detailed with every read of the transcripts. Hence, the Data Analysis Spiral depicts a more accurate experience of how I conducted my data analysis; I will discuss this below.

Once I decided on the data to work with, I began by organizing this data in an order that made sense for me: as mentioned, I began my data analysis by first carefully reading all of the transcripts of my chosen PLC, in chronological order, beginning with the first year of the project. As I read, I made margin notes and comments about some of the things I noted, or connections I began to see. In order to help me structure and visualize all of the pieces of my research, I created a color-coded analysis scheme. This scheme was divided into 4 categories, inspired from my theoretical framework; it contained the following color-coded bins:

1. Teachers' views of mathematics and mathematics teaching [red]
2. Teachers' intended model of teaching mathematics [blue]
3. Teachers' enacted model of teaching [yellow]
4. Teachers' views of EQAO and/or any mentions of EQAO [green]

As I read through the data, I highlighted relevant portions and quotes according to the bin that they corresponded to. For example, portions and quotes relevant to teachers' intended model

of mathematics were highlighted blue, while portions related to their enacted model were highlighted yellow. Once all of the transcripts were colour-coded and I had placed all of the relevant pieces in their corresponding bin, I used a macro setting and tables in Microsoft Word to group all pieces of each colour together. Since the themes corresponding to each coloured bin were very vast and encompassing, the bins contained a lot of information. When trying to make sense of this data and organize it in a way that made sense, I got stuck.

I turned to my supervisor, and together, we dove deeper into the data. We began by looking at one of the individual bins, reviewing the quotes therein, and still keeping them in the same bin, doing a second layer of coding using more specific codes. For example, a quote that I placed in the bin labeled as "intended model of teaching", now had a secondary coding of "classroom assessment", another "reorganizing the curriculum". Thus within each bin, I regrouped the data according to this additional analysis which helped me make sense of the data. Once most of the quotes were coded in more specific terms, we printed them, cut them into pieces, and proceeded to group similar ideas together within one of the bins. As we did this, themes and ideas started to emerge.

I continued with this method at home, on my own. As I got a better understanding of how to organize the data, coding the quotes became an easier task. To make sure that everything was included in my analysis, I reviewed all of the transcripts once again, this time going through more carefully and making sure that the pieces I selected had a specific code; as I was reading, quotes either fit with existing codes or were used to create new ones. Once I had coded all of the data, I grouped all pieces together by theme. In order to see the 'big picture' of my data analysis and see how the themes fit with my proposed theoretical framework, I placed all of the themes up on a wall. I shifted and re-arranged the themes until I noticed connections –both between themes and with my theoretical framework. Then, I matched each theme to a section in my theoretical framework and came up with an initial structure for the discussion of my analysis; following, I proceeded to write about these themes. As I wrote and my supervisor reviewed my work, we found that some of the themes fit better into other sections; thus, my original structure underwent multiple changes before I arrived to its final structure. I will discuss this in the following chapter.

CHAPTER 6: FINDINGS

In this chapter I discuss my research findings. As mentioned, I decided to organize and discuss my findings in a way that is aligned with my theoretical framework. More specifically, the elements presented in my findings are directly related to the way that theoretical framework is organized. However, before I proceed to discuss teachers' views of mathematics and teaching, their intended model of teaching and their enacted model of teaching, I begin by discussing the way the team worked and interacted and what they had planned for the two years of the research. This section is particularly important in setting the stage and creating a connection between teacher views of mathematics and mathematics teaching, their intended model of practice, and their enacted model of practice.

How the team worked

The team described themselves as a "department [that] is always finding new ways of doing things and always moving forward" (Group meeting, December 2014). The teachers reported being excited to be part of this research project opportunity. Specifically, they often discussed the importance of being able to take time together to collaborate and be able to work towards achieving their goals. As such, the majority of their meetings were spent creating materials and activities for the Grade 9 Applied course. In some cases, teachers also co-taught courses, including some of the sections of the Grade 9 Applied course, and a Grade 9 "Bridge" course. This "Bridge" course, created and co-taught by two teachers who are also the department and assistant department head, served as a preparatory course for students who were not yet ready for the Grade 9 Applied mathematics course.

During meetings, the teachers constantly interacted with one another by asking questions, seeking confirmation, or brainstorming suggestions or ideas; some of the teachers also reported that they constantly collaborate and communicate with one another. For example, the teachers said that when they were asked, on the EQAO teacher questionnaire, how often they collaborate with fellow teachers, they realized that they collaborate every day. They openly discussed this during meetings. Reflecting about their team dynamic, some of the participants discussed:

> **Natasha**: Oh I think we got a pretty good group.
> **Molly**: We do. I like our group.

> **Natasha**: I like our group. And it's funny, like, when we do things, say for EQAO, and they have those questions like "how often do you collaborate with other group members?", like in reality, we collaborate every single day.
> **Molly**: Umm hmm!
> **Natasha**: We're always, "what should we do here, what should I there, what are we doing?".
> **Molly**: Sometimes at night, [I am texting my colleagues] "what are you, like...". (Group meeting, October 2015)

This group also reported being willing to experiment and try different things in their classroom; the team reported that they took the approach of trying everything once. The department head discussed:

> **Ruth:** I think we are pretty good at giving ourselves permissions. We have all been doing this long enough that the idea of it not working doesn't scare us anymore. Like we are all at that stage like, "Well, we are going to try it and if that works, great and if it doesn't then we'll move on!". (Group meeting, December 2014)

The team members reported that their school is particular about the teachers that they assign to teach the Grade 9 Applied courses. In their opinion, it is important to always have a full time contract teacher as opposed to a temporary long term occasional (LTO) teacher teach the Grade 9 Applied course, because that way, the students can feel safer and are more likely to enjoy the course. The department head discussed:

> We try to put contract teachers in Grade 9 classrooms rather than LTOs…we want the Grade 9s coming to have a really positive experience and from when they first get here. And that's not to say that LTOs can't give them that but, um, I just always feel better when the Grade 9s are coming into the safe custody of our contract teachers which I always know are fantastic because sometimes you don't always have a say in who is coming in knowing enough about them…(Group meeting, April 2015)

Overall, these teachers' discussions and interactions showed that the team strived to be unified in their decision-making and in how they taught the Grade 9 Applied course. At the beginning of the research project, the teachers came up with unified goals for the Grade 9 Applied course. During meetings, the teachers worked to ensure that the course sequence, assessment strategies, and even some of the classroom activities were the same between the different sections of the Grade 9 Applied course. The department head talked about the team's reasoning behind this:

> **Ruth:** I do think it's important to have a shared vision. I don't think it's important that everybody does the same thing on the same day, but I do think umm, like in any good

> relationship, common values and common goals help you. Right? And so, it's sometimes trying to create, like have that common [goal] and still having everybody feel like they're heard, so that there's still a lot of respect happening, and everybody feels comfortable and safe to say what they want to say, but you're still sticking together as a team. (Personal interview, May 2016)

What the teachers want to achieve: Goals for the Grade 9 Applied course

Before proceeding to discuss the teachers' intended and enacted models of teaching, I would like to first discuss the teachers' goals for the Grade 9 Applied course. These goals are an important piece in creating the link between the teachers' intended and enacted models of teaching, as I will discuss later. The teachers' goals for the Grade 9 Applied course refer to what the teachers wanted to accomplish in the course, during the two years of the project. This information is important as it ties to the way that teachers decided to carry out their plans in the Grade 9 course, in a way that seems to be aligned with their goals.

As a team, the teachers collectively came up with two main goals for their work related to the Grade 9 Applied mathematics course: increase student engagement and increase student perseverance.

Engagement

Student engagement in the Grade 9 Applied mathematics course was an important piece in this team's teaching plans. As such, engagement came up many times in conversations. Although the team chose student engagement as a focus for this research project, they revealed that they have been working on achieving higher levels of student engagement in Grade 9 Applied course, long before the project started:

> **Research Assistant:** So how long have you been working, focusing on this engagement? Has this been a long term or is it just when this OAME [project] started?
> **Natasha**: How long ago did we start teaching? [Laughter]. (Group meeting, January 2015)

In discussing student engagement, the department head mentioned: "we just wanted more engagement […] it wasn't the problem that we didn't have any, we just wanted more (Group meeting, December 2014). Some of the teachers also reported that sometimes, students in the Grade 9 Applied mathematics course are reluctant to participate in the classroom and often prefer to let others do the work. For instance, at the beginning of the project, one teacher reported

reluctant behaviours in her Grade 9 Applied class, even when compared with the same Grade Academic students. She said:

> **Natasha**: To give you an example because I have a 9 Applied and a 9 Academic this semester. I will put a question out for the 9 Applied class to answer. There will be two kids working on it and 21 waiting for those kids to work on it and somebody else to put the answer up. (Group meeting, December 2014)

At a different time, another teacher reported similar reluctant behaviours when she explained how, compared to students in higher Grades, her Grade 9 students were less enthusiastic and engaged in the classroom, even when partaking in active, standing mathematics and writing on white boards on the walls:

> **Ruth**: September was my first time when I had, when I could get 34 kids up and have room to do it, and it was a 12U Functions class, it was un-believable. So I'm finding it, there's still up [working at the board] in Grade 9, but I'm finding it, they need to be coaxed a bit more. The 12U kids are so motivated that they automatically want to look at people's answers and share and figure out what it is. Whereas the Grade 9's, umm some of them are still quite happy to have somebody else write, and be like "okay, I don't have to do the work". So we're still working on that. Even my 9 Academics are willing to... Yeah, just be observers and not be active participants, yeah. So that is something that we've continually talked about. (Group meeting, March 2016)

Thus, engagement is a topic often discussed by the teachers as they hoped to be able to improve the level of student engagement and increase student willingness to participate in classroom activities.

Perseverance

Increasing student perseverance in the Grade 9 Applied mathematics course was the team's second goal. The department head discussed the team's reason for choosing to work on student perseverance by saying:

> […] originally when we were talking it did start with perseverance. We were getting really frustrated with the amount of effort that an Applied level student would spend on something before they gave up. Like... it wasn't long. Like it would be like, look at a question and "I can't do this!", without even trying. (Group meeting, December 2014)

One strategy that the team planned to use to increase perseverance was by having students "working on tougher thinking questions and setting up broad thinking and giving them tools to strategize" (Group meeting, January 2015).

In developing student perseverance, some of the teachers also hoped to help their students become more autonomous, independent learners, as one teacher discussed:

> **Natasha**: I want to be careful in that we're not preparing these kids properly that they, they will sit back and [say] "I don't have to look for it cause the teacher's gonna give it to me" [or] "I don't have to keep that [paper] cause the teacher's gonna give it to me". We are trying to develop independent learners as well. (Group meeting, October 2015)

The teachers also considered that it is important for students to understand that to some extent, students are responsible for their own learning and that the decisions they make have consequences; Natasha further added:

> Again, if we can look at the perseverance, intrinsic motivation, cause as we were saying we have got kids that don't finish assignments and need to come in and then [say] "I forgot, can I do it tomorrow?" so you give them until tomorrow. "Oh I forgot! Can I do it tomorrow?" At some point you have to say, "If it was important to you, you would be here". So, making it important for them. And I don't think some of the Grade 9s understand that there are consequences if they fail the course they have to do it again. I don't think that is fully set into them. (Group meeting, December 2014)

Overall, this group of teachers also considers perseverance to be an important life skill. For example, Molly, one of the teachers discussed how at the end of the school year, students may not remember all the mathematics that they were taught; instead, she said: "the process that they went through, and how they struggled and kept going, and revamped and tried something different, that they will [remember]. And so that made me happy, as a teacher. That I'm teaching them a process that's going to help them any time in their life" (Group meeting, April 2016).

Summary of how the team works and what they hoped to achieve

Looking at the way the team works and interacts, the teachers reported ongoing collaboration and partnership with one another. In their conversations, the teachers also reported being unified in their decisions about what material to teach their students, and the means to teach that material. Furthermore, when describing themselves, the teachers discussed their own willingness to experiment and try new things in the classroom. Lastly, the teachers revealed that they are particular about the way they teach their Grade 9 Applied courses, and also particular about who gets to teach these courses. In coming up with a plan for the 2 years of the research project, the teachers also created two goals for their Grade 9 Applied courses: increase levels of student engagement and perseverance; the teachers felt that those two attributes were elements in their Grade 9 Applied courses that could be further developed.

I. VIEWS OF TEACHING & INTENDED MODEL OF TEACHING

This section of my data analysis consists of two topics: the teachers' views of mathematics and teaching, and the teachers' intended model of teaching. I discuss each of these sections separately, and then provide a summary of my findings.

VIEWS OF TEACHING AND MATHEMATICS

In looking at this group of teachers' views of teaching and mathematics, I also discuss their views of how students learn, and their opinions about growth mindset and mistakes. These topics were often discussed by the teachers and are pertinent to their views of teaching and mathematics.

Views about teaching and mathematics, and teachers' roles in the classroom

The teachers' views about mathematics and teaching are often revealed in their conversations. These views surfaced through the teachers' discussions about their goals, and how they planned to achieve those goals in their classroom. In these conversations, the teachers discussed various things such as what they expected their students to take away from a certain classroom activity, how they planned to constructively challenge their students, and what goals they wanted their students to achieve.

Conversations revealed that these teachers attribute particular importance to the learning process that students go through when they learn a concept. For example, the teachers seemed to agree that having students understand a concept was much more worthwhile than memorizing a formula. One of the teachers discussed:

> **Tony**: Whenever we do have like any kind of formulas like our 3D formulas or our 2D formulas, we always have them in our Survival Guides, and those are one of the units when we say "refer" to them. Use the formulas. I don't want you spending the night before memorizing the formula. I want to know, "can you use the formula? Do you know what it means and what applies to what?". So we are there, which is hopefully reassuring as well. (Group meeting, October 2015)

Thus, from statements such as the one above, the teachers showed that they favour an active understanding of a concept over rote memorization.

These teachers' views about their role in the mathematics classroom were also revealed when some of them reported on classroom practice. For example, Tony, the assistant department head discussed how he introduces a new concept to his students:

> If there is a new concept, I'll kind of introduce it but then I let them explore the problem and try to figure it out how to do it together, I do a lot of vertical classrooms where I just go around and have little conversations with the groups, umm, it's just amazing and then we share afterwards. So I kind of just facilitate what's going on, and ask leading questions. (Personal interview, May 2016)

In describing his technique, Tony identified himself as a facilitator of mathematics, one who offers students guidance but also allows students to explore mathematics on their own. Other teachers often showed similar approaches when discussing their role in the classroom, such as when they reported encouraging their students to try things on their own, without much help from the teacher.

Generally, this group of teachers reported rather unified views about teaching and mathematics, as well as the teachers' role in the classroom. However, on a couple of instances, a difference of opinions was reported, such as when some of the teachers discussed their role in the mathematics classroom, in relation to their participation in professional development (PD) opportunities. For example, early in the research, Molly, one of the teachers reported having had strong feelings about PD days, which she felt had a negative impact on her ability to teach her students, as PD days required time away from the classroom and her students; Molly considered that she needed to be physically present in the classroom in order for her students to do well in the course. Although Molly reported subsequently changing her perspective towards PD days, it is interesting to note that her initial feelings were not shared by her department head, Ruth. Ruth considered that professional development was an important part of becoming a better mathematics teacher, and encouraged all of the other teachers to participate in professional development opportunities, without feeling guilty. Ruth, the department head shared:

> I have always expressed that I think professional development is important, you should never feel bad about it, umm, when you want to better yourself, that makes you better for all students […] I'm hoping that Molly will go on more PD and will not feel bad about it anymore, and just take the time that you need to take to learn. Like we [teachers] all still have lots to learn. (Personal interview, May 2016)

On another instance, some of the teachers were reported to have had a different opinion about what sort of activities would be appropriate to use during classroom instruction or on classroom assessments. For instance, Ruth, the department head described that her views towards what her Grade 12 students should be allowed to do on a classroom assessment did not align with the

views of her colleagues; since she could not 'sell' the other two teachers on her idea, she decided to drop it. She recalled:

> I tried to convince actually [two fellow teachers], who also teach Calculus, in the Optimization unit to give the questions to the kids and then allow them 15 minutes to chat to each other - not write things down, but 15 minutes to chat to each other. Cause there's no way you're gonna learn what you have to learn about optimization in 15 minutes. But it could take away some anxiety and it could help them [decide] where to start and they could talk about formulas, and relieve that stress and then let them sit down and write the test. But I could not convince them to do it […] One of these days I'll convince them. Or, I said if I was teaching this course of my own, this would for sure be... I would for sure do that. (Personal interview, May 2016)

While some of the above-mentioned examples show a possible existing difference in opinions regarding their views of teaching, overall, teachers showed themselves to be unified in their views about teaching, mathematics, and their role in the mathematics classroom.

Views about how students learn

In deciding their goals for this research project, and the things they wanted to achieve in the Grade 9 Applied course, the teachers discussed and took into consideration how students learn. Some of their views about how students learn come from past experience, however, the teachers also often consulted with Edna, their Special Education Resource Teacher to validate their ideas and clarify their concerns. Conversations revealed that the teachers believe that student learning happens when students are comfortable in their classroom environment, when they are confident in their mathematical thinking, and when they are engaged in the mathematics classroom.

Some of teachers considered that confidence is a very important aspect of student learning. For example, one teacher reported on her students' progress in the course by saying:

> **Natasha**: I think that starting with the geometry gives them confidence, so that when they tackle the algebra and the linear relationship set. I donno, they just have more confidence to try things, they're not afraid to be wrong, so I'm pleased with the way it's going. (Group meeting, January 2016)

According to the teachers, boosting the students' confidence in their own mathematical skills allows the students to take risks in the classroom and thus helps students persevere in the classroom and further their mathematical journey. Another teacher supported this argument when

he reported that during a classroom activity, once the students warmed up with easier, less-challenging questions, they were "begging" the teacher for harder, more-challenging questions.

In discussing student confidence in the mathematics classroom, most of the teachers also mentioned the importance of allowing students to explore mathematics on their own with only some guidance from the teacher; one teacher said:

> **Molly**: Their confidence is built all semester, and they like... I gave them like x to the power of 4 minus one, or minus 16, the other day. I'm like "okay, go!". And they stop and they're like "is this right?", I'm like "almost, almost, almost" and then they were like "well what is it? oh look there's another one!" and they were like attacking it; it was unbelievable. And like that's an academic question. Easily. And my 11 U's forget all the time. The kids rocked it. Like their confidence and their enthusiasm is unbelievable. (Group meeting, January 2016)

In an earlier meeting, another teacher expressed a similar view by saying:

> **Natasha**: I think, you have to challenge them to see where that line is, and you have to read your kids. Don't always go to the spoon feeding first. See what they can do, and then gauge how much support they need. (Group meeting, October 2015)

One teacher discussed the importance and benefit he discovered by giving his students the opportunity to do math, rather than have him do the math for them; he explained:

> **Tony**: My students are having more fun than ever, they're having a deeper understanding because they're not watching me do math. They're doing the math, they're having the conversations, they're doing the thinking. Um, I think sometimes we underestimate –I used to underestimate– what they're capable of doing. (Personal interview, May 2016)

The teachers seemed to agree that engagement and perseverance were very important in student learning. More specifically, the students' levels of engagement, the teachers considered, are also linked to how comfortable the students are in the classroom. At one of the meetings, some of the teachers discussed their goals for the Grade 9 Applied course and made the following remarks:

> **Celia:** That's the objective here, right? Increasing engagement. Making [students] comfortable, persevering and struggling, resiliency.
> **Tony:** And I think that perseverance comes if you're comfortable. Because you aren't going to take a risk and persevere at something if you aren't comfortable with it. The teachers considered that students who feel comfortable in the classroom will also try harder, take more risks and continuously persevere. (Group meeting, April, 2015)

In their discussions about how students learn, all of the teachers also often consulted with one another and shared teaching experiences and student examples from their classes. At a particular meeting, the team engaged in an active brainstorming session in which they discussed several strategies for classroom inclusion of all students with Individual Education Plans (IEPs). During this meeting, the team brought up actual students from their classrooms, and collaborated in coming up with teaching and classroom strategies to help all their students become more successful in the Grade 9 Applied classroom. For example, for a student who was reported to get distracted and get off task easily, the teachers came up with the idea of giving him a paper clip to "fidget" with while working on his tasks –thus, the teachers reported, that the student will be focused on task while playing with the paper clip quietly.

Although some of these particular strategies were related to individual students, by making them part of their discussions and taking the time to come up with such strategies, the teachers showed the importance that they attributed to paying attention to how students in the Grade 9 Applied classroom learn.

Views about growth mindset

Growth mindset appeared to be a very popular and current topic in the province of Ontario as it was discussed by many of the PLCs. The model of growth mindset is based on the work of Dr. Carol Dweck, who defined growth mindset as the belief that "intelligence [and abilities] can be developed" (Dweck, 2015, p. 24). The opposite of growth mindset is the term 'fixed mindset', which refers to a belief that intelligence and abilities cannot be changed. At the time of the OAME project, many teachers had been exposed to the idea of growth mindset and decided to pursue activities that fostered a growth mindset in their students.

In this section about growth mindset I have focused on two aspects: student growth mindset and teacher growth mindset. Although this group of teachers promote growth mindset in their students, they also discuss their own growth mindset. Growth mindset however is not solely a team view, but it is also reported to be a board-wide initiative, as Dean describes: "we have been doing a lot of work across the board on promoting growth mindsets try to foster them with students certainly but also with our teaching staff. Really try making that a key goal of our professional learning" (Group meeting, January 2015). I will address student and teacher growth mindset individually.

Student growth mindset

The teachers believe that it is important for students to have a growth mindset. All of the teachers reported that often, their students entering the Grade 9 courses come in with certain preconceptions about their own mathematical abilities and skills. More often than not, students were reported to feel that they did not have the abilities and skills to succeed in mathematics. For this reason, before even being exposed to high school mathematics, students already had the preconceived belief that they were not good at math; this, the teachers reported, caused students to shut down and not even attempt mathematics questions. As a means to change students' fixed mindset, the teachers reported engaging students in various activities to promote student growth mindset. For example, some of the teachers reported that on the first day of every Grade 9 Applied course, they spend the entire class period doing growth mindset exercises with their students; some of these exercises include watching mindset videos and creating a mindset spectrum with their students.

One of the teachers explained that by engaging students in these types of growth mindset exercises, students begin the course with the belief that everybody can do math if they are willing to try, regardless of their previous mathematical abilities. He said:

> **Tony:** The first day of the semester we don't even talk about math, really. We do a whole day on mindsets, and so we have a couple videos we used to look at. Michael Jordan, there's a whole article of Michael Jordan that we used. There's a whole activity where we take different statements about one from a fixed mindset, one from a growth mindset, etc. and they take it and decide what they agree with, what they don't agree with, and we talk about it as a class. And they write about that, but the whole day is just about mindset. And creating this belief that you can do math and shutting that belief down like that whatever your ability is you are stuck there. (Group meeting, April 2015)

Although the teachers did not discuss their justification for doing this particular activity, it was evident that they considered it to be important in fostering growth mindset in their students, and furthermore, they considered it a necessary step in the initiation of students to the Grade 9 Applied mathematics course.

Throughout the rest of the year, other teachers reported using other strategies to instil student growth mindset. For example, some teachers show students inspirational videos to share the message that mathematics is indeed for everybody and that basic mathematics skills are important. Molly discusses:

> We subscribe to a channel called The Futures Channel. It has a whole bunch of real life applications to math science so we found a great little video on geometry and its relation to architecture and it is actually talking about the Trump Tower and it's only three minutes long but in the video it says the architect...very simple concepts, a lot of people would think that you have to be some kind of math genius but really all you need is the basic skills and the enjoyment of building things so just that whole encouraging them that you don't have to be some kind of genius to get some places; you just have to work on basic skills. So we are going to start our next unit with that video. (Skype discussion, February 2015)

By showing students these inspirational videos, the teachers hoped that their students would develop the mindset that everybody can do math; that even having only a basic knowledge of math skills can build to great things in the future.

Another strategy that some of the teachers used to promote student growth mindset was getting students to set learning outcomes and goals for each unit in the course; in this process, the teachers encouraged their students to set realistic and achievable goals for each unit, goals that were not related to percentage grades. One of the teachers discusses an example:

> **Ruth**: One of my students for example in my class, I think his mark is somewhere in the 90s and his unit goal for this unit 3 was to pass. And so I said to him "you know what, I don't think that you are not setting your goal high enough. Like you don't want to just pass and have the ability to…so I think you have to revisit your goal and see if you can maybe push your potential a little bit don't just give yourself a…" –which is funny because today that student came to talk to me about taking, if I thought he was capable of taking the academic course. (Phone discussion, March 2015)

The teachers also began the Grade 9 course with less complicated units as a means to promote growth mindset in their students. They considered that this strategy helps to build student confidence from the beginning and gradually eases students into more complicated mathematical concepts. One of the teachers explained:

> **Natasha**: When you get to the algebra you don't get as many kids saying anymore, "Oh I'm bad at this". In my 9 Applied, I had two kids say "oh this is the unit when I'm not gonna do well in". But it was a third of the way through the year, when they build that confidence, so I said "well, let's try, let's see what you can do". And then, like the one boy in my class, I said "see, you're doing fine in this" and he says "well I didn't get it last year..." so it's just the confidence and risk taking." (Skype discussion, February 2015)

Although often the teachers did not openly discuss their reasons behind some of these growth mindset activities, the fact that they engaged their students in these activities and the fact

that they purposely spent time and planned for growth mindset activities indicated that the teachers considered student growth mindset to be particularly important for their Grade 9 Applied students.

Teacher growth mindset

In a sense, teacher growth mindset refers to two things: the teachers' growth mindset towards their own learning as teachers, but also a growth mindset towards the students in their Grade 9 Applied courses. First, the teachers show growth mindset through a reflection of how their own learning and teaching experience have evolved over time. For example, one of the teachers discussed the importance of professional development in the teaching profession and vowed that PD days actually better teachers and benefit students in the long run. Previously, this particular teacher reported being skeptical that time away from the classroom was a positive learning experience for either the teacher or their students. She discussed how her mentality has changed over time:

> **Molly**: I think that it's a mindset thing, right? Like I used to struggle immensely, I still don't love it, but I've helped along the mindset of realizing that I've been out of school, out of my class more, and not because of sickness or anything, because of PD, more in the last 2 years more than ever have, and I'm a way better teacher. And my kids are doing way better. Like, it's just... you think that if you're not there, they're not going to learn. But you're learning to teach them to learn better. (Group meeting, March 2016)

Another way that some of the teachers show growth mindset is in their conversations about the Grade 9 Applied students. They make positive comments about Grade 9 Applied students and reflect on how their own attitude about Applied classes has evolved over the years:

> **Ruth**: [The Grade 9 Applied class] is a really nice group.
> **Tony**: It's funny though, like... when's the last time we haven't heard that when we talk about our Grade 9 Applied classes?
> **Natasha**: Is it our mindset then that's changing? Ha-ha-ha.
> **Tony**: Cause I don't remember the last time anyone said "oh wow my 9 Applieds were a handful". I don't remember the last time any of us said that. (Group meeting, March 2016)

Towards the end of the project, the teachers reported a positive outlook toward their Grade 9 Applied classes; this attitude was also shared by other teachers as well as supply teachers who the teachers reported always complimenting the Grade 9 Applied classes. Along with the teachers' positive outlook towards Applied-level courses came their newfound excitement to

teach Grade 9 Applied. Reflecting on their past teaching experiences, some of the teachers reported "enjoying the [Grade 9 Applied] course much more" and having a lot of fun teaching it.

Views about mistakes

Along with growth mindset, the teachers also believed that it was important to teach students that mistakes are okay. They reported doing so through a variety of activities that encouraged students to take risks and attempted various mathematics challenges even if it meant making some mistakes in the process. Towards the second half of the first year, some of the teachers explained some of the ways they used mistakes in their classroom:

> **Ruth**: For lessons [...] like geometry [...] we gave them a sheet where there was actually a mistake in it and they had to pick up the mistake and then explain it and so we [the teachers] all really liked that start that started with the idea that we can make mistakes and fixing them and picking out what the problem was, so we liked that a lot. (Skype discussion, February 2015)

> **Tony:** We are intentionally making mistakes, and we always kind of talk about um, mistakes are just the best opportunity to learn, like you learn more from doing something wrong and figuring it out then you do when you get something right. So we all kind of try and push that message as well. (Group meeting, April 2015)

> **Molly:** Like we did a day where it's like "okay, now you guys make at least one mistake", so some of them made more because they aren't great at math, but it was okay. I'm like "wow I love that you did this", like we celebrated the mistakes and it gave them permission to be wrong, so they are less afraid to start. (Group meeting, April 2015)

Mistakes, the teachers considered, are also connected to growth mindset. One of the teachers discussed how mistakes are beneficial for learning:

> **Tony**: [...] That was a theme at OAME last year that…a featured speaker, was the whole idea that the only time your brain actually grows is when you make a mistake. So we've brought that in all the time, and when I go to students and they are working and someone stands up to talk and they are like "I don't know if it's right", I'm like that's okay, every answer is a great answer. So there's a comfort level, that's why that one student who talked about the fact that they feel comfortable here, like that's huge. Students feeling comfortable in the room and not afraid to take risks with math, and that's... I think that something we all strive for. (Group meeting, April 2015)

In encouraging students that mistakes are okay, the teachers reported that their students became more comfortable in the classroom, and were therefore more willing to take chances and attempt solving mathematical questions.

Summary and discussion of teacher views

Looking at these teachers' views of mathematics and teaching and comparing their reported views of mathematics and teaching to Ernest's (1989a) suggestions from **Table 2**, this particular group of teachers' views seem to best align with Ernest's "Problem-Solving" teacher description. As per Ernest's description, the problem-solving teacher's role in the mathematics classroom is that of a facilitator of mathematics –more so than an instructor or explainer. Ernest further suggests that the problem-solving teacher expects that his/her students will develop an active construction of understanding of mathematics and/or will seek to engage in autonomous mathematical quests.

Table 2: Philosophies of mathematics

PHILOSOPHY OF MATHEMATICS	TEACHER'S ROLE	INTENDED OUTCOME	CURRICULAR MATERIALS USED	STUDENT LEARNING MODEL
INSTRUMENTALIST *(knowledge of mathematics facts, rules and methods as separate entities)*	Instructor	Skills mastery with correct performance	Strict following of a text or scheme	Compliant behaviour and mastery of skills
PLATONIST *(global understanding of mathematics as consistent, connected and objective structure)*	Explainer	Conceptual understanding with unified knowledge	Modification of the textbook approach, enriched with additional problems and activities	Reception of knowledge
PROBLEM-SOLVING *(mathematics as a dynamically organized structure located in social and cultural context)*	Facilitator	Confident problem-posing and problem-solving	Teacher or school construction of the mathematics curriculum	Active construction of understanding Exploration and autonomous pursuit of own interests

Adapted from Ernest, P. (1989a). The impact of beliefs on the teaching of mathematics. In P. Ernest (Ed.), *Mathematics teaching: The state of the art*. New York: Falmer Press. p. 252

This group of teachers' view of mathematics best fits the 'problem-solving' description for a variety of reasons. For example, when describing their role in the mathematics classroom, some teachers used language similar to that of Ernest –for example, teachers referred to themselves as 'facilitators' of mathematics. Although not all teachers used the term 'facilitator' when referring to their role in the classroom, their conversations and reported classroom practice placed these teachers in the same category nonetheless.

Teachers' views of teaching signalled an attitude towards promoting a growth mindset and encouraging mistakes as a way of learning in their classrooms. Specifically, teachers often reported that they expect their students to explore mathematics and make attempts on

challenging questions, even if that means that sometimes students may make a mistake. Furthermore, teachers' views indicated that the value they attribute to the thinking process in solving a problem is much higher than the value they attribute to correct answers. This thinking process, teachers considered, is much more important and for this reason, these teachers did not put an emphasis on memorization and regurgitation of information. This view is much like in Ernest's table above, which highlights the value of confident problem-posing and solving and values an active construction of understanding of a concept much more than a compliant behaviour and mastery of skills. One of the teachers discussed an example:

> **Molly**: I didn't lead them at all in the question [on the test]. They were told "I don't care if you get the answer right, I'm not marking your knowledge, I'm marking what you thought. So just tell me, like fill this out and tell me and I can give you great marks, even if the math is wrong". (Group meeting, October 2015)

This teacher reported that despite not giving students any additional support on this question, the average for this question was 81%.

A difference in views regarding various aspects of teaching and mathematics was seldom discussed by this group of teachers. Although some difference of opinions may have existed between the teachers in this team, their discussions indicated that the teachers were generally united in their views about teaching and mathematics, about the teacher's role in the classroom, and also about how students learn and should learn. Overall, the teachers' individual and collective views of teaching and mathematics best aligned with Ernest's description of "Problem-Solving" teachers.

In the section below, I look at the teachers' intended model of teaching mathematics to determine whether their intended model is in any way similar to Ernest's description and if so, determine the ways in which these teachers' intended model might be aligned with their views as described above.

INTENDED MODEL OF TEACHING

In this portion of my analysis, I discuss the teachers' intended model of teaching mathematics by looking at the strategies that they discussed implementing and/or had implemented in order to achieve their goals of attaining higher levels of student engagement and perseverance in the Grade 9 Applied mathematics course. In a sense, the intended model of teaching that I discuss in this section may seem to overlap with the enacted model of teaching.

However, in my discussion of the intended model, I specifically do not incorporate any of the ways that teachers discussed implementing supports for EQAO. Those I will leave for the discussion of the enacted model, as the purpose of this study is to examine ways that EQAO influenced the teachers' actual practice.

Thus, the discussion of the intended model focuses on the teachers' goals for the Grade 9 Applied course, and the ways that they hoped to implement those goals. Given the nature of the OAME research project and the fact that the group meetings were conducted during somewhat uneven intervals of time, the teachers often discussed teaching strategies that they planned and had already tested out. Hence, I decided that my discussion would provide a more valuable insight into the teachers' intentions and plans for the Grade 9 Applied course if I was to use the insight provided by the teachers as their rationale for having chosen some of these specific strategies.

In summary, different than Ernest's model (see Chapter 4), my "Intended Model of Teaching" section discusses both intended and implemented strategies that the teachers planned and tested to achieve their initial goals, while the "Enacted Model of Teaching" section focuses on the aspects of the teachers' strategies related to the influences of the Grade 9 Applied EQAO assessment. Thus, I can compare the intended and enacted model with respect to how the teachers' views of the Grade 9 EQAO assessment influenced their practice.

The ways in which teachers planned to achieve their goals

In attempting to achieve their teaching goals of attaining higher levels of student engagement and perseverance, the teachers developed various strategies to implement throughout the course; these strategies were reflected as changes to the course unit sequence, classroom activities, as well as classroom assessments.

Re-arranging the curriculum

One of the strategies that the team prepared in order to achieve their goals was re-arranging the Grade 9 Applied curriculum, and redistributing the number of days spent teaching each unit. In re-arranging the curriculum, the teachers wanted to begin the Grade 9 Applied course with the Geometry unit, a unit that they considered to be easier and more engaging for students, while the units that followed became increasingly more difficult; this way, some of the teachers discussed, students may meet with some success in the first days of the course, and are

therefore less likely to be discouraged at the very beginning of the course. One of the teachers discussed:

> **Tony:** Specifically for the Grade 9 Applied, another thing that we did is we changed the order of the course that we taught in –that was a huge focus for us. We made it more accessible for students at the beginning, and started with umm, more of the measurement and the geometry-type stuff which they've seen before, and moved to the algebra partway through, and then some more complicated concepts later. Rather than slamming them with algebra right off the top. (Personal interview, May 2016)

This strategy, the teachers reported, would help students by first building their confidence in their mathematical abilities, and thus students continued to work hard in the classroom, even when faced with more complex mathematical concepts later in the course.

One of the teachers discussed that re-arranging the curriculum seemed like an effective strategy for Grade 9 Applied students because if they experience success early in the course, then students are more likely to continue to be successful in the course; she said:

> **Natasha**: If you hammer them with the hard stuff at the beginning or algebra at the beginning, they shut down and then you've lost them for the end of the year. Whereas if they can experience success at the beginning of the year, we're finding that they're more apt to take the risk, to make the mistakes. (Group meeting, January 2016)

The teachers also reported that in re-arranging the curriculum, they also changed the number of days they allocated to each unit. One of the teachers reflected on this change and he revealed: "what we used to do in 4 days, is now 3 units. And our longest unit [previously] isn't even being taught in 9 Applied anymore because it's not in the curriculum" (Group meeting, March 2016). This teacher also connected the curriculum re-arrangement to an increased student success on assessment. In an example, he used irony when he said:

> **Tony**: [On the classroom test,] there was also an optimization multiple-choice question, and I'm just looking, most of [the students] got that one. Which is kind of cool. It's funny but we didn't teach optimization years ago, they didn't do that well on this question [years ago]. Bizarre how that works [Sarcastic tone]. (Group meeting, March 2016).

Although the teachers decided on the re-arrangement of the curriculum at the beginning of the semester, they often reported constantly reflecting on the changes, such as after lessons, by debriefing with one another, by making mental notes about what to change next time, or even by having informal conversations with fellow colleagues; they also reported making tweaks to the lessons as they went along. In re-arranging the course sequence, the teachers also included more

student-centred and active classroom activities into their daily teaching, and made changes to their assessment strategies; these topics I will discuss below.

Active mathematics

In order to increase student engagement and perseverance in the classroom, the teachers developed a variety of active classroom activities; some examples of these included: having students work on white boards either at their desks or standing up around the classroom, doing hands-on activities around the school such as human graphs, Barbie Bungee Jumping (an activity where students simulate a safe bungee jump using a Barbie doll), scavenger races, and engaging in a regular targeted review day called Gap Day. One of the teachers described some of these activities:

> **Natasha**: We have brought in a lot more sort of hands-on activities and a lot more sort of chunking of materials so that we are not just 75 minutes sitting at a desk. So some of the things we have brought in: a few iPad exercises that get [the students] engaged right away. Gotta give them playtime though to take pictures and things or you are not going to get anywhere; vertical classrooms where they're up at the board, where everybody is up at the board with a partner doing things -they don't like doing presentations, at all. (Group meeting, December 2014)

The teachers considered that these various active mathematics activities are not only different than the more traditional ways of doing mathematics –such as filling out worksheets at a desk, or doing formal classroom presentations in front of peers– but they are also more engaging.

Of these strategies, the teachers reported most often using the white boards. Students work on white boards either individually, with a partner, or as a group, and sometimes, they also do informal classroom presentations and show their work to their colleagues. One of the teachers discussed that white boards in the classroom are a beneficial active strategy for various reasons: not only are the students engaged and even finish their homework questions in class without realizing, but by having students work on white boards, teachers are able to circulate in the classroom and look over the students' work and thus provide instant feedback on their work:

> **Molly**: Doing like the work on like the iPads, on the white boards, or vertically, they do get that feedback right away, and they do stay on task, and they do, you are giving, you know what I mean? Like it's harder for them to get off task if you literally do all the homework on white boards. And then you give them like 4 questions at the end. Like, they will get way more done, and there's less photocopying. And some kids don't like the white boards, so or, they still want to have something in their binder, so I'll give them the handout that was the handout anyways, and it's like "here, this is what, all the questions

> that we did. You just need to do the last three now". And they're like "what, we only need to do the last three?". I'm like "you already did all the other ones!" . Like and they don't realize how many questions they're doing. (Group meeting, October 2015)

Reflecting about the effectiveness of active mathematics classes, one of the teachers explained that because of their levels of engagement during active math classes, students also retain information better than in a traditional math class:

> **Natasha**: If you get everybody up and active, even if they're sort of watching what's going on, they're still gonna, sorta, if you make them become part of it, like, that's what we noticed with the filming outside, it took them a while to get going, even the next time that we did it, the next semester, it was the same thing; it took them a while to get going, it was motion graphs […] but at the end of it, I could... we went in, and asked "can you guys describe this graph now?". And not one kid couldn't. Not one kid couldn't do it. (Group meeting, October 2015)

Some of the teachers also reported that their students take fewer notes in the mathematics classroom. Instead, students write down important information and spend the majority of their classroom time practicing the skill in more engaging ways. Ruth discussed this with an example:

> If you looked at the notes that I take in my Grade 9 Applied class, they would fit, we call them their "Survival Guide", and they'd fit in this little booklet. It's 8 1/2 by 14, and they put in 8 sheets of foolscap, they fold it in half, we staple it and that's it. And those are the only math notes. Now if they need a second one cause they write big or whatever, they lose it, that's it, that's all we take. So... and, in my 9 Academic, it's the same. So I don't, we don't sit there and take math notes anymore, and me being up at the front, like we just jump into things. And I do not do the most talking in the room. Anymore. They do more talking, and sharing and learning and then we will... so I might consolidate something and then write it down, and then we'd write down an example and steps, or they might do that or I will start with that, depending on what skill it is I want to get across, and then we spend a lot of time like practicing or learning or going through. (Personal interview, May 2016)

Adding more active mathematics into their classroom, the teachers reported, is also a fun experience for the teachers; for example, Natasha explained how given the active mathematics lessons, she likes the algebra unit because it is a very fun and active unit: students use algebra tiles, play integer bingo or do a Kahoot! (a game-based learning platform), and she no longer considers it a "dry" unit as she did before.

Changes to classroom assessment strategies

The teachers also worked on changing their assessment methods to achieve their goals in the Grade 9 Applied course. Specifically, the team reported wanting to move away from paper and pencil assessments and instead try more active assessment strategies. One of the teachers discussed:

> **Natasha**: The other thing we have been looking at is changing assessment methods. So trying to get something more in other than just paper and pencils so our mid-term we usually have a paper and pencil exam we changed it up and it was an activity. Now, they still had to record on paper but when the kids were polled as to what they would prefer it was this activity as opposed to sitting and doing an exam. They thought it was more fun was the first word and it was good because at first they got to get out of their desks to do it then they had two more days in class to work on it. (Group meeting, December 2014)

Over the course of the research, the team reported creating and using multiple assessment methods such as: student portfolios, active midterm examinations, partner assessments, etc. Some of these assessments, the teachers found, worked better than others; as such, the teachers often reported reflecting on their assessment practices and making changes. For example, in the first year, the team used student portfolios as one of their assessment methods; however, in the second year, the team reported that they stopped using portfolios. "Portfolios were just becoming cumbersome, like they were a lot of work. We had them doing a lot of things like taking out what they were proud of, taking out what they weren't proud of, making corrections to tests, building a unit reflection" (Group meeting, March 2016). Although portfolios gave students the chance to make corrections to their classroom work and assessments, the teachers reported that it was a lot of work for both teachers and students. Instead, the teachers decided to have students create unit goals that were reflective of what students expected to learn in each unit. The teachers hoped that this practice would also create more responsible learners.

In the process of changing some assessment methods, the teachers also discussed changing the percentages allocated for the midterm and final examination in the course; in making this decision, they considered what percentages were reasonable for each assessment, and the tools that students should be able to use on these examinations –such as manipulatives, calculators, cheat sheets or formula sheets. The teachers explained that their focus was on 'authentic assessment' and ensuring that their classroom summative assessments do not consist solely of pen and paper type of assessments.

Discussing assessment, the teachers also often brainstormed ideas for specific questions to include on classroom assessments. For example, at one of the meetings, some of them had a rich conversation about creating a math question for a Grade 9 Applied assessment that consisted of a thinking component, as well as communication piece, and a calculation component.

As a team, the teachers were unified in their decisions of what model of assessment to use for all of the sections of the Grade 9 Applied course. They often spent time discussing and deciding on the assessment strategies to use in the course; the teachers considered that this way, all students are assessed the same way, regardless of the different sections on the course.

Group work

The team often reported doing in-class group work: having students sitting in 'pods' rather than by themselves, working collaboratively on classroom materials, test reviews, and even assessments. The teachers also often assigned students 'roles and responsibilities' during group work, this way ensuring that all students were contributing to the classroom learning. One of the teachers explained this:

> **Tony**: It's not just putting kids in groups and saying "work". You have to create a dynamic, you have to be actively involved in roles and things like that, and so we borrowed that idea and assigning roles has helped a lot. (Group meeting, April 2015).

The teachers prepared students for these roles through a discussion at the beginning of the semester. They reported that this strategy of assigning roles helped with the classroom dynamic and actively engaged students in their roles. Since the groups and student roles changed every unit, the teachers could assign students to specific roles. For example, during Gap Day, the teachers assign certain students with an "expert role" –students who are familiar with the unit content– and have them help their peers. Overall, the teachers reported using group work many times in the Grade 9 Applied course.

Offering guidance to students

Although the teachers often discussed making their students more independent learners, they also provided their students with guidance. Some of the teachers reported several ways of how they guided their students through activities and classroom assessments. For example, one of the teachers explained how for one of the classroom assessments, she and her students worked together through the first portion of a classroom assessment by highlighting key words and important facts about each question, then giving students time to answer the question before

moving onto the next. In this way, the teacher hoped that students would get into the habit of taking the time to read and answer assessment questions, without rushing through and missing key facts that would allow students to correctly answer questions. She said:

> **Ruth**: [I told my students:] "I know you really want to move forward, but just listen to what I say and we'll go through". So we actually went through the first two multiple choice together. Like we highlighted, talked about it: "this is where you do your work, this is what we're expecting, this is what you should do to your answer, I'm gonna give you like 3 minutes now, so just solve this question, and if you get it just relax and think about what we've talked about". And so we went through that, and then we went through the second multiple choice question, and they highlighted and they put their answer I there all together as a group, and then they circled the answer that they got. And I said "okay so the next three, you'll do the same way". But then we talked about it; we highlighted key words in the questions together. (Group meeting, March 2016)

Ruth also reported providing guidance to her students when correcting classroom tests: every day at the beginning of class, she would take 10 minutes to correct a question on the test, and ensure that all students wrote down the correct answer for future reference and exam review.

'Survival Guides' are another example of how the teachers provided guidance to their students. Survival Guides, the teachers explained, are booklets made out of 8 sheets of foolscap, folded in half and stapled, which students use for writing classroom notes and formulas. By creating these Survival Guides with their students, the teachers ensured that students take notes in class and record important information from each lesson. Teachers used Survival Guides in all of their Grade 9 and 10 courses. One of the teachers discussed how she has students use the Guides in her class:

> **Molly**: They have their Survival Guides, and I've only ever done notes into their Survival Guide. Like so, if there's something we need to write it down, we're putting it in right away. It's not like the day of the review we're doing Survival Guides, it's like "this is important, open up your Survival Guide, this is what we're writing down for today". Cause most of what I'm doing in class is white boards or chalk board or, like they're not, like we do homework on white boards, like we do... so they're doing more, and then we just write the brief notes on Survival Guides. (Group meeting, January 2015)

Although not all teachers reported using the same methods of assessment (such as when administering or correcting a test), they all reported on ways in which, to some extent they supported their students in their progression through the Grade 9 Applied course.

Helping students transition between grades

The teachers came up with different strategies to help their students transition into the Grade 9 course. As a means to help students transition from elementary school to high-school, in their classes, the teachers included models that students are familiar or should be familiar with from elementary school. One particular example of this is the 4-Block Thinking Template (**Appendix E**). In the second year of the research, and as a continuation of learning, the teachers also reported extending the 4-Block model into the Grade 10 Applied course. Talking about this template, one of the teachers said:

> **Ruth:** Yeah and we 'stole' from our elementary colleagues so like how they have the 4-Block thinking thing and we're working with that, so kids can actually write the process down so even if they don't get the question they can at least pick out what you have been told, what you have to find; any ideas you have on it, just to get them thinking about it. (Group meeting, December 2014)

As a special case, the team also created a 'bridge' course as a stepping stone for students who were not successful in Grade 8 mathematics. These students take the 'bridge' course to improve their mathematics skills and knowledge, prior to entering into the Grade 9 Applied course.

Other strategies that some of the teachers used to help students become acquainted with the Grade 9 environment included rotating students through different groups and having students work collaboratively in the classroom. One of the teachers discussed the importance of doing so, given her experience with how her Grade 9 Applied students generally interacted in the classroom:

> **Natasha:** The other thing that is interesting in the 9 Applieds – I am just comparing two classes I have so it might not be. I may be making a generalization. We do new seating arrangements every year in both classes. Last week I said to one of the kids in my Grade 9 Applied class, "Could you go give this to so-and-so" and he's like "Who's that?" This is December. We have been in the same class since whenever. My Grade 9 Academic class like everybody knows who everybody is. It's just a different social group of kids and so that was interesting which I thought and I said "This is-, well maybe it was November-, so I said this is November. It is time you got to know that person over there". And we do new seating arrangements every unit just to mix the students up, to learn other people's names, to get comfortable working with other people and so that was an interesting thing. (Group meeting, December 2014)

The teachers also helped their students make the transition from Grade 9 Applied into higher grades. For example, as a group, the teachers discussed the percentages they should allocate to the midterm and final examinations in each Grade, and the materials that students should be allowed to use on these examinations. This way, they reported, as students progress through the grades, they are met with similar experiences as in the Grade 9 Applied course, yet there is a gradual increase of responsibility –meant to assist students to better navigate through grades, and become more successful learners.

At one of the meetings, the teachers also brainstormed ideas about how to successfully incorporate strategies into the Grade 10 course; their plan was to "take what was working with [the Grade] 9s and bridge it to the curriculum in Grade 10" (Group meeting, October 2015) by looking at "what is successful in Grade 9, what did the kids really relate to, and find really engaging, and move those into Grade 10" (Group meeting, October 2015).

Summary and discussion about teacher views and their intended model of teaching mathematics

As discussed in this section, this group of teachers' views of mathematics seem best aligned with Ernest's 'Problem-Solving' type teachers; as such, these teachers present themselves as facilitators of mathematics, and have certain expectations of their students that are also aligned with their views. Based on the teachers' reports, these views seem to also carry over into the teachers' intentions in their classrooms. As mentioned, the teachers came up with several strategies that they hoped to implement in their classrooms, such as re-arranging the curriculum, creating active mathematics opportunities for their students, making changes to the assessment strategies in the Grade 9 Applied course, creating more opportunities for group and collaborative work, offering guidance to students, and helping students transition between grades. The teachers then implemented these plans in order to achieve their proposed goals for the Grade 9 Applied courses.

In coming up with a plan (intended model of teaching) for the Grade 9 Applied course, these teachers also revealed their expectations of their students. When looking at the teachers' expectations of their students (as discussed in the Student Learning Model column in **Table 2)**, it is evident that these expectations continue to align with Ernest's suggestions and strengthen the argument that this group of teachers best aligns their views and teaching models with what Ernest refers to as the "problem-solving" kind of teachers. For example, when introducing

students to new mathematical concepts, most of the teachers reported that they did not expect their students to perform mastery of skills and content regurgitation on assessments; instead, the teachers revealed that they expect their students to attain a conceptual understanding of the items taught in class, and even become confident problem-solvers –that is, the teachers value understanding of content rather than rote memorization.

These views carried over into the strategies that the teachers planned to use to increase student engagement and perseverance in the classroom. One strategy that most of the teachers used was creating active mathematics exercises and activities so that students would not only be engaged and willing to participate in the classroom, but also so that students would be able to explore mathematics in their own way and at their own speed –all the while doing something different than sitting at a desk for 75 minutes. Other strategies planned by various teachers focused on students becoming confident problem posers and solvers, and being willing to persevere in their mathematical journey.

In comparing the teachers' expectations of their students with Ernest's model ("Intended Outcome" column, **Table 2)** and taking into consideration these teachers' plans for the Grade 9 Applied course as discussed above, it appears that, for the most part these teachers' intended model of teaching continues to be aligned with their views, thus reinforcing the idea that these teachers are the 'problem-solving' kind of teachers.

II. TEACHER VIEWS OF EQAO

This section of my analysis is pertinent to my first research question and its sub-question**:** ***How do Grade 9 mathematics teachers view the Grade 9 EQAO Assessment of Mathematics?*** and ***What do teachers perceive to be some of the benefits and concerns of this assessment?***

As I read through the transcripts, I started to see certain themes emerge from the teachers' conversations. As such, I chose to organize my discussion about teachers' view of EQAO by reporting on what the teachers felt they learned from EQAO, the ways that teachers show they value EQAO, and the teachers' concerns of or related to EQAO. By exploring and discussing these topics, I found that I was able to provide a fairly comprehensive synopsis of these teachers' views of the Grade 9 EQAO.

What the teachers learned from EQAO

There are several things that the teachers report having learned from working with EQAO assessments and results. For example, by looking at student answers on EQAO, some of the teachers realized that they were not teaching the Grade 9 Applied curriculum. These teachers reported having a big 'aha moment' when, near the start of the project, after looking at their students' work on the Grade 9 Applied EQAO assessment they realized that they had not been teaching the Grade 9 curriculum –specifically, they realized that the EQAO assessment material and the classroom material they were teaching were not the same. In a personal interview with the department head, she recalled:

> **Ruth:** Tony and I taught the course and umm, and we kind of took what other teachers have given us, and it was like, and kind of went through with it, and thought we'll do it first semester and look at it second semester, and the kids wrote the EQAO, and Tony came in and said "I dunno who's off the mark, but that EQAO test is not the course I just taught my kids. So.... either they got it wrong, or we got it wrong. And I'm pretty sure it wasn't them". Hah!. Yeah so we were like... so I said "well get out..." and this is like 4 o'clock on whatever day, I said "well get out the curriculum guidelines". And so we sat there from 4 to 6:30 and we went through them and we were like "oh God...!". And so we changed the course for the second semester. Umm, and added like three... like we taught... that course isn't in the course book and so we've added a couple of units and kind of revamped it. (Personal Interview, May 2016)

As a result, the teachers decided to revisit the provincial mathematics curriculum and consequently changed several aspects of the Grade 9 Applied course, as discussed in the previous section. In revamping the course, the teachers came up with new ways of teaching the course, all the while keeping their goals of engagement and perseverance in focus.

Another thing that some of the teachers learned from considering the EQAO assessment was the importance and the need to make connections between classroom assessments and classroom content. One specific example of this is the 4-Block Thinking Template (**Appendix E**). In their discussions, some teachers reported that when they first brought the 4-Block Thinking Template into the Grade 9 Applied course, they did not extend the template to their classroom assessment. In other words, the teachers presented students with this model and taught them to solve questions using the 4-Block model, but they did not assess students using the 4-Block model –that is until they realized the importance of extending classroom models on assessments, when pointed out by a student on the EQAO assessment. Tony recalls:

> It was a real eye-opener as well, when we had the EQAO test where a student actually drew a 4-Block on, and used that to answer, I was like "wow! Like that really shows like...". And so then we brought it onto our tests, so now on our tests we have a Thinking section, there's the 4-Block there for them to use as well. So umm, it's really helped I would say students showing their thinking, getting a deep understanding of what's going on, being more engaged, and interested in learning mathematics, and believing they can do it. (Personal interview, May 2016)

By extending the 4-Block Thinking Template to their classroom assessments, these teachers reported that their students made attempts on questions that they may have otherwise left blank.

In looking at student solutions on the EQAO assessments, the teachers were able to realize that their students were not making some connections, and as a result, they reported changing some of their teaching strategies, as discussed in my previous section.

Ways that teachers value EQAO

There were several ways that the teachers demonstrated their views towards the EQAO assessment such as through the ways they discussed and valued the results of the EQAO assessment, and the ways that they approached student preparation for the Grade 9 Applied EQAO assessment.

How EQAO results were regarded

The teachers seemed to have mixed feelings regarding the value of the Grade 9 EQAO results. On the one hand, they paid attention to improvements in results, but on the other hand they also seemed to recognize that EQAO is just one measure of student achievement.

The group discussions provide some evidence that the teachers paid attention to the results of the EQAO assessment. For instance, at one of the monthly meetings during the beginning of the second year of the project, the group discussed that the Grade 9 EQAO results after the first year of the project had gone up since the previous year, and as a result, the school now has 50% of the students meeting the Level 3 expectations, up 5% from the previous year. The department head also noted that results were higher than the school board's overall results in the Grade 9 EQAO assessment. In this conversation, the team showed excitement when discussing their EQAO results:

> **Ruth**: ... Now our 9 Applied EQAO results are up, so yay team.
> **Molly**: Oh Yay!
> **Natasha**: Were they?
> **Ruth**: Yeah. Fifty, we have half the kids now meeting these expectations.

> **Someone:** That's awesome.
> **Ruth**: Yeah. Which..
> **Natasha**: We did the scoring, we didn't feel like it changed that much.
> **Ruth**: So we were at 45 last year, we're at 50 this year, and the board's at 46. They didn't do it provincially because boards are on strike.
> **Celia**: So you were saying..
> **Ruth**: We're at 50, percent, meeting expectations. And we were at 45 last year, so it was a 5 % increase. The board's up 46, so we're above the board. And provincially, they didn't [provide results]. (Group meeting, October 2015)

This conversation also highlights that some of the teachers did some of their own scoring of some of the EQAO assessment before submitting it to EQAO; their own scoring did not necessarily demonstrate a higher student achievement from the previous year. At a meeting at the end of the first semester in Year 2, after the Grade 9 students completed the EQAO assessment, one of the Grade 9 teachers reported on the results of her marking of the EQAO assessment: approximately 61% of the students seemed to have achieved a Level 3 on the multiple choice questions, and all word problems were filled in. She was also pleased that the students did better than she had anticipated in the Geometry section, despite the fact that Geometry was the first unit taught due to the team's re-organizing the content of the course, and despite not having much time to review before EQAO –due to a reported high number of snow days.

In one discussion about EQAO, Tony, the assistant department head questioned the value of the EQAO results. He suggested that in his experience, he finds that EQAO results may differ from semester to semester, and this difference is not necessarily associated with student learning. Instead, he suggests that there are other factors such as student absence on the day of the assessment that can influence the school's EQAO results: "When you look at a semester when we had fifty-eight 9 Applied students and four of them are away on one of the EQAO days, four, that's 8% right there, you know what I mean?" (Group meeting, October 2015). Tony reported that instead, he focuses on looking at how students are answering the questions, and he is encouraged because students are actually taking chances and attempting to answer questions rather than leaving blank questions as students may have in the past. He said:

> But when we moderate-mark and we look at the risks students are taking on long answer questions on the EQAO and there's no more blanks anymore, like we used to find blank page after blank page and read the answer "I dunno". Now they're taking risks. Like when I see students taking risks on something like that, then I feel as if we've reached a new level of engagement, and a new level of buying into math. (Group meeting, October 2015)

Although teachers attribute some importance to EQAO results, their actions and conversations indicate that the results themselves are not as important as is the information that teachers see in their students' learning by examining the student responses to the assessment.

Preparing students for EQAO

Another way that some of the teachers showed that they value EQAO is by including activities in their classroom learning that specifically prepare students for the Grade 9 EQAO Assessment of Mathematics. For example, teachers designed an active scavenger hunt review activity as prep for EQAO. In their practice, all of the teachers also reported preparing students for EQAO by familiarizing them with the EQAO Formula Sheet (**Appendix A)** and by including EQAO-like questions on their classroom assessments. These specific activities will be discussed in more detail in the "Enacted" section of my data analysis.

Teacher concerns of, or related to, EQAO

During conversations, some teachers reported several concerns of or related to the EQAO assessment. I consider the types of pressures the teachers report feeling in preparing students for EQAO, as well as some teacher concerns with the way that mathematics is presented in the EQAO.

Feeling under pressure

Some of the teachers reported feeling under pressure because of the EQAO assessment multiple times throughout the course of the research. For example, some of these pressures came from the limited amount of time to "finish the [Grade 9 Applied] course for the time EQAO comes around" (Phone discussion, March 2015). One of the Grade 9 teachers described how, since revamping the way they teach the curriculum, they have been doing extra things in the classroom, which consequently "is taking more time to go through the curriculum" (Phone discussion, March 2015), and they feel that they may not finish the course content before the EQAO assessment.

To a certain degree, pressure also comes from worrying about student results on the EQAO. At a meeting in Year 2, one of the Grade 9 teachers discussed how she was positively surprised by the EQAO results given that she did not have time to review classroom content with her students before EQAO. She mentioned: "we didn't have a lot of time to review with those snow days last week. So... I was a little worried" (Group meeting, January 2015). Although some teachers reported feeling under pressure and were at times worried about their students'

performance on the EQAO assessment, these teachers did not discuss their feelings in relation to whether they felt pressure from the administration to have their students do well on the assessment.

The way mathematics is presented in the EQAO

The teachers discussed their concerns with some of the ways that mathematics is presented by EQAO. One instance of this is the EQAO Formula Sheet. When discussing the formula sheet, some teachers used language such as "I hate the Formula Sheet on the EQAO" or "I don't really like the way that the formulas are set up [on the EQAO Formula Sheet]". On one particular instance, one of the teachers reported that a few years back, the EQAO Formula Sheet was "wrong". In a conversation about the Formula Sheet, multiple participants discussed:

> **Dean**: It seems to be evolving like it's getting more and more complicated.
> **Beatrix**: Yeah...And you just need a formula, and then you should be able to explain to the kids what each part of the formula represents, whereas on the EQAO they have lateral pyramid, this pyramid, surface... like this part, that part. Don't. You're giving them too much. Teach them how to understand the formula instead.
> **Natasha**: Area of the base times the height. And don't give them b squared divided by three.
> **Tony**: Formula sheet is not the teaching time, it's just the "refer to the formula kinda thing".
> **Beatrix:** Yeah. (Group meeting, March 2016)

These teachers considered that the Formula Sheet gives students information that students may not necessarily understand or need. Some considered that the EQAO Formula Sheet contains formulas that are different from what their students are familiar with; others considered that it contains too much information and that more often than not the sheet confuses the students rather than helps them.

Summary of teachers' views of EQAO

My analysis of these teachers' views of the Grade 9 Applied EQAO revealed some interesting things. First, some of the teachers reported looking at student solutions on the EQAO to inform their practice in the Grade 9 Applied classroom; from this, the teachers realized two things: the need to re-organize the Grade 9 curriculum and the items they assessed on classroom assessments; and the need to make connections between what they were teaching in the class and what they were assessing students by carrying over classroom models into classroom assessments.

The teachers also discussed the importance that they attribute to EQAO results: although some were excited that their students' results on the assessment have increased since previous years, most of the teachers do not consider EQAO results as the sole indicator of student success in the Grade 9 Applied course. Although they consider results are somewhat important, they do not consider them as the most important aspect of student learning –instead, these teachers report valuing the fact that their students are willing to take more risks and attempt answering questions which may have otherwise been left blank.

In their conversations about EQAO, the teachers also expressed some concerns related to the Grade 9 Assessment, such as the fact that they sometimes feel under pressure due to time constraints and the amount of time they have to review classroom material before the EQAO assessment. All of teachers also expressed some frustrations with the way that mathematics is portrayed in some of the EQAO documents, such as in the Formula Sheet.

III. ENACTED MODEL OF TEACHING

As mentioned above, this section discusses the teachers' enacted model of teaching with respect to the ways that their practices responded to their views of the Grade 9 Applied EQAO Assessment of Mathematics. In discussing their enacted model of teaching, I draw on these teachers' conversations and report on the ways that their practices were influenced by EQAO. Furthermore, I discuss the ways that the intended (their intentions and practices that were not directly influenced by EQAO) and enacted models (the practices that were influenced by EQAO) may differ, and also briefly look at whether the teachers considered EQAO preparation to be part of their teaching role.

Looking at these teachers' enacted model of teaching, I found that teachers seemed to maintain their original intentions, all the while incorporating aspects of the Grade 9 EQAO into their classrooms. As such, I chose to structure my discussion of the teachers' enacted model of teaching in a similar fashion to that of the discussion of their intended model of teaching. All but one of the original sub-sections are included and discussed below. I considered that this way of organizing and discussing my findings helped me draw a parallel between the intended model and the enacted model of teaching, with respect to the EQAO assessment.

Teachers' enacted model of teaching with respect to EQAO

Some of the teachers' intended models of teaching in the Grade 9 Applied course, as discussed before, are also enacted in their teaching and include components of the EQAO assessment. For example, the teachers considered and/or included portions of the EQAO assessment when re-arranging the Grade 9 Applied curriculum, when creating active mathematics activities and making changes to classroom assessments, but also when offering guidance to students and helping them transition between grades.

Re-arranging the curriculum: Teaching material that is on the EQAO

Re-arranging the curriculum was one of the strategies that all of the teachers used to achieve their goals in further developing their teaching of the Grade 9 Applied course – engagement and perseverance. In deciding the course sequence, the teachers chose an order that increased in complexity as the course went along. EQAO played a very important role in this team's approach to teaching the course, specifically when some of the teachers realized that they were not teaching the current Ontario curriculum, which is what is assessed on the Grade 9 EQAO. The teachers did not always mention EQAO in relation to the rearrangement of the Grade 9 curriculum; in some instances, they made reference to and considered the curriculum expectations assessed on the EQAO when determining what concepts to teach in their Grade 9 classrooms. For example, at one of the meetings, some of the teachers made reference to the EQAO assessment when discussing whether to teach ratios:

> **Tony:** Cause I don't do ratios in Grade 9 Academic, do you?
> **Natasha:** Not Academic. But Applied I do.
> **Tony:** Yeah, but not Academic.
> **Molly:** I think they're supposed to. Cause it is on the EQAO.
> **Tony:** Grade 9 Academic?
> **Natasha:** It is on the EQAO.
> **Molly:** Yes, it has been. (Group meeting, October 2015)

While some of these conversations were informal, the teachers nonetheless used these discussions to inform their practice.

Active mathematics: The Amazing EQAO Race

When looking at the teachers' intended model of teaching, many instances came up where the teachers discussed wanting to promote an active mathematics class where students were engaged in mathematical activities. One might question how it would be possible to prepare students for an EQAO assessment, given its pen and paper format, and still maintain a

commitment to active mathematics. In some ways, the teachers did this. One way that the teachers incorporated EQAO into their active mathematics teaching strategy was through a teacher-created dynamic classroom activity in which students used technology to scan QR codes and went on a scavenger hunt to solve questions similar to those on the EQAO assessment. The creation of this activity took place over the course of several weeks, and was consequently discussed at different group meetings. One of the teachers described the activity as follows:

> **Molly**: We are creating a QR code scavenger hunt for EQAO. So, the kids use iPads or their phones to read the QR and then a question will come up –we haven't finished that part yet, [laugh]– and then they are going to somehow record their information and answer the question and that will send them to another room to find the next question. (Group meeting, December 2014)

At the second meeting, some of the teachers reported on their progress with the activity and some of the things that they changed in the process; they also discussed how they envisioned the activity to take place, and described why they chose to organize the activity as such:

> **Edna**: We have also been looking at wording and time management and...
> **Molly:**... how to make it a successful event. Yeah, like if they get a question wrong, originally our thought was if they got a question wrong they would be sent to a room and then they would find in that room that it said "um oops, that is not the right answer, so go back to the question and try it again" and then we decided that it probably... some groups may struggle to get very much of the quiz done because they're stumped on one question. So instead we made little signs and it says "you have hit a detour" –not real negative – "make a note beside this question or page and go back if you have time at the end".
> **Research Assistant**: So really it was the language-,
> **Molly:** Yeah because say question one was wrong, we did not want to deflate them. (Group meeting, January 2015)

The two months that the teachers spent preparing this activity demonstrate the thought that went into several aspects of this activity, such as the wording used throughout the activity. The teachers used encouraging language such as "you have hit a detour" (Group meeting, January 2015) rather than "your answer is wrong" in order to help students persevere in their mathematical quest throughout the activity. As discussed by some of the teachers, this activity "ties nicely to the goal that we are working at [...] engagement and perseverance" (Group meeting, January 2015); not only is it in line with the team's overall goals, but it also prepares students for the assessment by having students complete sample questions similar to those on the EQAO. The teachers reported that this activity went well.

Changes to classroom assessment: The use of sample EQAO questions

Making changes to classroom assessments was another one of the teachers' intended model of teaching; specifically, multiple teachers brainstormed different ways to move away from traditional assessment strategies such as pen and paper assessments, and instead create more engaging, authentic assessments for their students.

In their practice, all of the teachers also incorporated EQAO preparation into their classroom assessments by using past EQAO questions on classroom assessments. Although this practice is not really considered to be an engaging piece, the teachers still considered it to be a valuable experience for their students, and thus included it in their classroom practice. Below, I will discuss some of the ways that the teachers include past EQAO questions as part of their classroom assessments, not necessarily as means to increase engagement and provide authentic assessment, but more so as means to prepare their students for the Grade 9 EQAO assessment.

At one of the meetings, the department head reported that all of the multiple choice questions on the Grade 9 classroom tests were taken from sample questions from previous EQAO assessments. She described that "every multiple choice question on any Grade 9 test is pulled from EQAO" and the questions are "exactly the same" (Group meeting, March 2016). The teachers also reported that students are told about this at the beginning of the year, and they are therefore aware that the multiple choice questions on their tests are questions identical to those on previous EQAO assessments. However, the teachers provide students extra space following each question so that students will show their work on these multiple-choice questions; this practice is different from EQAO's. The teachers considered it important to give the students the extra space because in this way, the teachers can see the students' thinking process throughout solving these questions and are able to address any issues that may not be otherwise evident. They discussed by saying:

> **Tony**: And sometimes they'll do great work, and then just, they don't quite have the right answer, but we give them the marks for the process because what they're doing is correctly; just made a little error or whatever. (Group meeting, March 2016)

Furthermore, on classroom assessments, the teachers made sure that students received marks for showing their work on multiple-choice questions and can get some marks even if the answer is not correct. As one teacher mentioned, this practice helps students "understand that it's not multiple guesses and that they have to do some work for [the multiple choice questions]"

(Group meeting, March 2016). By giving marks for showing work on multiple choice questions, the teachers reported helping their students understand that multiple choice questions do not consist of a guessing game, and that actual solutions are involved. It also helped teachers identify student misconceptions and areas where more work was needed, as well as showing students that their thinking was valued. The teachers mentioned that they also give extra space and marks for students showing their work on multiple-choice questions, in the Grade 10 Applied course as well.

One teacher mentioned that often, "students' opinion of multiple choice questions in math is that they're easy, otherwise they wouldn't be multiple choice" (Group meeting, March 2016). However, she herself does not consider EQAO questions to be easy. Giving students extra space on the test and allowing them to show their thinking helps debunk the myth that multiple-choice questions are easy and do not require any work. Overall, the teachers considered that the practice of having past EQAO multiple choice sample questions on their classroom tests throughout the year takes some of the pressure away from students when it comes to writing the Grade 9 EQAO assessment. This way, the teachers can encourage their students by telling them "you are ready, you've been doing them all year" (Group meeting, March 2016).

Although using past EQAO multiple choice questions on classroom assessments does not necessarily target the teachers' plans of creating engaging and authentic assessments for their students, it can still be considered a very beneficial practice. On the one hand, for teachers, it shows the student thinking behind multiple-choice questions and helps alienate misconceptions. On the other hand, this practice is also beneficial to students because it teaches them some important lessons such as the need to show their work and not take guesses on multiple choice questions, but it also, and more importantly, is reported to prepare students for the EQAO assessment and get students in the mentality that they are ready to tackle the EQAO assessment and its questions.

Offering guidance to students: The EQAO Formula Sheet

As part of their intended model of practice, the teachers decided to provide their students with some guidance through classroom activities and assessments. Some of these strategies included working together with students through tests, and creating 'Survival Guides'. Another way that all teachers offered guidance and support to their students was by familiarizing them with the EQAO Formula Sheet prior to the assessment. As mentioned previously, the team

discussed the EQAO Formula Sheet at several meetings during the course of the study, often expressing their frustration with the way that mathematics is presented in the Formula Sheet, and the fact that students are often confused by it. They reported:

> **Natasha**: How many of you, how many times in a EQAO or exam has a kid put their hand up say "I don't understand this formula", "I donno what this 'b' is" or "why does it say b squared?".
> **Beatrix**: Or "which formula do I use", cause they give you three or four formulas within one section.
> **Edna**: Always.
> **Natasha**: Oh yeah.
> **Tony**: So there's a good thing in our EQAO practice: maybe under a document camera go through the Formula Sheet. (Group meeting, March 2016)

Some teachers reported spending classroom time going over the EQAO Formula Sheet with their students as a means to prevent students from being confused when presented with formulas they do not understand. For example, some teachers showed students the EQAO Formula Sheet under a Document Camera and worked with them through the formulas step by step; this process, the teachers decided, shows students how the formulas are created and helps students understand the formulas rather than have students simply memorize formulas and input numbers. One teacher shared her experience and why she considers it is important to show students the Formula Sheet ahead of time:

> [One time,] I purposely didn't give them the Formula Sheet from EQAO, we went through how sorta the formulas are derived for volume, area of the bases times the height for this, area of the base times the height divided by three, cause you all know how to figure out area of the base, then square, then times it by the height of the pyramid, right? We've gone through that. They get the formula sheet where it says b squared x h. and during EQAO kids are coming over saying "I don't understand this", that's, you know... cause I said you have to have the basic understanding. Cause we always did length times width times height divided by three. (Group meeting, January 2016)

This teacher explained how, the way a specific formula is presented on the EQAO Formula Sheet is slightly different from the way students learn it in class; although only a small difference, she said, students who lack the understanding of how formulas are created will get confused by the way that formulas are presented on the Formula Sheet.

Thus, by familiarizing students with the EQAO Formula Sheet, the teachers not only offered their support to their students by preventing a potentially and confusing and stressful situation, but also prepared them for the EQAO Assessment.

Helping students transition between grades: Adapting the EQAO Formula Sheet

Another intended teaching strategy that the teachers used in their classroom was helping their students transition between grades; the teachers reported helping their students with the transition from elementary to high school, but also from Grade 9 into the higher grades by including models that students are familiar with –such as the 4-Block Thinking Template. When reporting on their practice, some of the teachers felt that the use of the EQAO Formula Sheet played a partial role in helping Grade 9 Applied students transition into higher grades. At one of the meetings, some of the teachers discussed the materials that students should be allowed to have access to during their classroom midterms and final exams. Inspired by the fact that students are provided a Formula Sheet to help them during the EQAO assessment, the teachers decided to allow their students in Grade 9 and in other courses various resources to use during classroom examinations. Specifically, teachers decided that for final examinations, students in Grade 9 could use their 'Survival Guide'. Then, in Grade 10, teachers and students co-create a formula sheet for students to use. Lastly, in Grade 11, students are responsible for making their own formula sheet with the help and guidance from their teachers. The teachers referred to this process of involving students more and more as they move through the grades as a "release of responsibility" and they considered it an important element in making students more autonomous once they move up from the Grade 9 Applied course.

Summary of teachers' enacted model of teaching mathematics

As discussed above, all of the teachers included the Grade 9 Applied EQAO Assessment of Mathematics as part of their enacted model of teaching mathematics. In certain circumstances, this enacted model of teaching also coincided with the teachers' intended model of teaching; specifically, the teachers incorporated some of their intended strategies into their enacted model, all the while including the EQAO assessment and keeping their goals.

Based on the discussion above, I found that the teachers used EQAO as part of their enacted model of practice for two reasons. First, the teachers found ways to incorporate the EQAO into their enacted model all the while keeping their goals of engagement and perseverance in sight. One such example of this is the EQAO Amazing Race activity that the teachers created and incorporated into the Grade 9 Applied classroom; this activity was in line with the teachers' goals of creating more engaging in-class activities for their students. Another example of how the teachers incorporated EQAO into their enacted model in order to achieve

their goals was by offering guidance to students and helping them transition between grades; specifically, most teachers did so by using EQAO resources, such as the Grade 9 Formula Sheet, to create consistency and an increase of responsibility as students proceeded into higher grades.

A second reason that the teachers reported including EQAO as part of their enacted model of teaching was in order to prepare students for the EQAO assessment. Some examples of this were the teachers' use of past EQAO sample questions on classroom assessments, and the different ways that the teachers familiarized students with the EQAO Formula Sheet prior to the assessment. Although these practices were not necessarily in line with the teachers' intended goals for the Grade 9 Applied course, by incorporating past EQAO sample questions on classroom assessments and familiarizing students with the Formula Sheet, the teachers reported better preparing their students for the Grade 9 Applied EQAO assessment.

Although none of the teachers openly discussed whether they considered EQAO preparation as part of their teaching duties or role, the practices described above and the effort which these teachers put into preparing classroom activities that include EQAO sample questions, highlight the importance that these teachers attributed to EQAO preparation and having their students be prepared for the Grade 9 EQAO Assessment of Mathematics.

CHAPTER 7: DISCUSSION OF FINDINGS

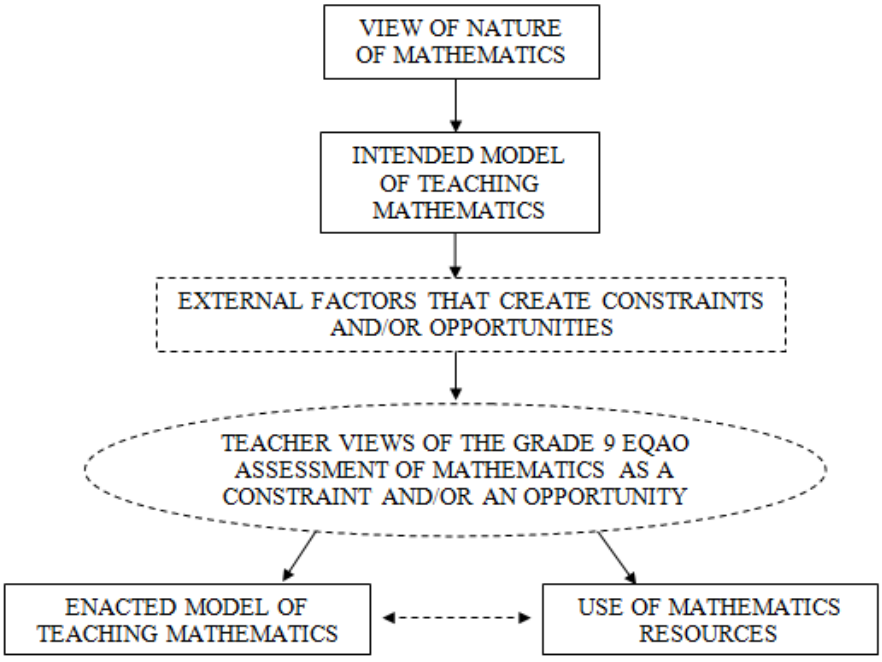
I begin this chapter by reiterating my research questions and then summarizing the process I underwent to address my two research questions. Following, I answer my two research questions before discussing links between my own study and existing literature on the topic of the Grade 9 EQAO Assessment of Mathematics.

The journey to answering my research questions

My study is guided by the following research questions:

1. How do Grade 9 mathematics teachers view the Grade 9 EQAO Assessment of Mathematics?
    - What do teachers perceive to be some of the benefits and concerns of this assessment?
2. In what ways, if any, do teachers' views of the mandatory Grade 9 EQAO mathematics assessment interact with their teaching practices in the classroom?

In order to address the research questions, I had to determine the teachers' views of the Grade 9 EQAO assessment and the ways in which these teachers' views of the assessment interact with their teaching practices in the classroom. I was guided by my theoretical framework scheme:



Adapted from Ernest, P. (1989a). The impact of beliefs on the teaching of mathematics. In P. Ernest (Ed.), *Mathematics Teaching: The state of the art*. New York: Falmer Press. p. 252

In order to discuss these teachers' views of mathematics and mathematics teaching, I first felt it was important to discuss how the team works and their goals for the Grade 9 Applied course. Then, I analyzed the data to understand the teachers' views of teaching and mathematics. In this, I leaned on Ernest's model (**Table 2**) to explore the teachers' views and to determine which orientation they were best aligned with. Based on the teachers' conversations about their views of teaching and mathematics, their role in the classroom, and how they consider how students learn, I determined that this group of teachers is best aligned with what Ernest calls "problem-solving" teachers. Then, I continued my discussion by looking at the teachers' intended model of teaching; in this section, I discussed the teachers' plans for the Grade 9 Applied course by reporting on their intended classroom strategies, the teachers' justification for wanting to use those specific strategies, as well as some of the ways that the teachers had already implemented those plans. Following, I referred back to Ernest's model to determine to what extent these teachers' views were aligned with their intended model of teaching; I found that, based on their conversations and examples provided, the teachers' intended model was aligned with their views of mathematics and teaching.

Later, I looked at the teachers' views of the EQAO assessment by examining what the teachers learned from EQAO, what values they attributed to EQAO, and what were some of their concerns related to the EQAO assessment. In this I found that the teachers used EQAO to inform their practice in the Grade 9 Applied course. I also found that on the one hand the teachers considered EQAO results to be important, but on the other hand, the teachers had some concerns and frustrations about the EQAO assessment.

I then continued my analysis by looking at the teachers' enacted model of teaching, with respect to the Grade 9 EQAO assessment. I found that teachers had incorporated aspects of EQAO into their classroom-enacted model, but they did so in a way that allowed them to continue to target their classroom goals of engagement and perseverance. Now I will use this journey to address my research questions.

Addressing Research Question 1 and its sub question:

How do Grade 9 mathematics teachers view the Grade 9 EQAO Assessment of Mathematics?
and What do teachers perceive to be some of the benefits and concerns of this assessment?

In looking at how these Grade 9 mathematics teachers view the Grade 9 EQAO Assessment of Mathematics I found that these teachers had somewhat mixed views about this

assessment; in a sense, the teachers saw value in the assessment, but they also disagreed with and had some concerns about the EQAO assessment. These views were evident not just through the teachers' conversations about the EQAO assessment, but also through their actions. On one hand, the teachers saw value in the EQAO assessment because it is well aligned with the curriculum that they teach. They also showed that they value EQAO through their efforts to prepare students for the assessment so that the students will feel confident when they approach the assessment and will persevere in the testing situation. For example, most of the teachers used EQAO as a guiding tool to inform the way they should implement the curriculum and to align their classroom content with the content on the assessment. The teachers in this PLC also used sample EQAO questions on classroom assessments and classroom activities as they saw value in the questions and wanted their students to be prepared. As another means of preparing their students for EQAO, these teachers presented students with the EQAO Formula Sheet, prior to the assessment, so that students became familiar with the way mathematics is presented in the Grade 9 EQAO, and also with the overall format of the assessment.

On the other hand, these teachers also had some concerns with some aspects of the EQAO assessment. For example, they worried that the nature of this large-scale paper and pencil assessment requires that class time be given for students to review material from an entire semester in order to prepare for the assessment –whereas they felt that there was not enough time to review the curriculum and classroom content before the EQAO assessment. Another concern that teachers had in regards to the assessment was with the way some of the mathematics was presented on the assessment. For instance, teachers believed it is important for students to use the formulas they have developed together in class, instead of the formulas provided by EQAO on the Formula Sheet; teachers reported that students better understand classroom formulas, such as how the formulas are derived and what each variable represents. Another concern the teachers had with the EQAO Grade 9 assessment was the lack of space provided to answer multiple-choice questions. They considered that students should have the space to explain their reasoning when solving multiple-choice questions. For this reason, on classroom assessments, all of which include multiple-choice questions, teachers provided their students with extra space to answer and calculate multiple-choice questions. Teachers also had mixed feelings about EQAO results. They were somewhat skeptical as to whether the EQAO assessment is a clear indication of student performance and abilities; thus, teachers reported paying more attention to classroom

results. And rather than paying attention to whether students have the correct answers to the EQAO questions, they valued the fact that students responded to more questions on the assessment, demonstrating student perseverance. Although teachers did not necessarily consider the EQAO assessment as an accurate means of gauging student learning in the Grade 9 course, they did show excitement that their EQAO results had increased over previous years.

Addressing Research Question 2:

In what ways, if any, do teachers' views of the mandatory Grade 9 EQAO mathematics assessment interact with their teaching practices in the classroom?

At the beginning of the research project, the teachers in this PLC came up with two goals and a plan for how they intended to teach their Grade 9 Applied courses. In coming up with their intended model of teaching, the teachers wanted to ensure that their plans would help their students attain higher levels of engagement and perseverance in the Grade 9 Applied course.

In comparing the teachers' intended and enacted model of teaching in accordance with the concepts presented in my theoretical framework, I determined that these teachers' enacted model of teaching mathematics continued to be aligned with their intended model of teaching mathematics, even when EQAO was included as an external factor to classroom teaching; thus, teachers worked on their goals of increasing student engagement and perseverance in the Grade 9 Applied course while incorporating certain aspects of the EQAO assessment in their teaching.

As discussed above, the teachers' views of the Grade 9 EQAO were mixed: on the one hand, teachers cared about the assessment and particularly about preparing their students for the assessment, but on the other hand, they also expressed some concerns related to the assessment.

Teachers cared about student performance on EQAO, and thus teachers created classroom activities and opportunities for students to properly prepare them for the Grade 9 assessment; however, they adapted these activities to suit their model of teaching. The importance that teachers attribute to students' preparation for the Grade 9 mathematics assessment was evident through their actions. As discussed, teachers included past EQAO questions on classroom assessments and on classroom activities. They did so in two ways: by including sample EQAO multiple choice questions on all classroom assessments, and by creating the Amazing EQAO Race scavenger hunt, an activity specific to EQAO prep, that consisted of students solving sample EQAO questions in an active and engaging way. Teachers also showed the importance they attribute to EQAO when they reported using the assessment as a guide to

inform classroom teaching. More specifically, by looking at student answers on the assessment, teachers changed their practice in a few ways. First, teachers revamped the curriculum and the order in which they taught the units in the course. In rearranging and revamping the Grade 9 course, teachers also planned various and more engaging classroom activities and assessment strategies. By using the EQAO assessment to inform their classroom practice, teachers ensured not only that they were teaching the Grade 9 Applied curriculum but also that they were teaching their students skills and content assessed on the EQAO.

On the opposite side, because teachers also disagreed with certain aspects of EQAO, they adapted EQAO preparation in ways that they were more comfortable with and in line with their intended plans. One such example was the teachers' use of multiple choice questions on classroom assessments. Although teachers considered it was important to incorporate past EQAO questions on classroom assessments in order to prepare students for the assessment, they also decided to give students extra space on the test to write down step by step answers to their questions. By doing this, teachers also reported informing students about the importance of multiple choice questions and the importance of writing down every step when solving a mathematical question. Another example of how teachers adapted EQAO concepts to their classroom teaching was through the EQAO Formula Sheet. Because of teachers' concerns with the Formula Sheet, teachers reported spending time with their students to show them how the formulas on the EQAO Formula Sheet are created and derived.

Looking at the evidence presented above, we can conclude that because teachers incorporated EQAO aspects into their practice, this did indeed impact their practice. Perhaps if EQAO was not a mandatory large-scale assessment to be implemented in their classroom towards the end of the school semester, teachers may not be including multiple-choice questions similar to those on the EQAO on their classroom assessment, they may not be creating scavenger hunts with EQAO questions, or they may not be showing students the formulas that exist on the EQAO Formula Sheet.

A synthesis of the findings: Connection to literature

In the literature review at the beginning of this dissertation, I looked at previous research regarding teacher views of large-scale assessments and the impact of large-scale assessments on teaching practice. This review helped me begin to understand some of the views that teachers have around large-scale assessments, and the impact that large-scale assessments might have on

teaching practice; I then used this knowledge to help structure my theoretical framework and guide my own research. In reviewing the literature, I looked not only at the broad works on these topics, but also at the literature pertinent to the Grade 9 EQAO context specifically. This way, I was able to frame my findings by drawing comparisons to previous research and to an extent, to continue to build on previous work. My literature review revealed some interesting insights about large-scale assessment, some of which I will reiterate below, while drawing comparisons to my own research findings.

The literature on teacher views of large-scale assessments indicated that teachers have both positive and negative views of large-scale assessments, not only in general but also specific to the Grade 9 EQAO Assessment of Mathematics; similarly, the impact of large-scale assessments on classroom practice was reported to have varied effects. Similar results were yielded by my data analysis: teachers had mixed views about the Grade 9 EQAO assessment, and they identified both best practices and concerns related to the assessment's impact on their classroom teaching. In the sections below I consider solely the case of the Grade 9 EQAO Assessment of Mathematics and the studies previously conducted on this topic as I make connections to my own findings.

EQAO as a resource

When looking at the literature related to the Grade 9 EQAO, one particular finding that was predominantly present in all studies was the teachers' use of EQAO sample questions on classroom assessments and classroom practice exercises. In all instances, teachers reported using past EQAO questions either as practice for the assessment and/or as means to teach students the Grade 9 curriculum: some teachers considered that EQAO questions are well-designed and thus chose to use past EQAO questions on classroom assessments instead of using their own questions (Kitto, 2006; Koch, 2010); other teachers provided their students with questions similar to those on the EQAO as a means to familiarize their students with the kind of questions asked on the assessment and thus to prepare their students for the assessment (Lock, 2002; Chapman, 2017). The teachers in my study used sample EQAO questions to prepare students for the assessment and to get students in the mindset that they are ready for whatever challenge they might be presented with; they also did this in a way that was aligned with their classroom goals and in a way that they agreed with –for example, giving students more room on assessments to explain their answers to multiple choice questions.

An interesting similarity that I found between my findings and the findings discussed by Koch (2010) was the fact that in both cases, teachers reported that looking at student work on the EQAO was a useful and enriching practice as teachers were able to: 1) familiarize themselves with the nature of the questions presented on this assessment, 2) learn about the content students are tested on, and 3) get an idea about the kinds of questions they too can ask on classroom assessments. Furthermore, teachers in my research reported that to some extent, EQAO also informed their practice in the Grade 9 Applied classroom, such as when determining what content to teach in the Grade 9 course, and when determining what tools students should be allowed to use on classroom assessments; as mentioned previously, these teachers revamped the curriculum and classroom content and changed the types of classroom activities and classroom assessments that they used in their Grade 9 Applied courses. This interesting correlation between teachers' familiarity with the questions on the EQAO assessment and their willingness to include sample EQAO questions on classroom assessment is also in a sense discussed by Kitto (2006) who suggests a positive link between teachers' familiarity with the assessments and their views towards them.

Overall, the teachers discussed in my research seem to have incorporated various aspects of the EQAO assessment in classroom teaching; this practice seems to be different than what Lock (2002) describes in her research, conducted a year after the assessment was first introduced. Since at the time of her research, the Grade 9 EQAO assessment was still a pilot assessment, it is safe to assume that the teachers' interviewed by Lock were not yet familiar with the EQAO assessment and thus their views of the assessment may not have had implications on classroom practice. Lock reported that teachers did not teach the curriculum any differently than they would have without the EQAO assessment. In addition, teachers interviewed by Lock did not consider that the assessment had positive effects on classroom practice; these teachers did however teach their students test-taking skills specifically with the intention to prepare them for the assessment. A potential reason for these teachers' hesitancy to establish a link between the EQAO assessment and classroom practices could come from the teachers' unfamiliarity with the assessment, as suggested and discussed above (see Kitto, 2006).

Concerns with EQAO

The literature on teacher views of the Grade 9 EQAO assessment indicated that teachers reported some concerns with the EQAO assessment. For example, in the research study by Kitto

(2006), teachers were reported to believe that the EQAO assessment provides inconsistent results when compared to classroom performance; therefore, the assessment cannot be used as an accurate indication of student performance and skills in the Grade 9 course. The sample of teachers used in my research reported similar beliefs and further argued that EQAO results at a school level can be easily skewed if students are absent the day of the assessment; in both cases, teachers were reported to allocate higher importance to results from classroom assessments than EQAO results –even though the sample of teachers used in my research also showed some excitement towards an increase in EQAO scores.

Teachers also pointed out other concerns related to the Grade 9 EQAO assessment such as issues of inconsistency between content found on the EQAO and classroom content, as discussed in Kitto (2006) and Koch (2010). Similar concerns were vocalized by the teachers in my research, specifically in relation to the EQAO Formula Sheet and teachers' concern with the way that mathematics is presented on this sheet, different from the classroom, and much more confusing for the students.

Furthermore, in Koch (2010), teachers identified concerns specifically related to the appropriateness of the Applied-level assessment in comparison to how the students were taught in class. More specifically, these teachers noted that the assessment does not correspond with the way Applied students explore some mathematical ideas in the classroom, such as by using hands-on techniques or active mathematics; therefore, these teachers deemed the EQAO assessment to be not only less relevant but also more complicated for Grade 9 Applied students (Koch, 2010). No such concerns were mentioned by the sample of teachers used in my research. Instead, these teachers reported using the Grade 9 EQAO assessment and students' responses on the assessment to inform their practice and help guide them in determining what mathematical concepts should be taught in class. These practices could indicate that teachers consider the EQAO assessment questions and student answers on this assessment to be more useful and relevant in informing their classroom practices, more so than the EQAO results themselves – which, as discussed in my literature review, many other teachers do not also rely on, due to the fact that EQAO results are shared with the teachers well after the course has finished and the new semester has already started, therefore making EQAO results less timely (Koch, 2010).

In general, teachers in previous research studies were reported to have more negative views towards the EQAO assessment than the group of teachers discussed in my research (eg.

Kitto, 2006; Lock, 2002). Furthermore, some of the teachers interviewed in previous studies were also reported to feel pressured for time to finish the curriculum in time for the EQAO assessment (Lock, 2002). On one particular instance, the teachers discussed in my research also felt a similar pressure; however, this pressure was reported to come as a result of revamping the way that they teach, and thus the teachers were much busier in the classroom doing additional activities and teaching additional things.

Teaching to the test

As discussed in my literature review, sometimes when teachers are concerned about an assessment they adopt a practice commonly referred to as 'teaching to the test'. This might mean that in focusing on preparing students for an assessment, teachers change their usual teaching practices –for example, by having students practice assessment questions in the classroom setting. Teaching to the test might also mean that the content covered in class is strictly the content covered on the assessment. In most cases, teaching to the test is considered to be an unfavourable teaching practice, as it often narrows what teachers teach and the way they teach it.

In the case of this PLC, it could be said that some of their practices appear as though they are 'teaching to the test'. For example, teachers used past EQAO questions on their classroom assessments, they introduced students to the EQAO Formula Sheet prior to the EQAO assessment, and they created the Amazing Race scavenger hunt activity as specific practice for EQAO.

Some could argue that since the Grade 9 EQAO Assessment of Mathematics is reported to be well aligned with the Ontario curriculum, teaching to this test actually means focusing on the Grade 9 curriculum. Although these teachers addressed content found on the Grade 9 EQAO assessment, they focused on student understanding of this content rather than specific item-teaching. Furthermore, when adopting the practices that could be considered as 'teaching to the test' these teachers enacted them in ways that aligned with their intended model of teaching. For example, when using EQAO multiple choice questions on classroom assessments, the teachers used them in a different way than EQAO: they broadened the question and encouraged students' full solution so that they could view and understand the students' thinking process. Similarly, when showing students the Formula Sheet prior to the assessment, teachers worked together with the students to unpack the formulas and determine how they are created and derived, so that students would have an easier time understanding and applying these formulas on the EQAO

assessment. When creating the EQAO Amazing Race scavenger hunt, teachers used positive language to provide feedback on the questions, and allowed students to work through questions in their own order and at their own pace; students were thus encouraged to persevere through answering questions, all the while being positively engaged in active mathematics.

Looking at these teachers' classroom practices, we can say that their teaching to the test practices actually mean teaching in a way that is aligned with their teaching goals, that prepares students for the Grade 9 assessment, and that also teaches students the mathematical concepts identified in the Grade 9 Applied mathematics curriculum. Since this particular group of teachers showcases results that may have been more positive than expected, perhaps teaching to the test in this way is not necessarily such a bad thing.

Conclusion

Overall, in discussing teacher views of the Grade 9 EQAO assessment, a review of the research indicates that views seemed to have evolved over time: a year after the assessment was first implemented, teachers were skeptical whether the Grade 9 EQAO assessment would be a useful tool in reporting on student achievement (Lock, 2002), while in subsequent research studies, teachers not only questioned the assessment but also began to identify discrepancies between student performance on classroom assessments and on the Grade 9 EQAO mathematics assessment (Kitto, 2006; Koch, 2010). Teachers in previous research studies reported somewhat negative views towards EQAO and some further reported that the Applied-level assessment did not correspond with the way students are generally taught in the Grade 9 Applied course. Such opinions against the EQAO were not vocalized by the group of teachers used in my study; instead, their practices and ways of incorporating EQAO as part of their classroom practices suggested that they have, in a sense, accepted the EQAO assessment as part of the usual Grade 9 course requirements –or found an effective way to align the two. Looking at the overall findings of my research, and comparing them to the previous research related to teachers' views of the Grade 9 EQAO, it seems as though my findings support a shift in teachers' views of the Grade 9 EQAO Assessment of Mathematics.

Furthermore, the research studies discussed above, and others discussed in my literature review, make the connection between views and practice; more specifically, views are reported to influence practice, and can do so in different ways. In my study, teachers' enacted teaching

practices where influenced not only by their views about mathematics, teaching, and learning, but also, to some extent, by their views about the Grade 9 EQAO Assessment of Mathematics. Therefore, as teachers' views of the EQAO assessment might continue to change over time, the impact of these views on classroom practice should continue to be documented with further research studies.

CHAPTER 8: CONCLUSION

I begin this chapter by discussing some personal wonderings that arose as I conducted this study; specifically, I discuss the feedback that teachers obtained as to whether their way of teaching yielded the results they wished for. I then discuss the limitations, as well as the contributions and implications of this study, and following, I make some suggestions for future research to be conducted on the topic of the Grade 9 EQAO Assessment of Mathematics.

Wonderings

The personal wonderings discussed in this section were part of my natural thought process, as a researcher conducting a qualitative study. This willingness to learn more, discussed in Tesch (1990) depicts a researcher "involved, committed, interested, concerned" in their research (Moustakas, 1981, p. 212, as cited in Tesch, 1990, p. 70) but often hypothesising as opposed to relying on facts extracted from data (Tesch, 1990). Although I too became curious and interested in my research, I found answers to my wonderings in the data; thus, below, I will discuss some additional findings yielded by the data, and not personal speculations.

As part of their work for the OAME research project, the teachers in my study came up with two goals to increase student perseverance and to engage students in the Grade 9 Applied mathematics course. The teachers created not only goals but also a definitive plan, and they used this plan hoping to make a difference in their Grade 9 Applied students' mathematical journey.

In looking at the teachers' plans for the Grade 9 Applied course, I wondered how the teachers saw their goals and plans playing out in the implementation of their strategies. Here, I think it is worthwhile to discuss some of the ways that the teachers reflected on their goals and plans and how they determined whether these goals and plans really made a difference in their students' learning. I believe that, for the teachers, obtaining feedback and validation that the goals and plans they developed yielded fruitful results was important. Furthermore, I was curious to know about the feedback that the teachers obtained, and how they integrated this into their teaching practice.

My findings revealed that the teachers received feedback in different ways and from different stakeholders. From this feedback, the teachers drew conclusions and may have been able to determine whether their efforts were fruitful and their intended goals successful. Below, I will discuss the ways in which the teachers received feedback to assess whether their plans and practices worked to achieve the goals they had set for their Grade 9 Applied courses.

Student responses on classroom assessments

One of the ways that the teachers in this study obtained feedback on the effectiveness of their teaching practices was by looking at students' responses on classroom assessments and on the Grade 9 EQAO assessment. Reflecting on student responses on classroom assessments, the teachers often remarked that students' responses to assessments were full of writing and assessment questions were no longer left blank as they were in the past; some of the teachers mentioned that even though the solutions were not always correct, students were almost always taking chances and attempting to answer even the more difficult questions. During one of their conversations, the team discussed how they went from having a "massive" failure rate in the Grade 9 Applied course because students would easily give up and not make attempts to answer questions on classroom assessments and exams, to having students fill out all of these questions; this way, the teachers were able to give part marks to solutions even if they were not completely correct, which in turn made a difference in student achievement. One teacher stated:

> Not only are there attempts but the attempts have some justification in them. That's what's... you know, lots of kids could finish their exams, but there would be no, zero connection on many parts of it. Where now, I mean they still may have the wrong, incorrect answer, but they [have a partial solution]. (Group meeting, March 2016)

Similarly, when reflecting on the EQAO assessment, some teachers reported that students "[try] to write something on every long answer" (Group meeting, December 2014), a fact which is another indication of student willingness to persevere and attempt answering questions that they may have otherwise left blank before.

The teachers also discussed some specific examples of student work on classroom assessments, and described that students even get creative when attempting to solve mathematics questions. Teachers associated these creative attempts with an increased level of confidence that students have in the Grade 9 Applied course; one of the teachers affirmed, "I think they'll do whatever we toss at them" (Group meeting, March 2016).

Student feedback

Another way that the teachers were able to evaluate the outcome of their teaching and collect data pertinent to the effectiveness of their classroom practices was through student feedback such as through surveys and conversations with students. The teachers reported collecting student feedback on multiple instances through multiple means. One such way of collecting student feedback was through surveys about classroom activities such as Gap Day and

active mathematics. In their feedback, students reported an increased level of engagement and interest in classroom material and activities, and often reported to be surprised by how quickly math class goes by. Most of teachers also reported obtaining positive feedback from conversations with their students:

> **Natasha:** And I don't know how many times I hear "Oh, math is over already?"
> **Tony**: Yeah. Kids tell us that it's the fastest class of the day, like all the time. And then you, last semester, you had like half a dozen kids come up after the exams and say "thank you for a great semester"...
> **Natasha**: And shake my hand. I've never had that one happen in a 9 Applied.
> **Researcher**: Wow.
> **Natasha**: ...and shake your hand and say "thank you for a great semester, I really enjoyed that, that was fantastic". (Group meeting, March 2016)

Comments from others

On multiple instances, the PLC reported receiving feedback from other stakeholders such as fellow mathematics teachers, as well as their school's administration and support staff. PLC members reported sharing and showing their students' responses on classroom assessments with other mathematics teachers from other schools, who were surprised by the fact that all questions were completely responded to. In looking at student answers on these assessments, fellow mathematics teachers were also amazed by the students' overall performance in the Grade 9 Applied course, not only in comparison with students from other Grade 9 Applied courses, but also in comparison with students in the Grade 9 Academic courses, and even courses in higher grades; some fellow teachers complimented the PLC members by saying that even their Grade 10 Academic students could not perform as well as this PLC's Grade 9 Applied students.

The PLC also received feedback from the school administration. The PLC reported on multiple occasions that their administration was "thrilled" with the results in their Grade 9 Applied courses. As a result of this success, the PLC was asked to present and discuss their progress and success in the Grade 9 Applied course to teachers and principals from other schools within their school board as means to share success stories and valuable lessons that others could learn from.

Feedback also came from mathematics specialists at the school board. During two of the monthly interview meetings, the PLC was joined by a mathematics specialist from the school board who was amazed by their work, and even validated and weighed-in on some of the student learning and classroom teaching practices that the PLC engaged in.

Lastly, the teachers on the PLC received feedback from their team members who were not directly teaching mathematics, as they reinforced the fact that in the two years of the OAME project, the PLC not only managed to achieve their goals that they had proposed, but also had gone above and beyond. She said:

> **Edna:** So when we started this project, the big thing we put above this board was "student engagement". I just have to congratulate you guys because you just, your conversation now to the conversation we had at that time is not of student engagement. Now it's talking about getting them to the next level (Group meeting, March 2016).

Overall, the teachers seemed to be happy with the outcome of their goals and the validation they obtained not just from their peers but also from their own Grade 9 Applied students. Since the feedback reported by the teachers was positive, the teachers were assured and obtained their confirmation that their intended goals and plans had indeed worked as they had hoped.

Limitations

There are several limitations to this study, all of which I was aware of going into my research and selecting the data to work with. One of these limitations is the fact that only one case study was used for the purpose of my research, and thus, this case study cannot be used to generalize the views and practices of the whole project or a whole province. Although other teachers in Ontario may have different views and engage in different classroom practices than what was depicted in my findings, this study helps to demonstrate that views of EQAO may impact classroom practice and suggest ways that may take place. A second limitation of the study pertains to the fact that I did a secondary data analysis of previously collected data. Although the data collected was fairly recent (2014-2016), I did not have the opportunity to ask additional questions or to have the teachers go into more detail about certain aspects of their conversations. I think the opportunity to follow up with a participant's comments or even ask the group some questions would have enriched the findings of my data. For instance, I would have particularly liked to ask additional questions about the ways that teachers incorporated aspects of the EQAO assessment into their classroom teaching, so that I could better understand the correlation between this particular group of teachers' views of EQAO and their impact on classroom teaching. However, as I was limited by the data that was already collected and available for my analysis, my conclusions were based on teachers' previous conversations alone.

Furthermore, it should be noted that the teachers who participated in the OAME research project received support from the Ontario Ministry of Education (OME) and the Ontario Association of Mathematics Education (OAME). Specifically, this support came in the form of time away from their classroom: one day per month for meeting and planning, plus additional days for the attendance of conferences and out-of-school events; a certain budget was also allocated for each PLC for the purchase of classroom resources. They also had the support of outside experts in mathematics education and the network of working with other school groups in the province. These are all factors that could have influenced the results and findings of my study, as these supports are not generally widely available to teachers, and thus under different circumstances, this group of teachers may not have had the same opportunities for collaboration or been able to engage in classroom practices that were related to the EQAO assessment.

It is not possible to determine the outcomes when these forms of support were no longer available as the PLC may not have had the same opportunities to meet and discuss their ideas. This may have directly impacted the teachers' opportunity to meet as a group, discuss and collaborate in creating goals and plans for their courses. In addition, this could have direct influence on teachers' views which, in my study, were reported to be a collective team view as opposed to a personal view. This, in turn, could have further effects on the way that each teacher implements the curriculum and chooses to teach their students. As such, a similar study conducted under different circumstances could have yielded different results.

Given all of the factors mentioned above, it is important to restate that the findings presented in my research may not representative of all teachers' views of the Grade 9 EQAO Assessment of Mathematics, and of the way that these views may or may not influence classroom practices in a similar way as discussed in my study. Despite this, the study nonetheless enriches the existing literature by drawing attention to the close connection that exists between teacher views and classroom practice, and its possible implications.

A constraint within this study was the theoretical framework that the study rested on. Although Ernest's model provided good guidance in terms of how to organize my data and report on the findings, I struggled with making the distinction between what data should fall under the "intended" and what data should fall under the "enacted" category of the framework. Furthermore, since my adapted model included an extra layer, specifically the *EQAO assessment as a possible constraint and/or opportunity*, I struggled with reporting on the data in a way that

would both make sense to the reader but also that remained aligned with the framework. As discussed above, in the end, I needed to make an adjustment to how I reported on the data: the intended model included both aspects of teachers' plans and their actual practice that was not directly related to EQAO whereas the enacted section focused on their practice as influenced by the EQAO assessment –that is, the enacted model focused on teachers' enacted practices, in relation to the Grade 9 EQAO assessment. Although at a first glance this specific framework seems fairly straightforward, the link between the intended model of teaching and the enacted model of teaching did not turn out to be as straightforward as I had anticipated, since teachers did not speak about their practices in a linear fashion (for example, beginning with their views, continuing with their intended practices, and ending with their enacted practices). It is possible that this particular theoretical framework may be easier to use in a situation in which the researcher collets his/her own data, and therefore would be able to design research and interview questions in a way that can more accurately address the different sections in Ernest's model, thus being able to make concise connections between certain views and practice.

Contributions and implications

This study contributes to the literature focused around the Grade 9 EQAO Assessment of Mathematics by providing a current overview of teacher views of this assessment and discussing the impact that these views have on classroom teaching. More specifically, the study outlines some of the perceived benefits and concerns that a particular group of teachers have related to the Grade 9 EQAO assessment, and identifies these teachers' classroom practices when preparing their students for EQAO assessment. This study discusses classroom practices that prepare students for the EQAO but in a way that does not affect classroom content, or that requires time away from other important mathematical activities outlined in the Grade 9 curriculum –such as observations and explorations– and which are not evaluated on the EQAO assessment. When compared to other research discussed in my literature review, this study provides a somewhat different outlook on the generalized impact that large-scale assessment is said to generally have on classroom practice; as discussed in my literature reviews, large-scale assessments are deemed to have negative effects on classroom practice, such as narrowing the curriculum and some aspects of teaching to the test, whereas my study revealed different results. The study also outlines the benefits of having teachers familiarise themselves with various aspects of the Grade 9 EQAO Assessment of Mathematics –such as for example, the format of

the assessment, the kinds of questions that exist, and the kind of language used on the assessment.

The benefits and concerns discussed by teachers and identified in this study have implications for various stakeholders such as teachers, administrators, and researchers; these benefits, concerns, and classroom practices related to the Grade 9 assessment could also have implications for EQAO personnel, in particular those who design assessment questions and those who make decisions about the assessment –such as to the format of the assessment, the number of questions or the curriculum objective addressed in each question.

Implications for teachers

This study has implications for teachers as it highlights the importance of teachers' need to reflect on their own views of EQAO and determine how these views may influence the way they teach their students. Furthermore, as the study provides a look into one group's best practices and discusses the specific model of teaching adopted by this group, teachers could use this group's best practices as an inspiration for their own classroom practice. Teachers can also benefit from this study by reading about practices that prepare students for the Grade 9 EQAO assessment in a way that does not jeopardize student learning or that requires time away from other important mathematical activities outlined in the Grade 9 curriculum –such as observations and explorations– and which are not evaluated on the EQAO assessment.

Implications for administrators

This study also has implications for school administrators as the study showcases the benefits of giving teachers the opportunity to meet on a regular basis, to collaborate, plan and have unified goals for their courses. There are also other implications for administrators, specifically linked to their decision whether teachers will mark portions of the EQAO assessment to use towards classroom final marks. Since administrators make this decision and also decide the percentage allocated to this practice, they need to consider teacher biases of the EQAO Grade 9 assessment when making a decision –especially since teacher views of the Grade 9 EQAO assessment not only influence classroom teaching but can also affect student learning and student performance in classroom and on the EQAO assessment.

Implications for researchers

This study has implications for researchers, especially since future research in this area is still needed. More specifically, the implications for researchers are related to the research design

chosen and the researcher's approach to analyzing and discussing the data. This specific qualitative research, discussed as a case study, allowed for an in-depth look at one particular group of teachers' views and the impact of those views on practice; the extent of the connection between teachers' views and their impact on classroom practice, discussed at length in this study, may not have emerged without a deep dive into the data; such an in-depth exploration and analysis was only possible thorough qualitative research. Although conducting a qualitative study takes time and requires that the researcher becomes thoroughly familiar with their data, such a study can provide very rich results. Researchers interested in using a model or adaptation of Ernest's model, such as the one I used in my research, should consider all aspects of this framework, as discussed in the Limitations section above.

Future research

Although there are several studies on the topic of the Grade 9 EQAO Assessment of Mathematics, there continues to be a need for further research on this topic. Despite the low-stakes nature of this assessment, its mandatory mandate seems to have an impact on Grade 9 teachers' practices. While my research, in a sense, builds on the work of previous researchers such as Lock (2002), Kitto (2006), and Koch (2010), I believe that there are more questions left to explore related to the topic of EQAO. Some examples include questions related to the impact of the assessment not only on classroom practice but also on student performance in the Grade 9 course and on the Grade 9 EQAO assessment. A recent in-depth report by Dr. Carol Campbell (April, 2018) further prompts us to take a closer look at this assessment; in her report, Campbell suggests that the province of Ontario should eliminate some of the EQAO assessments, especially those in Grades 3 and 9, and instead place a higher emphasis on classroom assessment and giving proper feedback to students (Campbell et al, 2018).

Future research on this topic could also look at student teacher and new teachers' opinions of the Grade 9 EQAO assessment to determine when teachers' opinions are shaped –for example, is it during their formative years in teachers' college, after years of practice, or as a result of their school and school board's influence? Similarly, other research could look at teachers' support and/or influence from their administration and school board in order to see if this too affects teachers' opinion of the assessment and consequently the way that they teach their students. Exploring these topics could provide a better understanding behind how teacher

views of a particular large-scale assessment are formed and what may be some factors that influence those views.

The framework, from Ernest, which I adapted and used for the purpose of this study can be used by future researchers to look at different external factors that could potentially create constraints and opportunities and determine how these constraints and/or opportunities may or may not influence classroom teaching. Some examples of such constraints and/or opportunities could be the role of administration, support and/or pressure from parents, the influence of social media, or school prestige and having students perform certain ways on the assessment. Similarly, other researchers could use this framework to further expand this research to other schools in Ontario and explore if the findings presented in this study can be generalized by other cases or whether they would yield different results.

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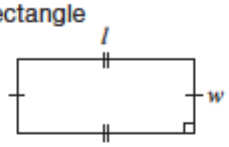
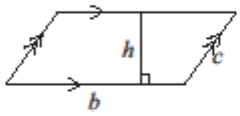
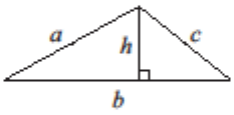
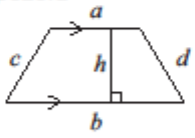
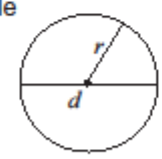
APPENDIX A

Formula Sheet
Grade 9 Applied

Geometric Figure	Perimeter	Area
Rectangle 	$P = l + l + w + w$ or $P = 2(l + w)$	$A = lw$
Parallelogram 	$P = b + b + c + c$ or $P = 2(b + c)$	$A = bh$
Triangle 	$P = a + b + c$	$A = \frac{bh}{2}$ or $A = \frac{1}{2}bh$
Trapezoid 	$P = a + b + c + d$	$A = \frac{(a + b)h}{2}$ or $A = \frac{1}{2}(a + b)h$
Circle 	$C = \pi d$ or $C = 2\pi r$	$A = \pi r^2$

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APPENDIX B

Philosophies of mathematics

The model presented in **Table 2** is adapted from Ernest (1989a). The model depicts the three different philosophies of teaching mathematics as described by Ernest, along with their respective teacher's role, intended learning outcome, curricular materials used, and student learning model expected.

Table 2. Philosophies of mathematics

PHILOSOPHY OF MATHEMATICS	TEACHER'S ROLE	INTENDED OUTCOME	CURRICULAR MATERIALS USED	STUDENT LEARNING MODEL
INSTRUMENTALIST *(knowledge of mathematics facts, rules and methods as separate entities)*	Instructor	Skills mastery with correct performance	Strict following of a text or scheme	Compliant behaviour and mastery of skills
PLATONIST *(global understanding of mathematics as consistent, connected and objective structure)*	Explainer	Conceptual understanding with unified knowledge	Modification of the textbook approach, enriched with additional problems and activities	Reception of knowledge
PROBLEM-SOLVING *(mathematics as a dynamically organized structure located in social and cultural context)*	Facilitator	Confident problem-posing and problem-solving	Teacher or school construction of the mathematics curriculum	Active construction of understanding Exploration and autonomous pursuit of own interests

Adapted from Ernest, P. (1989a). The impact of beliefs on the teaching of mathematics. In P. Ernest (Ed.), *Mathematics teaching: The state of the art*. New York: Falmer Press. p. 252

APPENDIX C

List of all available data sources

Table 3. Data sources available for analysis

Year 1		
DATA SOURCE	**DATES**	**TYPE OF DATA**
Monthly Individual PLC meetings	November 2014-April 2015 (various dates determined by each PLC)	Audio files and transcripts from focus group interviews; -Classroom materials
"Wrap" of Year 1: Individual and Focus Group Interviews	May 2015	-Audio files and transcripts from focus group interviews; -Audio files and transcripts from focus individual interviews
Year 2		
DATA SOURCE	**DATES**	**TYPE OF DATA**
Summer Institute	August 2015	-Audio files and transcripts from focus group Interviews
Monthly Individual PLC meetings	September 2015 - May 2016 (various dates determined by each PLC)	-Audio files and transcripts from focus group interviews; -Classroom materials
May Institute – Individual and Focus group Interviews	May 2016	-Audio files and transcripts from focus group interviews; -Audio files and transcripts from focus individual interviews

Adapted from Suurtamm et al. (2017). *OAME Project: Research Report, Teaching Grade 9 Applied Mathematics: A Collaborative Inquiry.* Report to the Ontario Association for Mathematics Education (OAME), January, 2017. p. 4-5

APPENDIX D

List of duration and length of each PLC meeting and individual interview

Table 4. Data sources used for analysis

Year 1	**Date of meeting**	**Type of meeting**	**Audio (hh:mm:ss)**	**Transcript # pages (12 font, TNR)**
Visit 1	Dec 17, 2014	Group meeting	01:00:26	13
Visit 2	Jan 8, 2015	Group meeting	00:59:00	9
Visit 3	Feb 19, 2015	Skype discussion	00:20:32	4
Visit 4	March 12, 2015	Phone discussion	00:24:28	11
Visit 5	April 23, 2015	Group meeting	01:11:06	14
Year 2	**Date of meeting**		**Audio (hh:mm:ss)**	**Transcript # pages (12 font, TNR)**
Visit 1	Oct 1, 2015	Group meeting	03:12:06	73
Visit 2	Oct 29, 2015	Group meeting	03:09:12	54
Visit 3	Jan 25, 2016	Group meeting	03:30:28	24
Visit 4	Mar 1, 2016	Group meeting	03:09:06	46
Visit 5	Mar 23, 2016	Group meeting	03:30:23	18
Visit 6	April 21, 2016	Group meeting	03:38:05	26
Individual Interviews (Year 2)	**Date of interview**		**Audio (hh:mm:ss)**	**Transcript # pages (12 font, TNR)**
Tony	May 21, 2016	Personal interview	00:09:48	4
Celia	May 21, 2016	Personal interview	00:15:37	5
Ruth	May 21, 2016	Personal interview	00:31:40	11
Molly	May 21, 2016	Personal interview	00:11:06	4

APPENDIX E

The 4-Block Thinking Template