

The Voices of Teachers on Mandated Changes to Math Curriculum and Policy

by

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Abstract

This study explores the issue of teacher underrepresentation in curriculum and policy development. The specific focus is on elementary public-school teachers in Ontario and their experiences with mandated changes to math curriculum and policy. Eight teachers were interviewed on this topic and a document analysis was conducted of curriculum, policies, and guides that are related to math education. The findings from the interviews and documents were triangulated through a conceptual framework that integrates sensemaking and contingency theories, to explore the relationship between individual responses to change and the constituents of an organization. Results from the analysis indicate that teachers are currently underrepresented in math curriculum and policy change processes even though they directly impact those changes. The findings carry significant implications for teacher roles and curriculum and policy development outcomes, emphasizing the need for congruent alignment between teachers' voices and how the education system is structured.

Dedication

This thesis is dedicated to my sister, Afsheen Ahmed Chowdhury. Despite being younger than me, you always have so much to teach me. Thank you for being my best friend.

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Teaching is a very noble profession that shapes the character, caliber and future of an individual. If the people remember me as a good teacher, that will be the biggest honour for me.

-Avul Pakir Jainulabdeen Abdul Kalam

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Chapter 1: Introduction

1.1 Research Problem

Teachers' perspectives and input have always been underrepresented in the process of curriculum and curriculum-related policy reform and innovation (Bailey, 2000; Cohen and Mehta, 2017; Priestley et al., 2012). Historically, the lack of teachers' input on curriculum changes has led to a gap between the guidelines of the curriculum and what teachers choose to implement, because they do not find the guidelines feasible for the classroom (Ball and Cohen, 1996; Handal and Harrington, 2003; Levin, 2008). It is important to include teachers in the development of education change because they are at the forefront of implementing those changes, as they have the knowledge and expertise to understand how the changes can be effective and successful (Bailey, 2000; Charalambos et al., 2010; Clement, 2013; Fullan, 2001; Harlen, 1977). The lack of teacher representation can be detrimental to education reform, and it can even lead to reform implementation failure (Bailey, 2000; Fullan, 2001; Handal and Harrington, 2003).

1.2 Purpose of the Study

There is a two-fold purpose to this study. The first is to further explore the role of teachers in curriculum and policy development through a topical context in relations to the extant issue. It is significant to explore a topical context because it can potentially inform future issues and contingent outcomes of reform, which is useful information for scholars and stakeholders involved in the development and implementation process.

The second purpose is to provide teachers with an opportunity to share their insights, and perspectives, which is imperative to do during the process of education reform (Bailey, 2000; Charalambos et al., 2010; Clement, 2013). This is achieved through this thesis because it reports

on firsthand accounts of teachers' perspectives on the relationship between education reform processes and their role and representation in those processes.

1.3 Scope of the Study

This study focuses on elementary public-school teachers in Ontario, and their experiences with math education reform, including mandated changes to math curriculum and policies which have occurred over the course of their teaching career. It is pertinent to hone in on math education because teachers are underrepresented in math education reform, as there is a frequent mismatch between the curriculum that is developed, and what teachers choose to implement (Handal and Harrington, 2003). Consequently, "If the mathematics teachers' beliefs are not congruent with the beliefs underpinning an educational reform, then the aftermath of such a mismatch can affect the degree of success of the innovation as well as the teachers' morale and willingness to implement further innovation (Handal and Harrington, 2003, pp. 60)."

I chose to focus on elementary teachers because of current policy and curriculum changes at the elementary level. These changes include the implementation of Policy and Program Memorandum 160 (PPM160) in 2016, which is a math policy mandating teachers to implement at least 300 minutes of math instruction a week, and the prospective rollout of the revised elementary math curriculum for the 2019-2020 school year (Ontario Ministry of Education, 2016a; Ontario Ministry of Education, 2019b). In addition, I chose public elementary schools because teachers in public schools are required to follow the curriculum and policy changes (Ontario Ministry of Education, 2016c). It is lucrative to explore teachers' perspectives on education change because their experiences affect education reform, an aspect that will be further explored in the literature review and through the analysis of the interview and document data. I use the word "teacher" instead of "educator" because I focus on individuals teaching in direct

classroom settings. Mandated changes, also known as external approach or top-down changes, are defined as changes initiated by the state, transmitted by the government to schools, with the expectation that teachers will implement them (Clement, 2013). In this study, ‘mandated changes’, ‘changes’ and ‘reform’ are used interchangeably.

1.4 Research Questions

The overarching question of the study is: What are public teachers’ experiences with mandated changes to math curriculum and policy?

This question guides the following lines of inquiry, informing the literature review, the structure of the interview protocol, and method for data analysis:

- 1) How do mandated changes in math curriculum and policy impact and shape teachers’ experiences teaching math?
- 2) How are teachers represented in math curriculum and policy reform processes?
- 3) What is the relationship between teachers’ experiences with math reform and the outcomes of its implementation?

These sub-questions address teachers’ experiences in three forms; the first sub-question examines how teachers are impacted by reform processes; the second sub-question explores how teachers are represented in the education system and their perception of their representation; and the third sub-question investigates how teachers impact reform processes, which is an inverse inquiry of sub-question one.

1.5 Context of the study

This study explores the research problem within the context of Ontario because of its topicality. It is significant to explore a topical context, such as this one, because it can potentially inform future outcomes of reform, which is useful for those involved in reform making processes

to know. This section will provide an overview of the education system in Ontario, the trajectory of math reform in the province, and its current series of math curriculum and policy changes.

1.5.1 The education system in Ontario. In Canada, the education system falls under provincial or territorial jurisdiction. The Education Act gives the Ontario Ministry of Education (the Ministry) the authority over the courses and content taught in public elementary and secondary schools. Following recommendations from the auditor general's 1993 Annual Report, the Ministry assumed responsibility over curriculum policy (Office of the Provincial Auditor of Ontario, 2003). Currently, there are over 4000 public schools in 72 boards across Ontario (Ontario Ministry of Education, 2019a). While all public schools in Ontario follow the same curriculum, each school board is managed by a Director of Education and a group of superintendents who administer schools within a geographical designation, including electing trustees within the community and overseeing hiring practices of all school staff including principals and teachers (Ontario Association of School Districts International, 2016).

1.5.2 History of math reform in Ontario. Education policy in Ontario went through a major shift from the 1990s into the early 21st century. Mike Harris and the Progressive Conservative Party came into power from 1995 to 2002, and they placed a larger emphasis on accountability by enforcing mandated curriculum content, standardized assessments, reporting of student progress, and the regulation of teacher professionalism (Anderson and Jafar, 2003). In the spirit of this ideology, the Conservative government set up the Education Quality and Accountability Office (EQAO). This is a semi-independent agency, separate from the Ministry. Established in 1996, EQAO started administering standardized tests for Grade 3 students in math, reading, and writing and expanded to Grade 6 testing in 1997. Even though school boards

are required to submit plans for EQAO assessments, there are no sanctions for not administering the test within each school board (Anderson and Jafar, 2003).

In addition to EQAO, the Ministry introduced a mandated math curriculum for Grades 1-8 (Ministry of Education and Training, 1997). This curriculum policy was disseminated through a top-down approach, where the Ministry expected teachers to follow the mandated guidelines as soon as it came into effect in September, 1997 (Kajander and Holm, 2013).

In 2005, while the Liberal Party was in office, the Ministry of Education released a revised edition of the math curriculum (Ontario Ministry of Education, 2005). Both the 1997 and 2005 editions were highly influenced by *The Curriculum and Evaluation Standards for School Mathematics*, which emphasizes constructivist learning over traditional rote learning (National Council of Teachers of Mathematics [NCTM], 1989). The constructivist approach emphasizes active involvement of the students with a focus on inquiry and open-ended challenges where students work in groups, and the teacher's role shifts from an instructor to a facilitator.

1.5.3 Current context in Ontario. For the past few years, elementary students' math performance in Ontario has been cited as a major area of concern (Reid and Reid, 2017). This is based on student achievement results from Grade 3 and 6 EQAO math and language assessments (Reid & Reid, 2017; Stokke, 2015). EQAO results from 2009 to 2018 exhibit a steady decline in the percentage of students who had achieved at or above the provincial standard for math in Grade 3, decreasing from 71% to 61%, and in Grade 6, dropping from 63% to 49% over those nine years (EQAO, 2014; EQAO, 2018).

In response to the EQAO scores, the provincial government implemented Ontario's Renewed Mathematics Strategy (ORMS) in 2016, which dedicated sixty million dollars over three years to increase student achievement, and introduced a policy mandating all public-school

teachers to provide three hundred minutes of math instruction per week (Ontario Ministry of Education, 2016a). After the provincial elections in 2018, there was a shift in ideology, because the Progressive Conservative Party of Ontario replaced the Liberal Party of Ontario, who was in power for ten years. The Progressive Conservatives replaced the ORMS with the Focusing on the Fundamentals of Math (FFM) strategy, retaining the funding from the ORMS but placing emphasis on numeracy and number properties, delivering on the election promise of deviating from the Liberal Party's focus on inquiry-based math (Ontario Ministry of Education, 2018a). In addition, the curriculum is being revised after 14 years and the new edition is slated for release in September, 2019 (Ontario Ministry of Education, 2019b).

1.6 Researcher's Standpoint

When I was an elementary school student, I experienced immense math anxiety and would receive low marks in math. I was fortunate enough to have a Grade 4 teacher who believed that I had the potential to improve on my math skills and she always encouraged me to try my best. As a result of my teacher's faith in my capabilities, I became more confident in math. My teacher inspired me to be an ardent proponent of the growth mindset and I became a teacher myself so that I could help other students realize their math proclivity. As such, my research interest stems from my own teaching experiences as a math educator in various capacities in South Korea, United Kingdom, and Canada. I encountered several changes in math curriculum and policies at the state and school levels, and my experiences differed based on my own beliefs as a teacher, the amount of support I received, and my perceived level of autonomy. In conversations with colleagues and former peers from my initial teacher education program, I heard similar sentiments on varied experiences with math reform. In this study, I situate myself

as a practitioner conducting this research study, and I am using my experiences as motivation to academically inquire into the relationship between teacher experiences and math reform.

1.7 Organization of the Thesis

This thesis is divided into six chapters. In Chapter 1, I introduced the research problem, the purpose of the study, and the context including the history of math reform in Ontario and its current circumstances. I also described my standpoint as a researcher, the main research question, and its three concomitant lines of inquiry. In Chapter 2, I present a review of the literature, covering the following topics: change theories pertaining to teachers' positionality in education change; the role of teachers in curriculum and policy development and implementation; and teacher characteristics that significantly impact math reform. In Chapter 3, I delineate the theoretical foundation of the study, including sensemaking and contingency theories. Then I describe my conceptual framework, which integrates core elements of both theories. In Chapter 4, I outline the research design of the study, including how I conducted qualitative interviews and the documents analysis, ethical considerations, and method of analyses. In Chapter 5, I present the thematic findings from the qualitative interviews and documents based on the main research question and its lines of inquiry, and an analysis of the findings through the conceptual framework. In Chapter 6, the concluding chapter, I discuss how this study contributes to the extant literature and education policy field, a limitation of this study, suggestions for future research, and concluding remarks.

Chapter 2: Review of the Literature

2.1 Introduction

The purpose of this study is to explore teachers' experiences with mandated changes to math curriculum and policy. As such, my literature review is organized based on theoretical scholarship and empirical research related to teachers and educational change, guided by my sub-questions:

1. How do mandated changes in math curriculum and policy impact and shape teachers' experiences teaching math?
2. How are teachers represented in math curriculum and policy reform?
3. What is the relationship between teachers' experiences with math reform and the outcomes of its implementation?

The first two sections focus on change and reform from a general, rather than math, perspective. In the first section, I analyze three change theories which have implications for teachers' roles and experiences. The section seeks to answer sub-question one, providing a theoretical foundation on the impact of change on teachers. The second section addresses sub-question two, including the literature on teachers' perspectives of their role and representation in curriculum and policy development, and how education system organization impacts teacher roles. There is limited research on the first two sections in regards to math; as such, I explore general education change for the first two sections, and hone in on math based on the resources I was able to elicit from my literature search. The third section addresses all three sub-questions from a math education context. The last section provides a brief overview of the literature in the Ontarian context; it is the shortest section as research in Ontario on this topic is scant. Lastly, I

summarize the findings from the literature review, address gaps in the literature, and explain how my study contributes to the literature.

I conducted a thorough search of the literature through a systematic process. I created a list of key terms and its related terms and used the University of Toronto Libraries search tool to find pertinent academic books, articles, and theses. I inputted each concept or term individually into the search tool. Table 1 is a list of concepts and terms I inputted to elicit pertinent literature. My exclusion criteria included anything before 1995, and non-English speaking countries.

Table 1: List of Key Concepts and Related Terms of the Literature Search

<i>Key concepts</i>	<i>Related terms</i>
Change theory	Change theories; education AND change theory; educational change theory
Math teacher	Math educator
Math policy	Math guideline; math law; math curriculum; math pedagogy
Policy AND teacher	Guidelines AND teacher; rule AND teacher
Teacher experience	Math teacher AND experience; teacher perception; teacher perspective; teacher satisfaction
Teacher AND characteristics	Math self-efficacy; math confidence; math anxiety; math uncertainty; teacher career
Education AND reform	Education change; mandated change; policy change; curriculum change; math change; math education; math education reform; math reform; top-down change
Teacher AND reform process	Teacher AND policy creation; teacher AND policy conception; teacher AND policy development; teacher AND curriculum development; teacher AND policy making, teacher AND policy implementation; teacher AND policy outcome; teacher AND policy result

2.2 Change Theories

Change theories originated in the business world, and gradually seeped through the education sector. These theories posit change as a multi-dimensional and complex process achieved through government policies, curricula, teachers, students, schools, and administration. In this section, I analyze three change theories that have implications for teachers and their practice: Larry Cuban's theory of planned change, Michael Fullan's insights on top-down and bottom-up approaches, and Jal Mehta's theory of sectorial overhaul. The objective of this analysis is to provide a background on the theoretical scholarship on education change in relations to teachers.

2.2.1 Larry Cuban's theory of planned change. Cuban (1988) argues planned change does not necessarily lead to improvement. He proposes there are two kinds of planned change: first-order and second-order reform. First-order reform tries to change existing conditions to increase efficiency. These changes alter the rules rather than the system. Examples in schools include selecting higher quality textbooks and hiring distinctive teachers and administrators. Second-order changes on the other hand, seek to alter how systems and structures are organized (Cuban, 1988). An example of that is the creation of charter schools, which deviates from the typical top-down relationship between funding and jurisdiction.

According to Cuban (1988), first-order changes succeed while second-order changes do not. He reasons that second-order reform have often been resisted by teachers and administrators, because they saw little gain from accepting reforms created by those who did not have direct experience in the classroom. On the other hand, they felt that first-order changes were within their own control. This implies that teachers have a direct impact on the outcomes of reform because they choose which ones to accept and which ones to resist. As such, Cuban (1988) calls

for a shift from prescribing what teachers should do to developing an understanding on which reforms teachers choose to accept and resist, and why. He believes policymakers and practitioners can help reframe the problem and address effective solutions if they collaborate.

2.2.2 Michael Fullan's insights on top-down changes. While Cuban (1988) calls for collaboration, Fullan (1994) asserts that neither top-down nor bottom-down changes are effective in education reform. Governments cannot mandate what matters because street-level bureaucrats need to be included when changes are made. Top-down is addressed primarily due to restructuring, not classroom teaching. This deters teachers from being motivated by these changes due to the perceived incompatibility in the classroom. Top-down changes are created without considering the significance of the work done by those in the field, namely teachers. When teachers view the solutions delivered by policymakers as counterproductive, they usually resist, and these changes fail (Fullan, 1994). On the other hand, Fullan (1994) explains that bottom-up approach, with teachers having a significant part in the decision-making process is also ineffective, because teachers do not change their strategies and there is minimal teacher-to-teacher collaboration. Hence, Fullan (1994) concludes that choosing solely lateral or vertical organizational approaches for change are fruitless and an alternative option is essential.

2.2.3 Jal Mehta's theory of sectorial overhaul. Mehta (2013) provides an alternative option. He rejects both top-down and bottom-up approaches; he calls for remaking the education sector itself, coining it as 'sectorial overhaul'. This diverges from Cuban's (1988) assertions where he nullifies systematic changes as Mehta (2013) suggests changing the entire system itself. Mehta (2013) reshapes the problem and argues that the main issue lies in the fact that the teaching occupation has not been professionalized. Mehta (2013) prescribes a four-step process to remake the sector to professionalize teachers: building an expert workforce with qualified and

dedicated teachers, creating a sound knowledge base, mobilizing knowledge into direct practice, and creating accountability measures to ensure all of these steps are implemented and maintained. This way government, school administration, and teachers will work in harmony.

Cuban (1988), Fullan (1994) and Mehta (2013) presented three discrete perspectives on education reform. Like Fullan (1994), Mehta (2013) renounces top-down and bottom-up approaches but calls for remaking the sector itself. This is different from the other thinkers as he is focusing on macro-level changes. However, a common thread flows between all of these lines of thought: that teachers have a significant role and impact on reform, and future changes need to consider teacher deference.

2.3 Teachers' Role in Development and Implementation

This section explores the evolving literature on teachers' role in curriculum and policy development and implementation. Most of the literature focuses on curriculum development and implementation rather than policy development. However, curriculum development is a policy in itself, so it can be explored from a policy perspective.

2.3.1 Theoretical perspective. Croll et al. (1994) theorized a four-part model of teachers' role in creating education policy, to provide scholars with a framework to understand possibilities and limitations for teachers and their role in education policy development. The four parts are as follows:

- Teachers as partners: teachers are partners with other educational actors, where all those involved view their roles as equally legitimate. This conception is derived from pluralist values, which involves decentralized and distributed power.

- Teachers as implementers of education policy: teachers do not have an equal role with policymakers because bureaucracies believe they know what is best for education.
- Teachers as opponents of governments: teachers resist changes imposed by the government.
- Teachers as policymakers in practice: this is in contrast to a mechanistic structure where teachers are organically developing curricula and policies through their practice.

2.3.2 Passive role. Most of the research portrays teachers as passive implementers of policy because they have had a limited role in curriculum and policy development (Bailey, 2000; Cohen and Mehta, 2017; Oloruntegbe, 2011; Priestley et al., 2012; Wiles and Bondi, 2007). Political actors decide how to develop and revise curriculum and policies to shape what students are learning and to fulfill their political agendas (Ball and Cohen, 1996). Another reason that is suggested for the lack of active participation is teachers do not have enough time, incentive, or support to apply their expertise in an effective manner (Harlen, 1977).

2.3.3 Local level versus provincial or state level. Some scholars posit teachers have an active role in implementing the curriculum at the local level (Kirk and MacDonald, 2001; Rohrig et al., 2007). This is closer to the concept of ‘teachers as partners’ and ‘teachers as policymakers in practice’ (Croll et al., 1994). There is a wealth of literature exploring how certain teacher characteristics and traits determine their responses to change and reform and in turn, impact outcomes of the development and implementation of curricula and concomitant policies. This area of inquiry is explored in the next subsection, because the wealth of research in this topic warrants its own section. However, implementation is different from development. Dominant

narratives claim development and implementation are distinct practices, and both are carried out in top-down processes, transmitted from the policymakers to the teachers (Bascia et al., 2014). This implies that teachers have less autonomy because these top-down changes are mandated, and teachers are not given a significant role in the development process.

The research on teachers' influence on curriculum and policy change at district, provincial or state level is scant (Bascia et al., 2014). Bascia et al., (2014) conducted a study in Ontario and shared three cases of 'teacher-driven curriculum' where teachers worked on developing new curricular content or pedagogical approaches which were later adopted at the provincial level. In one case, for example, secondary teachers and postsecondary philosophy professors formed a committee and drafted a course outline which was approved by the Ministry. The significance of this study is that there is evidence of teacher-driven development; however the research on this is very limited.

2.3.4 Teachers' perception. There is limited research on teachers' firsthand accounts of their perspectives on the role they play in math policy and education policy development and implementation. Researchers argue that it is crucial to examine teachers' trajectories through their accounts because it provides in-depth insights into their beliefs, knowledge and experience (Drake, 2006; Drake and Sherin, 2006; Senger, 1999).

One the few studies that was found in the literature on teachers' perception was a study by Bař and řENTÜRK (2019), where they interviewed teachers on their participation in the curriculum development process in Turkey. All the teachers reported that they had an opportunity to participate in curriculum development processes at the state level. However, they felt that their input was not impactful because it was not implemented. Some teachers believed

they are still significantly impact curriculum development because they implement it at the local level.

Bascia and Maton (2016) found curriculum innovation is possible in niche settings such as alternative schools. This is because of the distinctive characteristics of alternative schools, with their small staff and class sizes, minimal administrative oversight, and heavier teacher workloads providing opportunities for curriculum innovation. However, the teachers in the study reported how they were aware that they have a higher level of autonomy because of the nature of alternative schools and that it is much more challenging for teachers in mainstream schools.

2.4 Teacher Characteristics and Response to Math Education and Reform

Math teaching is an idiosyncratic practice in that a discrete set of teacher characteristics impact response to math education and reform. The following characteristics are covered in this section: self-efficacy, uncertainty, confidence, career stage and personal beliefs. As emphasized in the literature, these characteristics significantly impact how teachers respond to math education and reform and in turn, how they impact reform outcomes.

2.4.1 Self-efficacy. Teacher self-efficacy is the belief of one's own capabilities to provide a quality learning environment for students and being able to accomplish teaching tasks (Charalambos et al. 2010; Tschannen-Moran and Hoy, 2001). Self-efficacy beliefs enable individuals to remain persistent and fulfill planned goals and actions. Teachers' self-efficacy impacts educational outcomes (Charalambos, et al., 2010; Tschannen-Moran and Hoy, 2001). In a study examining the interplay between elementary math teachers' self-efficacy beliefs and mandated changes to the math curriculum, Charalambos et al. (2010) found that teachers high in self-efficacy beliefs were more likely to resist the curriculum changes. This was because the

teachers were not given any support to transition into the new approaches and felt more confident in their pre-reform approaches.

A component of self-efficacy, or rather lack of it, is math anxiety. Math anxiety is a negative affective response to math which leads to the belief that one is incapable of performing math-related activities (Beilock et al., 2010). Several studies have found a causal relationship between teachers' math anxieties and students' math performance (Beilock et al., 2009; Beilock et al., 2010; Gunderson et al., 2012; Ramirez et al., 2018). The higher the level of anxiety, the lower achievement in math. This is because teachers high in math anxiety are more likely to implement ineffective practices including an overemphasis on rote instruction; students in turn, are more likely to follow the sentiments that their teacher models (Ramirez et al., 2018). Even though there are several studies that illuminate the impact of teachers' math anxiety in the classroom, there is a gap in the literature on the relationship between teachers' math anxiety and their experiences with math reform.

2.4.2 Uncertainty. In the literature on teachers and math reform, uncertainty is a common response to reform (Drake, 2002; Manouchehri and Goodman, 2010; Melville et al., 2013; Remillard & Bryans, 2004). In their study, Melville et al. (2013) highlights three types of uncertainties teachers faced when transitioning from traditional to constructivist methods: uncertainty about learning and teaching in terms of addressing student understanding; uncertainty about subject matter, where teachers struggled with their math knowledge; and uncertainty about improving one's own teaching.

Teachers' uncertainty can stem from the lack of support provided during the change implementation process. Several studies emphasize the importance of providing the necessary support for teachers when math curriculum and policy changes are implemented (Charalambos et

al, 2010; Manouchehri and Goodman, 2010; McGee et al., 2013; Remillard and Bryans, 2004). When teachers are not provided with sufficient support to adapt to curriculum and policy changes, they are less likely to implement those changes (Charalambos et al, 2010; Drake, 2002; Manouchehri and Goodman, 2010). This suggests that reforms are more likely to fail when the changes do not address teachers' retrospective beliefs in math education, and when they are not provided with the support to bridge that gap (Charalambos et al., 2010).

2.4.3 Career stage. A few studies have found that teachers' response to changes in math curriculum and policy is contingent upon their career stage (Drake, 2002; Remillard & Bryans, 2004; Manouchehri and Goodman, 2010). Career stage is measured in the number of years of experience (Drake, 2002). While career stage does not provide the context or content of one's teaching career, it is still an indicator of the influence innovation and development has on teachers' interpretations of subsequent reform implementation (Drake, 2002).

Drake (2002) found that early-career teachers with three or less years of experience, mid-level career teachers with four to twenty years of experience, and late-career teachers with twenty-one or more years of experience differed on their attitudes towards math education reform and their subsequent choices to implement these changes in the classroom. Early-career and mid-career teachers were more likely to turn to the new curriculum documents as sources for planning, whereas late-career teachers were less likely to view the curriculum documents as mandated sources and chose to adapt materials based on their own judgement.

Manouchehri's and Goodman's (2010) study further explicated how teachers were more likely to embrace new curriculum materials during their early career stages. On the other hand, teachers with extensive experience were more likely to resist the new materials because they believed the materials did not prepare the students in mastering mathematical concepts. As a

result, teachers and would continue using their own materials instead (Manouchehri and Goodman, 2010). This again, alludes to the impact of retrospective beliefs on reform outcomes.

2.4.4 Teachers' math beliefs. Teachers' math beliefs are a relatively new field of study in math education research, with most research focusing on primary teachers than on secondary and postsecondary teachers (Forgasz and Leder (2008). Teachers' math beliefs are defined as how teachers engage in math pedagogy and tasks, and how they learn and unlearn concepts (Ball, 1996; Handal and Harrington, 2003). Gujarati (2011) refers to teachers' beliefs as 'personal beliefs', to describe their judgement on whether the mandated math curriculum should be implemented in the classroom. Spillane (1999) coined the term 'zones of enactment,' the hypothetical intersection between reform implementation and the teacher's belief and choice to accept the reform.

In the past, policymakers explored different methods to change teachers' beliefs so that they followed math innovations. In reality, it is actually the other way around where teachers use their own beliefs to determine whether to follow math changes or not (Ball, 1996; Gujarati, 2011; Roehrig et al., 2007; Senger, 1999; Spillane, 1999). In the process of policy implementation and other math changes, teachers bring in their math beliefs, which are cultivated through their professional and personal trajectories (Ball, 1996; Drake, 2006; Drake and Sherin, 2006). If teachers' math beliefs are not congruent with the underlying beliefs of curriculum changes, then teachers are less willing to implement the changes because they believe that their divergence better serves the needs of their students (Gujarati, 2011; Handal and Harrinton, 2003; Spillane et al., 2002). Aptly articulated by Drake (2006) on the importance of revering teachers' beliefs, "The challenge for everyone interested in promoting mathematics education reform – teachers, teacher educators, curriculum designers, and policymakers – is to

support these different groups of teachers in making sense of reform and incorporating ideas about reform into their ongoing stories of mathematics learning and teaching (Drake, 2006, pp. 601).” Teachers need to be given the required support and reverence to ensure change implementation is effective and successful.

2.5 Contextual Dimension

There are limited studies that focus on teachers’ experiences with math education reform in Ontario itself. Jarvis (2006), explored teachers’ experiences with changes to the math curriculum from 2005 and found how teachers acknowledged that a transition period is necessary for trial and error. Kajander and Holm (2013) investigated the math knowledge of pre-service teachers in Ontario based on their exposure to the curriculum before and after 2005. Reid and Reid (2017) explored a similar dimension on pre-service teachers’ math knowledge but without focusing on reform.

However, none of these studies examined teachers’ perceptions of their own roles in mandated changes or how they would prefer to be represented before, during and after these changes. In addition, there is no focus on the degree to which the teachers embraced or resisted the math curriculum and policies. Lastly, implications for reform outcomes is scant in the literature. My study further contributes to the research on mandated changes to math education in Ontario as it focuses on both, choices to accept, resist, or reject reform, and implications for reform outcomes.

2.6 Summary and Conclusion of the Literature Review

These are the core findings from the literature review:

- Theoretical scholarship on education change illuminates the significance of teachers’ impact on reform outcomes, with implications for system organization.

- The dominant narrative in the research is that teachers' role in curriculum development and implementation is mostly through local implementation, rather than through state, provincial, or district-level development.
- Self-efficacy, confidence, career stage, and personal beliefs are significant teacher characteristics that impact how teachers work with and respond to math reform.
- Uncertainty and lack of support are intertwined characteristics in the literature that also impact reform outcomes.

In regards to the main research question and its lines of inquiry, the literature comprehensively explores sub-questions one and three. In both theoretical and empirical research, characteristics of teachers and their roles in mandated changes impact their experiences. While there is a rich focus on experiences and responses to reform, there is a shortage of insight on sub-question two, on how teachers perceive their own role and representation in mandated changes. My study extended this line of research through the collection of firsthand accounts of teachers' perspectives. In reference to the contextual scarcity of my thesis topic, this study contributes to the theoretical and empirical literature by further exploring the sub-questions within the context of public schools in Ontario.

Chapter 3: Theoretical Foundation and Conceptual Framework

3.1 Sensemaking Theory

Sensemaking is a process in which people give meaning to their experiences.

Sensemaking was conceptualized by Karl E. Weick in the 1970s. Weick (1993) introduced this framework with the intention of shifting the focus from decision-making to how decisions affect individuals. The sensemaking framework engages with organizational studies by adding a dimension on how human perception affects identity, actions, and subsequently, the structures around them (Drake, 2006; Weick et al., 2005). Sensemaking tends to occur when individuals experience changes or disruptions that differ from prior beliefs and expectations (Weick et al., 2005). The sensemaking framework affirms that individuals engage in active communication in order to understand the situations and to build resilience for changes and disruptions.

Sensemaking affects changes and creates intra-organizational evolution (Weick et al., 2005).

Spillane et al. (2002) delineate the sensemaking process for educators within a policy implementation context. Sensemaking is not a simple procedure of deciphering messages; rather it is an active process where individuals integrate new information and experiences with their existing knowledge structures. Therefore, educators' interpretation of policy is contingent on how they process their prior knowledge and experience. Policymakers should ensure educators have opportunities for making sense of new policies in order to develop a shared understanding among stakeholders, and to increase the likelihood of effective policy implementation. Spillane et al. (2002) assert that in order to provide opportunities for that shared understanding, educators need to be active participants in the implementation process so that the policies engage with teachers' existing schema.

Drake (2006) used the key concepts from sensemaking to explore teachers' experiences with math education and reform throughout their career trajectories and implications for curriculum development. During reform implementation, individuals, including teachers, understand the policy through sensemaking, an iterative cycle of interpreting and implementing change. This process is highly dependent on the beliefs and understandings of individuals and there are patterns in the way teachers make sense of policy and curriculum changes.

3.2 Contingency Theory

Contingency theorists posit that the effectiveness of an organization or administration is contingent on environmental or situational characteristics (Derr and Gabaroo, 1972; Donaldson, 2006; Goodnow, 1982; Kieser, 1979; Lawrence and Lorsch, 1967; Morse and Lorsch, 1970). For example, mechanistic environments work more effectively through stable measures including hierarchy, role expectations, and highly defined rules and procedures. Organic environments, on the other hand, are more fluid in their changing conditions, and these types of environments rely on expertise rather than hierarchy (Hanson, 1979). This theory gained prominence in the 1970s and the 1980s with Lawrence and Lorsch being the primary drivers in acknowledging contingency theory as a field of study. Lawrence and Lorsch (1967) explored and theorized about internal differentiation and integration between organizations and how it impacted their environments. Differentiation is defined as the assignment of separate tasks because of perceived differences in cognition and attitudes. Integration is the state of collaboration between major subunits. Organizations divide themselves into subunits, with each subunit focusing on a particular set of tasks. Segmentation into units can lead to differentiation among members. According to empirical studies by Lawrence and Lorsch (1967) the greater the level of differentiation, the more challenging it becomes to integrate the segments.

Contingency theory has been used by scholars in the education field. Hanson (1979) developed research questions on contingency theory within the context of education. The questions were related to internal issues, types of responses, leadership styles within schools, and whether educational organizations conduct forecasting exercises. Contingency theory has been used in empirical studies on school-based systems (Derr and Gabarro, 1972), teacher leadership (Goodnow, 1982), and structural organization in higher education (Kovats, 2018). While these studies explored school-level structures, my study contributes to the scholarship on contingency theory as it analyzes the dynamics of a provincial education system.

3.3 Conceptual Framework for This Study

This conceptual framework integrates core elements from sensemaking and contingency frameworks. Within this framework, individual and collective sensemaking of teachers occur within an organization, which in this context, is the education system. Teachers' sensemaking and the organization of the education system are bidirectional contingents of each other. The sensemaking process of teachers impacts the environment including reform outcomes of the education system. In turn, sensemaking processes are contingent on curriculum and policy development and implementation processes, which are contingent on how the education system is organized. I use the following key components from the framework to analyze the findings in Chapter 5: teachers' sensemaking; teachers' role and participation; and system organization.

Figure 1 is a visual representation of my conceptual framework. In this framework, all the stakeholders are intricately connected within the education system. Curriculum and policy development and implementation processes are constantly occurring, which affects all stakeholders. Depending on the organization and processes of the system, there is scope for differentiation and integration among stakeholders.

It is important to acknowledge that all constituents experience sensemaking processes; I only explore the sensemaking of teachers because they are the focus of my study. Teachers' sensemaking involves active integration of new information and knowledge, such as mandated changes, through the integration of prior knowledge and experiences. Teachers' responses to the changes is contingent on the level of differentiation and integration between their prior experiences and the changes they are experiencing. Their experience is also impacted by the support provided to them at the local level, including resources, professional development opportunities, and support from school leaders.

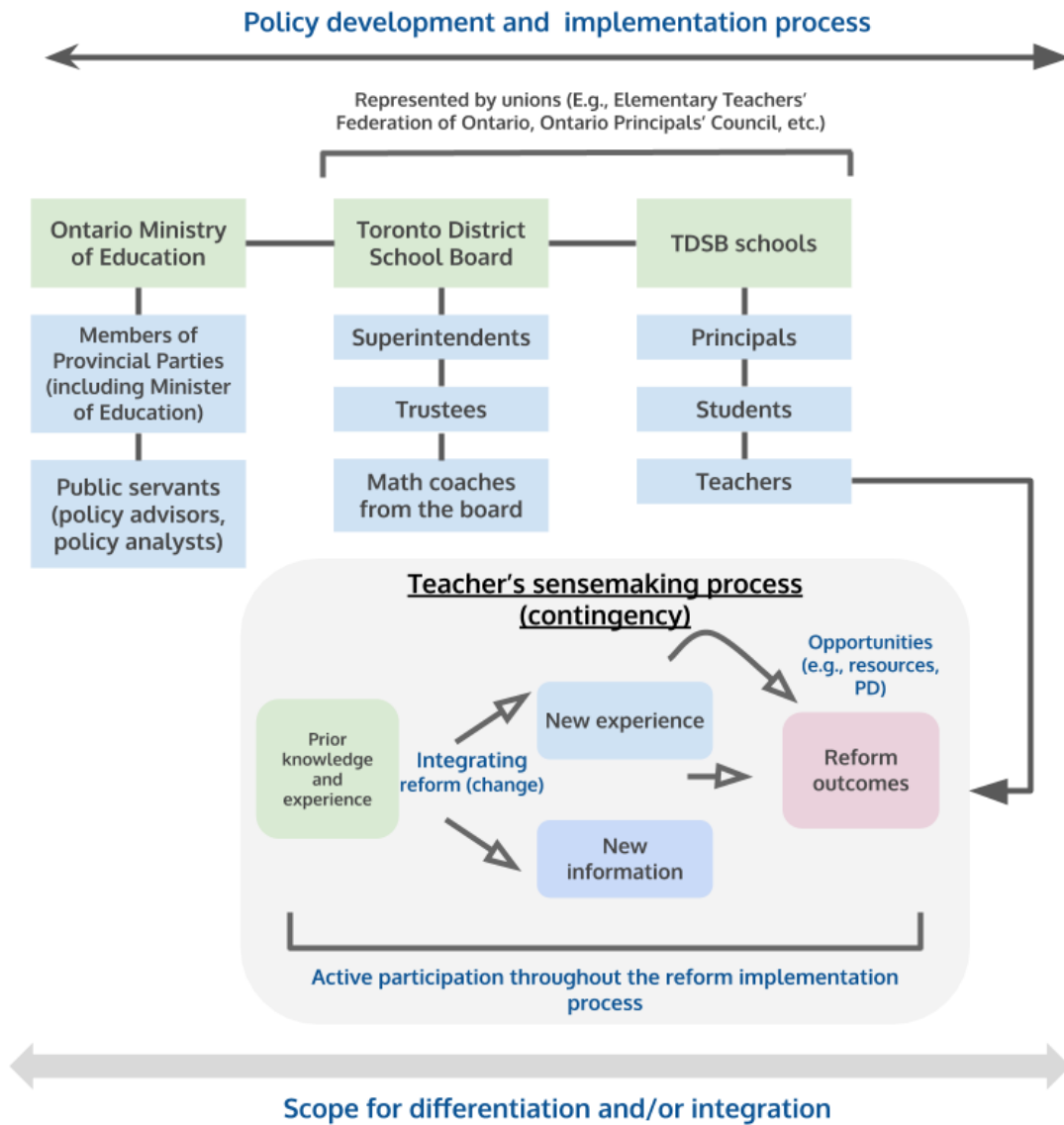


Figure 1: Conceptual Framework

Chapter 4: Research Methodology

4.1 Research design

My research design consists of two qualitative approaches. First, I conducted one-on-one semi-structured interviews with teachers in two public schools within the Toronto District School Board (TDSB). Several researchers from the literature review collected data through semi-structured interviews (Bailey, 2000; Gujarati, 2011; Jarvis, 2016; Manouchehri & Goodman, 2010; Melville et al., 2013; Remillard & Bryans, 2004). I chose a semi-structured format because these type of interviews contain open-ended questions, which provided the participants with an opportunity to share detailed descriptions of their perspectives on teaching math and experiencing changes to math curriculum and policy.

Second, in addition to the interviews, I conducted a document analysis of key documents from the Ministry and the TDSB. Document analysis is a procedure to examine and interpret data to construct and elicit meaning. Documents provide data on the context within the research participants operate. It is often used in conjunction with other qualitative methods for triangulation when studying the same phenomenon (Bowen, 2009). As such, in accordance to my conceptual framework, the document analysis provides insight on the organizational structure of Ontario's education system including the Ministry and the TDSB, while the interviews illuminate how teachers process and work with change; the triangulation of the data from the interviews and documents paints a holistic picture of the relationship between teacher sensemaking and the structure of the education system, which addresses sub-question two, 'How are teachers represented in math curriculum and policy reform processes.'

4.2 Qualitative Interviews

4.2.1 Instruments. Firstly, I created two letters of consent. One was to seek the permission of the principals from each school to conduct the study (see ‘APPENDIX A’). The other consent letter was for the teacher participants (see ‘APPENDIX B’). Both letters were constructed based on The University of Toronto’s Policy on Ethical Conduct in Research.

Secondly, I created an interview protocol with open-ended questions for the participants (see ‘APPENDIX C’). The questions were modelled after my research questions and were divided into the following sets:

- Set 1- The participant’s general experience as a teacher.
- Set 2 - Background on the participant’s experience teaching math.
- Set 3- Participant’s experiences with math reform, focusing on research sub-questions one and two, ‘How do mandated changes in math curriculum and policy impact and shape teachers’ experiences teaching math?’ and ‘How are teachers represented in math curriculum and policy reform processes?’
- Set 4 - Teacher representation in math reform, focusing on sub-question two again and sub-question three, ‘What is the relationship between teachers’ experiences with math reform and the outcomes of its implementation?’

The purpose of structuring the interview in this manner was to garner a comprehensive understanding of the participants’ experience as a public-school teacher teaching math.

Lastly, I created an additional information sheet for teacher participants (see ‘APPENDIX D’). This document contains a list of key terms which provided participants with the context and background of the study.

4.2.2 Sites and sample selection. I chose the two public schools based on a convenience sample, as it was easier to contact the school administration and staff since I had worked in those schools before. Convenience sampling might not yield the most representative sample of the target population, but it can still provide useful information (Creswell, 2012). Since I have worked in both schools, I knew there was variety of teachers in each school in terms of years of teaching experience and types of experiences.

I interviewed four teachers from each school, a total of eight participants. First, I contacted the principals from each school to seek formal permission to conduct my study at the school. The principals were provided with a letter of consent to review and sign. Then, I sought permission from the principal to contact the teachers I already knew from my past working experience. Participants were selected based on evidence of prior experiences teaching math in the classroom. I chose a sample of teachers from a diverse range of career stages.

4.2.3 Ethical considerations. Due to the multijurisdictional nature of the study, I had to seek permission from the University of Toronto, my academic affiliation, and the TDSB, the board where the two schools reside. It was a lengthy process, but well worth ensuring that all ethical standards were being met. I submitted an ethics approval protocol with the University of Toronto Ethics Board and received approval on August 16th, 2018. Afterwards, I submitted an ethics approval protocol to the TDSB External Research Review Committee and received approval from them on October 11th, 2018. I started collecting data only after obtaining permission from both jurisdictions.

All the information is reported in a way where individual persons and schools cannot be identified. Each school and participant were given a pseudonym from the beginning of the recruitment process. The participants were given the option to choose their own pseudonym. The

interviews were held using those pseudonyms and were recorded on the transcripts as well. The pseudonyms were used in place of the participants' name for this thesis. Extra precautions were taken since the sample sizes from each school is small, with four participants from each school. Each participant is described using generic descriptors (e.g., teacher with experience teaching math). The participants are not identified by the grade or subject they teach.

4.2.4 Data collection. I approached interested teachers with a formal invitation through a letter of consent, a strategy recommended by Creswell (2012). The letter of consent contained information on the study, the duration and contents of the interview, ethical standards regarding participation, and contact information of my thesis supervisor and the University of Toronto Research Ethics Board. Each participant was given the time to review and sign the letter of consent and then they proceeded to participate in the interview. Participants were informed of their right to withdraw on their consent form. They could have provided verbal or written notice of their intention to withdraw, and none of the data obtained from the participant's contribution would have been used for the study.

The interviews were conducted from December 10th to December 20th, 2019. The participants chose the interview site within the school; all of them chose to be interviewed in the classroom they teach in. Before the interview, participants were provided with the interview protocol. They were given time to review the protocol and use it as reference during the interview. The interviews were 20 to 45 minutes in duration. All the participants provided consent to record the interviews, which I did using a voice recorder while I simultaneously wrote notes. Within two weeks of each interview, I transcribed the audio recordings. I chose to transcribe the transcripts myself as it seemed most ethically sound and also because the process of rehearing and transcribing the interviews helped me understand the data in-depth. After

transcribing the interviews, I sent it to the participants so that they had the chance to add further information and correct any misinterpretations. The participants had the option to completely withdraw from the project within two weeks of receiving a copy of their transcription.

There are two copies of the transcripts. The first copy is part of the main data set and has the actual name of the participant along with their assigned pseudonym. The second copy just includes the participant's pseudonym. Only the second copy of the transcripts were sent to each participant to review. This way, the main data set containing the participants' real names were kept separate from the transcripts with the pseudonyms of the participants. Only I, the principal investigator, have access to the main data set with the actual names. The participants, my thesis supervisor and second reader, the University of Toronto Research Ethics Board, and the TDSB External Research Review Committee has access to the second set of data. The second set of the transcripts were used during the drafting of the thesis and during consultations with my thesis supervisor and second reader, The same pseudonyms were used in place of the participants' names for the final thesis, including the rough and final drafts.

All written notes are stored in a physical notebook which was used solely for this project. All audio recordings were stored on my personal voice recorder which only I have access to. The audio recordings were transferred to my personal computer which is password protected and only accessible to me. I will retain the data for five years and then they will be completely destroyed. I will permanently delete the electronic transcriptions from my phone, recorder and my personal computer, and shred the physical interview notes from my notebook.

4.2.5 Data analysis. I developed descriptive codes from my research questions and interview protocol, and subsequent nodes were inputted into NVivo software. The nodes included the following:

- Desired changes (of the teacher participants)
- Math changes
- Math curriculum
- Math teaching experience
- Ministry of Education
- Policy transmission
- Reform outcome
- Teacher career
- Teacher confidence
- Teacher consultation
- Teacher role and representation
- Teaching experience

I manually coded the eight transcripts and analyzed the text through conventional content analysis. Conventional content analysis is when codes and categories are extracted directly from the text. Content analysis itself is a widely used iterative technique in qualitative research to subjectively interpret the content of the text or data. I read the coded transcripts thoroughly and repeatedly to obtain a comprehensive understanding of the data, which is recommended by Hsieh and Shannon (2005). In addition, I took notes on my initial thoughts and impressions.

Following content analysis, I used the coded transcripts and initial notes to create a table which contains the names of the participants, interview excerpt and its accompanying codes, and analytical memos. The analytical memos were based on my initial notes. I used the chart to develop emergent themes from the data which informed my findings. Baş and ŞENTÜRK (2019)

used a similar method of creating an analytical chart to analyze qualitative data of teachers who shared their experiences on their participation in the curriculum development process. It was pertinent for me to use this method since the focus of their study was similar to the topic of this thesis. Table 2 showcases a few examples from the table I created.

Table 2: Examples from the Data Analysis Table

<i>Participant</i>	<i>Interview Excerpt</i>	<i>Code(s)</i>	<i>Analytical Memo</i>
James	I teach good math. If the changes appear to be better for student learning, such as closing the gaps for university or for high school, then I would do that. If I feel the changes do not benefit them in anyway then I will not incorporate them.	Math confidence; math teaching experience	James has high confidence in math. Because of his high confidence, he feels it's his discretion to decide whether to accept or resist changes to math education.
Kyle	Yeah, I mean I think that I would yes, they should be consulted. The format of how the consultation happens should be up for debate. I don't know if I need to be called into a town hall to offer my thinking on things. People doing research projects, like yourself, getting feedback from teachers that way.	Teacher consultation; teacher role and representation	Kyle believes teachers should provide input during the curriculum reform process. He sees research projects as a form of effective consultation, which places value to the research project itself.

4.3 Document Analysis

4.3.1 Data collection. The scope of the document analysis includes Ministry and TDSB documents related to math education at the elementary level including related curricula, policies, and reform. The timeframe is from 2004, the year before the math curriculum was last revised, to 2019. I checked for completeness of the documents as it is imperative to ensure the documents are comprehensive (Bowen, 2009).

Table 3 provides an overview of the documents that were analyzed. There are 18 documents in total: seven news releases, three policy documents, three guides, two webpages, one curriculum document, one information note, and one presentation slide deck.

Table 3: Documents for Analysis

<i>Title</i>	<i>Type</i>	<i>Jurisdiction</i>	<i>Release Date</i>	<i>Brief Description</i>
McGuinty Government Delivers More Respect for Teachers (Ontario Ministry of Education, 2004)	News release	Ministry	December 15, 2004	An announcement that the government had cancelled the 'teacher testing' program.
McGuinty Government Applauds Students, Teachers and Principals for A Third Year of Progress in Reading, Writing and Math (Ontario Ministry of Education, 2006)	News release	Ministry	August 31, 2006	The provincial government commended principals, teachers, parents, and students for working collaboratively to increase EQAO scores.
Ontario Dedicating \$60 Million for Renewed Math Strategy (Ontario Ministry of Education, 2016d).	News release	Ministry	April 4, 2016	An announcement on a \$60-million-dollar effort by the Ministry of Education to improve student mathematics achievement.
Ontario's Government for the People Respecting Parents by Holding Unprecedented Consultation into Education Reform (Ontario Ministry of Education, 2018 b)	News release	Ministry	August 22, 2018	The Premier and Minister of Education announced that the Government of Ontario would be consulting parents on education reform.

Consultation into Education Reform (Ontario Ministry of Education, 2018c)	News release	Ministry	August 22, 2018	Details of a province-wide consultation which was held by the Government of Ontario on education reform.
Statement by Education Minister on EQAO Results (Ontario Ministry of Education, 2018d)	News release	Ministry	August 29, 2018	The Minister of Education discussed policy actions being taken to address declining EQAO scores.
Back-to-Basics' Math Curriculum, Renewed Focus on Skilled Trades and Cellphone Ban in the Classroom Coming Soon to Ontario (Ontario Ministry of Education, 2019a)	News release	Ministry	March 15, 2019	The Minister of Education introduced a range of education policies as part of a new vision called, 'Education that Works for You.'
The Ontario Curriculum Grades 1-8: Mathematics (Ontario Ministry of Education, 2005)	Curriculum document	Ministry	2005	Outlines the general and specific expectations for teachers to teach math.
Ontario's Renewed Mathematics Strategy (Ontario Ministry of Education, 2016a)	Policy document	Ministry	April 8, 2016	Outlines the details of the Strategy, including a policy where elementary teachers are required to teach 300 minutes of math per week.
Appendix I. Funding for the Renewed Mathematics Strategy (Ontario Ministry of Education, 2016b)	Policy document	Ministry	April 8, 2016	Outlines a detailed funding model from 2016-17 for the Ontario Renewed Mathematics strategy.

Capacity Building Series: Maximizing Student Mathematical Learning in the Early Years (Ontario Ministry of Education, 2011).	Guide	Ministry	September, 2011	A guide providing a literature review on math learners and teachers, along with steps on how teachers can apply math knowledge to their teaching.
A Guide to Effective Mathematics Grades 1 to 3 Number Sense and Numeration (Ontario Ministry of Education, 2016e)	Guide	Ministry	2016	A guide written by the Ministry to provide Grade 1-3 teachers with information on helping students achieve the expectations under the Number Sense and Numeracy strand.
Focusing on the Fundamentals of Math: A Teacher's Guide (Ontario Ministry of Education, 2018a)	Guide	Ministry	April 23, 2018	A guide written by the Ministry providing elementary teachers information on how to teach students Number Sense and Numeracy and Patterning and Algebra strands.
Curriculum Day 2014 "Curriculum 101" – The evolving Ontario Curriculum (Ontario Ministry of Education, 2014)	Presentation Slide Deck	Ministry	2014	The presentation provides an overview of the curriculum review and revision process within the Ministry.
Transformation of Curriculum (Ontario Ministry of Education, 2017)	Public-facing webpage	Ministry	2017	Describes the initiatives that were taken for revisions and innovations of provincial curricula.

Education in Ontario Consultation (Ontario Ministry of Education, 2019c)	Public-facing webpage	Ministry	2019	Provides data collected from province-wide consultations on education.
Strategic Plan – An Overview Improving Student Success in Mathematics: K-12 Strategy (Toronto District School Board, 2014)	Policy document	TDSB	2014	Identifies goals and actions to support students in mathematics learning within the TDSB system.
Facts: Mathematics and Numeracy in TDSB Schools (Toronto District School Board, 2013)	Information note	TDSB	2013	Provides information on the types of programming and resources that are available for math education in the TDSB.

4.3.2 Data analysis. I used NVivo software to manually code the themes. I inputted the following parent nodes and child nodes:

- Audience
 - Teachers
 - Boards
 - Parents
 - Other
- Collaboration
- Consultations
- Mandated change
- Professional development and supports
- Teacher involvement

After inputting the nodes, I analyzed the data through a method which integrates content and thematic analyses, a common practice in document analysis (Bowen, 2009). I organized the coded documents into categories through iterative reading and analysis and then I searched for patterns to organize the data into key themes.

Chapter 5: Findings and Analysis

5.1 Organization of the Chapter

First, I present the thematic findings and analysis from the qualitative interviews. This includes a table of names of the schools and participants, and a diagram of how the themes from the interviews are interrelated. Next, I present the findings from the document analysis. Lastly, I synthesize and analyze the findings from the interviews and document analysis using my conceptual framework I described in Chapter 3.

5.2 Thematic Findings and Analysis from the Interviews

5.2.1 Names of schools and participants. Table 4 presents a list of the schools and teacher participants. The participants' career lengths span from three to 15 years. To abide by the ethical guidelines of the Toronto District School Board, I did not provide a detailed overview of school or participant profiles. As stated before, I use pseudonyms in place of the schools' and participants' real names.

Table 4: School and Participant Pseudonyms

<i>School</i>	<i>Participant</i>
Grand Alley Junior and Senior Public School	Douglas James Lily Sarah
Tulip Street Junior Public School	Kyle Shawn Sidney Yatze

5.2.2 Organization of the findings. I organized the findings into three main categories : math confidence, math curriculum and policy, and math reform process. Within each category, there are key themes that emerged from the content analysis of the data. As I am focusing on the qualitative nature of the data, rather than choosing themes based on the number of comments, I

based my selections on their corroborations with the literature review, conceptual framework, and document analysis. To sustain the authenticity of the data, I share direct excerpts from the interviews rather than paraphrasing it; after all, this thesis is about the voices of teachers! I cross-referenced the selection of quotes with the analytical chart to ensure I present the data in an inclusive manner. Rather than choosing an exclusive selection of excerpts, I included teacher excerpts whenever they elaborated on the categories and their accompanying themes. All of these categories and associated themes are interrelated, which is further explained in Section 5.4.

Figure 2 provides a visual summary of the categories and themes extrapolated from the data.

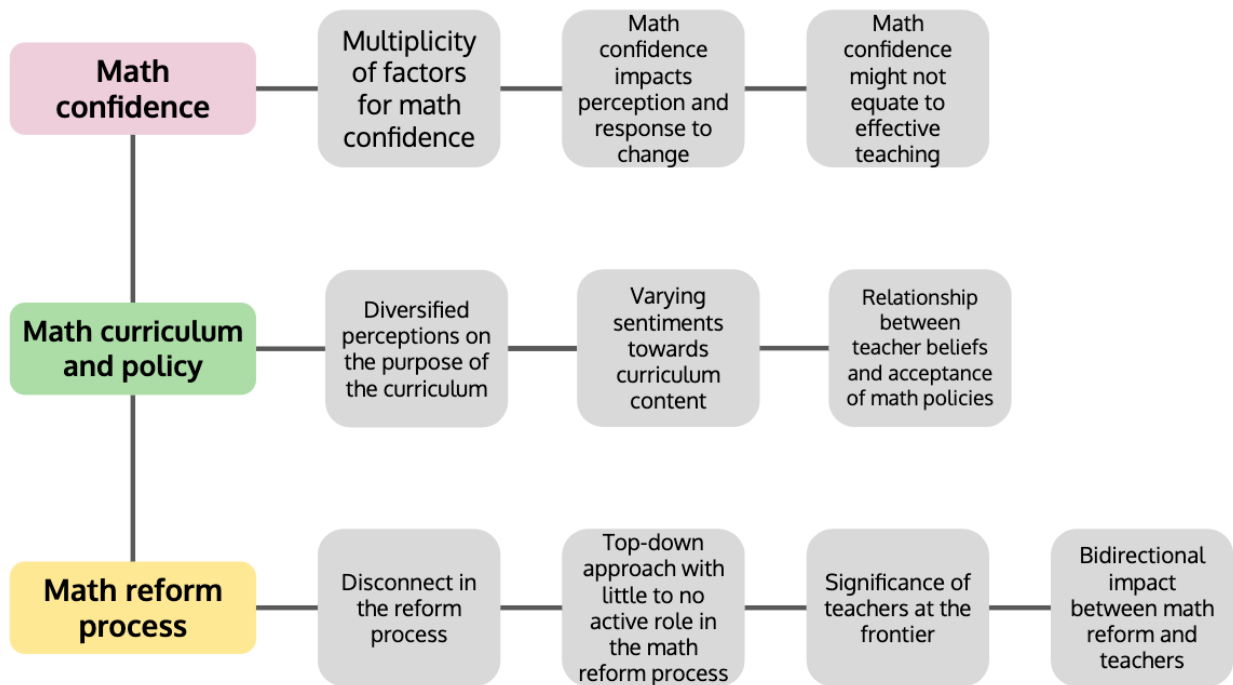


Figure 2: Categories and Themes that Emerged from the Findings

5.2.3 Math confidence.

Multiplicity of factors for math confidence

Each teacher participant reported a unique set of reasons and a combination of factors that increased their confidence in math. This implicates that there is not a sole source for math confidence but rather a multiplicity of interrelated factors.

Shawn was the only one who explicitly reported that he is naturally good at math. He further explained that his natural propensity for math is not the sole source of his confidence. The support he received during teachers' college also contributed to it.

I've always been good at math. But I think looking at problems in different ways, I learned that through teachers' college from a teacher. So that's when I learned how to solve problems in different and then I gained a love of math in teachers' college.

(Shawn)

Kyle also reported how access to resources helped increase his confidence in math.

I am certainly much more confident now. I find that having a resource like we have right now with JUMP Math has really given me a foundational backbone, in combination with the number of years that I've done it. (Kyle)

The literature emphasizes the importance of providing teachers with resources and support (Charalambos et al, 2010; Manouchehri and Goodman, 2010; McGee et al., 2013; Remillard and Bryans, 2004). Kyle's comment further explicates how support can boost one's potential.

As Kyle mentioned that his years of experience as a teacher helped increase his math confidence, Sarah and Yatze also commented how there might be a link between math confidence and teaching experience. This is logical as the more time one uses to hone their skills, the better they become, which in turn can increase their confidence.

I think certain teachers who have been teaching for longer periods and are confident in their teaching practice, will continue to grow professionally and try new things. (Sarah)

I'd say I'm more organic now than I've ever been...Oh for sure, yeah [it has to do with experience]. Because I know the curriculum inside out, and I know the difference between, like when I taught split classes, I know the little differences between Grade 5 and Grade 6. (Yatze)

In addition to experience, Sidney also cited her students as a source of her confidence.

Yeah, definitely [it has to do with experience], and also the thing that has given me confidence is the response of students. When I'm teaching math, I feel like the kids are really enjoying math. I feel like they're learning, and their very positive feedback is affirming for me. (Sidney)

From natural skills, to resources, to confidence, to students, there are a variety of factors that help teachers increase their confidence in math.

Math confidence impacts perception and response to change

Teachers who discussed the relationship between math confidence and response to change explained how teachers' confidence in math knowledge and pedagogy is a key determiner in how they perceive and respond to math reform. James, who reported having confidence in math, stated he would use his own judgment in deciding whether to implement changes or not.

I teach good math. If the changes appear to be better for student learning, such as closing the gaps for university or for high school, then I would do that. If I feel the changes do not benefit them in anyway then I will not incorporate them. (James)

This response reflects the literature on self-efficacy and curriculum changes, how teachers have the self-efficacy to resist changes if they believe the changes do not serve the needs of the students (Charalambos et al. 2010; Gujarati, 2011). Douglas and Shawn, who also reported having math confidence, said they believed they had the skills to adapt their practices accordingly, rather than resisting the changes.

I feel pretty confident in my math pedagogy as I am able to help kids meet with success. If something radical were to change, I think I'll be able to roll with the punches. You know, I really have made a very conscious effort and not just with my math teaching, but teaching in general to not get kind of stuck in the mud or mired in a certain way. This is the way I've always done it. I'm always looking to evolve my program.

(Douglas)

I don't think changes impact me in any way. I'm very flexible, I do everything. I have my math specialist, I can do three-part, I can use the math textbook, I could make centers. I use the computers for a group. So yeah, I could do it, teach it in any way. (Shawn)

Both teachers explicitly indicated that they are flexible enough to respond to changes because of their math confidence. Meanwhile, Lily was the only participant who explicitly reported having lower levels of math confidence. She exhibited uncertainty on how to respond to the prospect of future reform.

...sorry I don't know. I guess it makes me nervous because he's talking about how they don't know times tables but, I don't know, I really don't know. (Lily)

Uncertainty can stem from dissonance between prior beliefs and current changes, and a dearth of support during change implementation. Teachers who lack math confidence may not be able to respond to uncertainty by using individual judgment or by being adaptable. This in turn carries significant implications as teachers who are uncertain are less likely to implement changes, which can lead to reform ineffectiveness or failure (Charalambos et al., 2010).

Math confidence might not equate to effective teaching

The participants' responses and the literature indicate that teachers' confidence increases their likelihood to resist changes if it conflicts with their beliefs. Lily and Sarah addressed a nuanced point that there is no guarantee that resistance due to confidence is the most effective teaching practice.

I guess if you know you have an inherent confidence in math, then I guess you can decide what is right. Yeah, maybe, I don't know if they're right though. (Lily)

Yeah, I think it depends on the teacher. Certain teachers who have been teaching for longer periods and are confident in their teaching practice will continue to grow professionally and try new things. But I would say also, it sometimes backfires on those other teachers who have been working for a very long time and are very much set in their ways. Even if they are confident teachers and they are confident in their program, they don't want to try anything new. I think it depends on the person, more than their experience. (Sarah)

Sarah raised a valid point; just because a teacher has math confidence does not mean that they are always making the most effective teaching choices for the students. While it is fair to assume that experience hones knowledge and practice, this might not always be the case. As Sarah notes, teachers may become regimented in their practices and reject new pedagogies even if they may be more effective in addressing the needs of the students than prior practices. Future research should explore the nuanced relationship between math confidence, response to reform, and effectiveness of the choices made on responding to reform.

5.2.4 Math curriculum and policy.

Diversified perceptions on the purpose of the curriculum

All the participants acknowledged that curriculum expectations are mandated by the Ministry. However, participants who elaborated on that point shared diverse perceptions on the

reasons why the curriculum is mandated. Sarah and Kyle believe it is mandatory to follow the curriculum for assessment and reporting purposes.

Well yeah, I do believe it's mandatory because that's what goes down on the report cards. (Sarah)

I certainly think that it's mandatory in that wherever you are, whatever the report card is, it is an evaluation of the curriculum. So to assess and evaluate, and to produce a legal document that is not connected to that curriculum is problematic. (Kyle)

Sidney believes it is a general responsibility of the teacher to follow the curriculum and holds a positive perception of it.

I do think it's mandatory to follow because I think first off, it's my responsibility as a public-school teacher to deliver the curriculum. So I mean, I think that's a professional responsibility. And then I think that so far, I feel in my teaching experience the kind of curriculum and policy changes have been well considered so far. I think the math curriculum is pretty good, it's a spiral curriculum, one level builds on the other, it circles back and goes over things again, and I think that's really good. So yeah, I do think it's mandatory and I think it's my responsibility to deliver. (Sidney)

Like Sidney, James also reported an explicitly positive outlook on the curriculum. He believes following the goals of the curriculum is prudent and that his choice to follow the

curriculum is an indicator of his improvement as a teacher. In addition, he does not believe the curriculum is coercive, but serves as a guide.

I don't think that's [the curriculum is] forced upon you, but I think it's encouraged as good teaching and good practice...It [the curriculum] does [match with his own philosophies]. And that has evolved over time and I learned to be a better teacher. Now that's fully the way I do things, with a focus on learning goals. (James)

Yatze, Shawn, Douglas, and Kyle also view the curriculum as a guide, even though they believe it is mandated.

So yes, I see it as mandatory and those are things I need to follow. But I also see that as, what do I need to follow, balancing that with what I know is right...I'm still doing things from the curriculum, but if I know that there is something important, then I will lean into that a little bit. Yeah, I mean it guides, but you have to use your good judgment as well. (Yatze)

I don't think...like you should follow it, but again there's no one here to say if I'm doing it or not, if I'm following it or not. But, it is a good, it provides a direction. I would say all the teachers follow it, because we just don't have time, like you don't have time, what are you going to do. Because you have a clear direction to follow, like make your lessons, make your units so, I think everyone follows it. I follow it. (Shawn)

I mean sure, the simple answer is of course. The government sets the standard. I'm regularly going back to the curriculum and making sure that I'm hitting the points that I'm supposed to hit, and that is the main guiding document of what I'm doing. So, I certainly go with that...So yes, I see it as mandatory and those are things I need to follow. But I also see that as, what do I need to follow, balancing that with what I know is right.
(Douglas)

It is possible that all three of them view the curriculum as a guide while being aware that the curriculum is mandated because it stems from their math confidence, which all of them reported having. In contrast, Lily has an absolutist position on the mandated nature of the curriculum, which she attributes to her level of math confidence.

I follow the Ministry curriculum for all the subjects that I teach, so that is where I start. Especially because I wouldn't say math is the most comfortable I am with. I pay a lot of attention to what the curriculum is saying, and then I use resources that are curriculum-based as well. (Lily)

The relationship between teachers' view of the purpose of curriculum and math confidence explicates once again the significant role of math confidence in teaching and perception. This is an imperative field of study for researchers, practitioners, and policy makers. The diversified views of the purpose of following the curriculum - from assessment, general teacher responsibility, a guide, and a mandate - indicates that perhaps the curriculum itself is

flexible enough for intricate teacher characteristics to feed into the perception process. This possibility will be further explored in Section 5.4.

Varying sentiments towards curriculum content

As there is a diversified range of opinions on the purpose of the curriculum, there are also varying sentiments on the math curriculum itself. As mentioned before, Sidney and James share a positive outlook on the curriculum. Kyle and Douglas are also relatively satisfied with the curriculum.

But in terms of my own practice in my own classroom I'm quite satisfied with where the curriculum is. (Kyle)

Yes, So I've looked at that but again there's nothing in there that doesn't try to match up with what we're doing already. Yeah, I didn't feel that there was any real need to shift my practice based on that, because again, there was nothing that wouldn't fit with a solid math program as it is. (Douglas)

Even though Douglas is content with the curriculum, he expressed his concerns with the gap between the Grade 8 and Grade 9 curriculum, which carries significant implications for students transitioning from elementary to secondary school. This is the type of insight that can only be garnered from someone working in the field itself because the teacher knows what is being translated into practice and can identify the gaps based on those experiences.

I would say one of the biggest concerns that I have around the curriculum if there was one thing, is the gap between the Grade 8 and Grade 9 curriculum. You look at the difference between the Grade 8 and the Grade 9 curriculum and honestly if it didn't have 'Ontario' written on it, then you wouldn't guess that it was from the same jurisdiction. And so, then we wonder why kids sometimes struggle with that leap from the Grade 8 to Grade 9, when it's being done, and it's organized in a totally different way. (Douglas)

Shawn also addressed the perceived gap between elementary and secondary schools. He suggested that elementary schools should have specialist math teachers like secondary schools do, to keep a consistent quality of math teachers since not all teacher are confident in math. Again, these are insights that only teachers are able to share because they understand the realities on the ground and the needs of the classroom.

Yatze and Sidney commented on how the curriculum structure should be improved.

Like I said, I would love to see a math curriculum where it gives teachers the flexibility to really focus in on areas where they see student engagement, student need. (Yatze)

I sometimes feel that the way that the curriculum is presented is a little overcomplicated, so it could be presented in a simpler way, and then adding detail. Like right now, it is like the big ideas at the top, and then each strand is kind of itemized. Sometimes I feel that's like not that clear. It's kind of too much to go through, and it's harder for young teachers to read it. (Sidney)

Sarah suggested that curriculum and policy changes should reflect teacher input which implies that current change processes do not include teacher representation.

I think it would be definitely beneficial to teachers to have policy changes and curriculum changes based on what teachers are saying, like current teachers, what they think works. I think that would be most beneficial. (Sarah)

Relationship between teacher beliefs and acceptance of math policies

All the participants remarked on how PPM 160, the policy mandating 300 minutes of math instruction per week, did not interfere with their practice because they were all implementing 300 or more minutes of math instruction anyway. James further explained how following PPM160 did not impact him because of his prior practices.

Again, I've been using the same curriculum, and I always did over 300 minutes so that message didn't need to be passed on to me. I already do that stuff, and the curriculum hasn't changed. So, it has not impacted me. (James)

On the other hand, some teacher participants had differing opinions on inquiry-based math and traditional approaches also known as 'back-to-basics,' a moniker currently used by the Progressive Conservative government (Ontario Ministry of Education, 2018a). Kyle explained how inquiry-based approaches were disseminated through professional development at the board level, shortly after the revised math curriculum as released in 2005. He said that some teachers were not happy with the emphasis on inquiry-based approaches because they learned traditional

approaches when they were in school and were only confident enough to use those methods. Lily, on the other hand, explained how some teachers are not happy with the ‘back to basics’ traditional approach because inquiry-based is more appropriate for their students, and that there are consequences for mandating changes that go against prior beliefs.

So for example, the idea of having play-based, inquiry-based stuff. I’m a big proponent of that, but there are teachers who are not. So, the Kindergarten program, the math program, there are lots of sheets being done. But really, it should be play-based, it should be inquiry-based. And when teachers feel like they don’t have a voice, when they feel like something is foisted upon them, like a lot of Kindergarten teachers feel, they don’t deliver the program. So, if people don’t feel they have been represented in the curriculum then they’re not going to do it. (Lily)

Whether it is PPM160, inquiry-based learning versus ‘back-to-basics,’ or any other math policy, the participants indicate that teachers’ sentiments towards the policies is contingent on their prior and current beliefs and practices, and based on those sentiments, they choose to accept, resist, or reject policy changes.

5.2.5 Math reform process.

Disconnect in the reform process

During the interviews, math reform processes was defined as discussing, creating, and transmitting changes to the classroom. All eight participants reported they were never consulted or invited to actively participate in math reform processes, nor could they recall of any other teachers being involved in it.

Douglas and Yatze elaborated and explained how the lack of outreach is causing a ‘disconnect’ between what is being created and disseminated by the Ministry of Education, and how it plays out in the classroom itself. They believe the reason for this is because the people who create curriculum and policy do not understand or have experience in the classroom itself.

I think at times it could be a bit of a broken telephone situation, and sometimes I think decisions made at the Ministry level may not recognize or understand the realities on the ground. And it does have to filter through a lot of different stages, to go from the Ministry to the boards, from the boards to the superintendents, from superintendents to the principals, from the principals to the teachers, there are a lot of steps in there. I don't know, I find that by the time it gets to me, that practical level, we're suggested that something be done. Then we figure out how to make that work in a way that that makes sense for teaching our students and the learning environment in our classroom. (Douglas)

For me, it had to be someone who was connected to the classroom, to actual student practice. And someone like Kathy Kubota coming into the Ministry and saying, this is how you do bansho, this is what I saw in Japan, and this is what happens in my school. I felt like it had more credibility than the platitudes that do come out, where it's completely disconnected from what is actually happening in the classroom. So for me, I saw it in a pretty positive way. But now, I don't know, I am very cynical of when things come out because I think, how connected is that person to a classroom really. And how can they

tell us what to do in the classroom when they haven't been lived there. Or recently lived it. (Yatze)

Yatze touched upon resources again like Drake (2006) mentions in the literature. She wants credible resources, which she believe only comes from individuals with a teaching or education background.

Top-down approach with little to no active role in the math reform process

Shawn and Sarah believe the disconnect in policy implementation is due to a top-down process, where policies are created and transmitted from the Ministry to the classroom, and teachers have little to no contribution to this process.

I think it's just top-down, there's no input from the teachers. Sometimes I feel it's more reactive, so the scores are low, whoever's in the Ministry, what changes do we think we need to make. And then pass this to the principals and then to the teachers. I don't think the teachers have a say, and I don't think the Ministry understands exactly what is happening in the classroom. (Shawn)

I think it's a top-down approach for sure because it's like, "Okay so we didn't do well on the EQAO scores, so the board is going to provide you with these math coaches to help, to get math scores back up. And then once they are back up we are going to pull those math coaches. (Sarah)

These responses underscore the participants' perception of the lack of opportunities in being actively involved in creating mandated changes to math curriculum and policy. Douglas also expressed his concerns with the top-down approach.

I think sometimes when things are being created a few steps removed from the classroom, you lose some of that efficiency and effectiveness because they're trying to do so much. They're trying to say this massive thing, look at this amazing thing we've done, and then it doesn't translate into an easily applicable document, or initiative, or policy. (Douglas)

Douglas is concerned about the gap between policy and practice, and how policy transmission can get lost in translation by the time it reaches the classroom. This implies that teachers' underrepresentation in reform processes and its transmission is detrimental to the progress of reform implementation, because teachers are the ones who can identify and address those gaps, and without their input there is susceptibility for ineffective policies and curriculum content.

Significance of teachers at the frontier

Shawn, Sidney and James believe that teachers should be consulted on math education reform during the implementation process because of the valuable insights they gain from their role at the frontier.

I think so [teachers should be consulted]. Because, the teachers are the ones that see what's happening and they're the ones that know the children, and what the struggle is. So, I think they should have some kind of input, to any changes. It shouldn't just be,

“We’re making a change because of a score”. It should be, “Okay yeah the score is low, but what’s happening inside the classroom? Let’s hear what the teacher has to say, that could help us create something new.” So yeah, I think the teachers should have some kind of voice. (Shawn)

I think they should. I think that, because teachers are the ones on the ground teaching. And, I think they have a lot to offer. And ideas. So, I think they should definitely be consulted before, for sure after, to see the effect of those changes. (Sidney)

Yes, because they’re the ones working directly with the students. I know there was a lot of integration with special education and that was done without direct teacher consultations, so I think talking to people that are actually doing the teaching, that are day-to-day interacting with the students probably know better how they learn and would be the people to consult on this. (James)

These teacher participants believe their role as frontline workers is a strong reason to be given the opportunity to be actively involved in creating mandated changes to math curriculum and policy. This sentiment is echoed by the literature on treating teachers as change agents (Bailey, 2000; Charalambos et al., 2010; Clement, 2013; Lipsky, 1980).

Bidirectional impact between math reform and teachers

In addition to their perceived significance as teachers, all the participants believe that teachers impact math reform outcomes, as reforms will not be successful if teachers do not implement them. Lily, Douglas, and James further elaborated on that point. As quoted earlier

from Lily's interview, she explicitly stated what the consequences are if teachers' voices are not represented.

And when teachers feel like they don't have a voice, when they feel like something is foisted upon them, like a lot of Kindergarten teachers feel, they don't deliver the program. So, if people don't feel they have been represented in the curriculum then they're not going to do it. (Lily).

Douglas and James echoed this sentiment, emphasizing the lower likelihood of implementation.

I mean yeah, you have to have a certain level of buy-in and that's both in terms of, you have to have people buying in a philosophical sense but also in a practical sense. And when you drop things that are not carefully crafted, then, I mean for teachers, if something is going to be hard to implement in the classroom, then they could be a lot less likely to try to implement it. (Douglas)

If the teacher doesn't implement it, then it's not going to be a successful addition to the curriculum. So I kind of think of the sexual education curriculum change, and if teachers don't implement the change, then it's not going to be the way the government designs it to be. (James)

Even though these teachers have not been given the opportunities to participate in the math reform process, they believe they are still being active participants and impacting reform outcomes through their roles as frontline workers and implementing those changes in the classroom. This is one of the most powerful findings from this study – that participants believe there is a bidirectional impact between teachers and reform; not only does math reform impact their teaching experiences, but their roles as teachers impact math reform outcomes as well.

5.3 Thematic Findings from the Document Analysis

As recommended by Bowen (2009), while I was analyzing the documents, I considered the original purpose of each document and its target audience - all in relation to teachers as they are the focus of this study. News releases target the general public including parents, students, and teachers. News releases are fluid in the sense that sentiments and values change over time depending on political priorities and ideologies. Static documents on the other hand, including curricula, policy documents, and teacher guides remain in effect for longer periods of time and do not change with ideologies. The following themes emerged from the document analysis: decline in teacher involvement; rise of teacher deprofessionalization; top-down language with flexibility.

5.3.1 Decline in teacher involvement

When comparing between older and recent documents, it is apparent that teachers had a more active involvement in curriculum and policy development processes in the past. Over the years, there has been a decline in that involvement. In a 2014 presentation on the Ontario curriculum, which was held for Faculties of Education, Ministry of Education, and Subject-Division Associations, the curriculum revision process was described as a collaborative process with rich input from teachers.

As a part of the curriculum review process, the Ministry of Education brings together educators who have a broad range of experiences, perspectives and expertise connected to different ministry priorities to contribute to all phases of curriculum review. Training is provided to build a common understanding of ministry policies, strategies, initiatives and frameworks. (Ontario Ministry of Education, 2014).

The PowerPoint even includes direct quotes from teachers on curriculum revision processes from the past (Ontario Ministry of Education, 2014). On the other hand, the news releases and policy documents from 2016 through 2019 indicate a decline in teacher involvement in making changes to math curriculum and policy since 2014. For example, amid the policy and curriculum changes, neither PPM160 nor the FFM document (Ontario Ministry of Education, 2016a; Ontario Ministry of Education 2018a) explain whether teachers were involved in these changes and if they were consulted on their experiences after these changes. There is only one statement from the ORMS that mentions teachers' input: "Data from student, teacher and principal questionnaires, are a key source of information for how the strategy was developed and contributed to the funding model" (Ontario Ministry of Education, 2016b). However, this statement does not explain what the structure of the questionnaire was, how those questionnaires shaped the strategy, and whether the teachers had any other involvement.

For the 2019 math curriculum revision process, there is no evidence of teacher input. One of the news releases mentions that teachers will be consulted through province-wide consultations: "Although our government has already started to take the necessary steps to improve our children's understanding of fundamental math, we look forward to hearing from parents and educators this September as we engage in unprecedented provincewide public consultations (Ontario Ministry of Education, 2018d)."

However, this was mentioned after a news release from the week before that stated that the consultations were for parents only: “Today, Premier Doug Ford and Lisa Thompson, Minister of Education, announced the scope of an unprecedented parental consultation into Ontario’s curriculum (Ontario Ministry of Education, 2018b).” Based on the wording and ordering of the news releases, it seems teachers’ input was an afterthought.

Even the data from the consultations seem to indicate that teachers’ input was not initially factored in, nor was it prioritized. The consultation data is aggregated which means teachers were not given the opportunity to provide niche input (Ontario Ministry of Education, 2019c). In addition, the website address itself is,

‘<http://www.edu.gov.on.ca/eng/parents/consultations.html>’, which implies that the consultations were catered towards the parents, and again corroborates that teachers were an afterthought. The trajectory of narratives created from these news releases indicate that the importance of teachers’ involvement has declined even from as recently as five years ago.

5.3.2. Rise of teacher deprofessionalization

Teachers’ lack of input is a tacit form of deprofessionalization. However, the stark differences between news releases from two discrete time periods indicates how teachers are blatantly being deprofessionalized. For example, these are two excerpts from news releases from 2004 and 2006, when the Liberal Party held office.

Ontario's 193,000 teachers are professionals and we're treating them with the professional respect they deserve," said Kennedy after the Professional Learning Program Cancellation Act, 2004 was passed by the legislature earlier today (Ontario Ministry of Education, 2004).

This is a clear indication that our shared commitment with teachers, principals, parents and school boards to focus more on literacy and numeracy in the early years is making a real positive impact on students (Ontario Ministry of Education 2006).

From these statements, it is clear that teachers were revered and valued as professionals. In contrast, this excerpt from a 2018 news release from the Progressive Conservative Party, released after the first few months of their tenure, portrays teachers in a distrustful light.

For any parent who believes that their child's teacher is jeopardizing their child's education by deliberately ignoring Ontario's curriculum should call the Ontario College of Teachers' Investigations and Hearing's Department (Ontario Ministry of Education, 2018c).

The stark contrast between the statements from 2004 and 2006, and the one from 2018 implicates the shift in narrative from teachers as professionals, to the need for teachers to be held accountable through sanctioning. Again, the fluid nature of the news releases illuminate how shifting political ideologies can mold the portrayal and treatment of teachers.

5.3.3 Top-down language with flexibility

The curriculum, policy documents, and guides all cater towards teachers. All of these documents explain teacher practice and policy in a top-down manner. The most explicit top-down statement is from the 2014 presentation on curriculum, "The Ministry of Education is responsible for developing curriculum policy and implementation of policy is the responsibility of school boards (Ontario Ministry of Education, 2014)." This statement delineates clear boundaries between curriculum policy development and its implementation. The Ontario Math Curriculum (Ontario Ministry of Education, 2005) addresses teacher assessment and pedagogy in a prescriptive manner:

It is important for teachers to use a variety of instructional, assessment, and evaluation strategies, in order to provide numerous opportunities for students to develop their ability to solve problems, reason mathematically, and connect the mathematics they are learning to the real world around them (Ontario Ministry of Education, 2005).

Teachers will ensure that student work is assessed and/or evaluated in a balanced manner with respect to the four categories, and that achievement of particular expectations is considered within the appropriate categories (Ontario Ministry of Education, 2005).

However, even within the top-down language, these statements are broad enough to provide scope for flexibility in teacher practice. Teacher guides, such as *A Guide to Effective Mathematics: Grades 1 to 3 Number Sense and Numeration* (Ontario Ministry of Education, 2016e) contains language such as, ‘Teachers **are encouraged**’ or ‘Teachers **can** use these models’ which implies flexibility rather than regimentation. Documents from both the Ministry and TDSB indicate that these organizations are intending to support teachers in a top-down manner, in that the Ministry and TDSB are providing unilateral assistance to teachers (Ontario Ministry of Education, 2018a; Ontario Ministry of Education, 2018d). Within this approach, the TDSB encourages collaboration among math coaches and teachers:

In order to provide on-going, classroom-based support, 10 numeracy coaches who have a specialized focus on teaching math will work directly with teachers. They will co-teach with staff to incorporate effective math teaching practices and develop strategies to support all students (Toronto District School Board, 2014).

In summary, news releases are transient in their portrayal of teachers, while curricula, policy documents, and guides are nuanced in their top-down language while simultaneously encouraging support and collaboration with teachers. The common thread between these

documents and concomitant themes is the stark underrepresentation of teachers at the curriculum and policy development level in Ontario's education system.

5.4 Analysis Through the Lens of the Conceptual Framework

To triangulate the findings from the interviews and document analysis, I created a table which aligned key concepts and analytical points from the conceptual framework, literature review, interview findings, and document analysis findings. As I mentioned before, I analyzed the data through three key components of the conceptual framework: teachers' sensemaking process; teachers' role and participation; and system organization. It is important to note that these components are not discrete but are interrelated, hence there are recurring ideas in each proceeding sub-section.

5.4.1 Teachers' sensemaking process. The interview data clearly indicates that teachers are constantly participating in sensemaking processes, whether it is during classroom teaching or when they are encountering changes. The findings illuminate the diverse range of factors behind math confidence including innate propensity, teaching experience, and student feedback. Regardless of where math confidence stems from, it plays a significant role in sensemaking when one is processing curriculum or policy change. Individuals such as James, Kyle, and Shawn said they will reject changes if they feel the changes are dissonant with their prior experiences and knowledge on effective teaching. Their math confidence is a significant influence behind those decisions because their confidence helps them believe they are making sound judgements on whether to accept, resist, or reject changes. On the flip side of the coin, teachers who experience uncertainty and math anxiety are still participating in sensemaking like those who have more confidence, except they find it more challenging to deal with the differentiation between their prior beliefs and current changes.

While the literature emphasizes how teacher characteristics, including self-efficacy, career stage, and teacher beliefs are significant influencers for how teachers respond to change (Charalambos et al., 2010; Drake, 2002; Manouchehri and Goodman, 2010; Remillard & Bryans, 2004), findings from the interviews indicate that these characteristics are interrelated. Sarah, Sidney, and Yatze pointed out how confidence can grow with experience, as one takes the time to experience and learn, and in effect are more likely to use their own judgement to decide on whether to accept, resist, or reject changes.

It is important to note that the interviews were conducted before the public announcement was made on the math curriculum revision. However, a few participants predicted that there would be a math curriculum revision soon. Douglas explained how he would respond to a potential curriculum revision, again drawing upon his math confidence and applying it to prospective sensemaking.

I know there are ongoing rumours that there will be an update to the curriculum at some point soon. And certainly with the new government's approach, I imagine that might well happen. I'm interested in seeing what that will be like, cause again, when the last update happened I was only a few years in, I was still getting my head around things. Now, for having it for as long as I had, I might have it as a bigger shock to my system, if there's major changes. At the same time, I'm not worried about that either, I think I'll be able to adapt my practice to whatever the curriculum is asking for relatively easily. (Douglas)

Sensemaking is useful in understanding how teachers process and respond to changes in teacher portrayal, such as the rise of deprofessionalization. Yatze commented on how the current

premier of Ontario will “drive some people” out of the teaching profession because of regimentation and constraint. According to the facets of sensemaking, this would happen because deprofessionalization clashes with teachers’ beliefs of themselves and the value they place in their profession. In summary, teachers’ sensemaking processes should be explored and considered in the education system especially when curriculum and policy changes are made, because it provides insight on how teachers might respond to change and how teacher characteristics influence those responses and decisions.

5.4.2 Teachers’ role and participation. All the participants from the interviews reported that they were never consulted on changes to math curriculum and policy nor did they know anyone who was consulted. This reflects most of the research on teachers’ role in curriculum development and implementation where it was found that teachers were passive implementers rather than active developers (Bailey, 2000; Cohen and Mehta, 2017; Oloruntegbe, 2011; Priestley et al., 2012; Wiles and Bondi, 2007). While there is evidence that teachers were consulted on the 2005 math curriculum revision (Ontario Ministry of Education, 2014), it is possible that none of the interview participants were consulted because the most experienced teachers among the participants were one or two years into their career in 2004. In recent times, there is no indication of teacher involvement in math policy changes including PPM160 and FFM nor any involvement to the 2019 revision of the math curriculum. Even though teachers were consulted before, it is a different situation in the current environment, where teachers are underrepresented in math curriculum and policy development, even though they can contribute an invaluable amount of insight.

There are a number of possible reasons why teachers are underrepresented in such processes. The development of curriculum and policy is the responsibility of the Ministry of

Education (Office of the Provincial Auditor of Ontario, 2003) and perhaps politicians and policy actors are sustaining the status quo to fulfill their political agendas. Or, in the process of pushing agendas and priorities forward within time constraints, curriculum and policy developers do not have the time, budget, and/or scope to seek out teacher input. Regardless of the reasons, it is imperative to treat teachers as change agents and include them in the process of curriculum and policy development, because as the interview participants point out, teachers are the ones who choose whether to implement mandated changes and their decisions inform the outcomes of those changes. If teachers continue to be deprofessionalized and they do not agree with math changes, then reform efforts will fail.

5.4.3 System organization. Figure 3 presents a visual summary of how the Ontario education system should be structured, based on the contingents and needs of those who are part of the organization. Currently, it is a top-down structure where the Ministry disseminates changes to the boards, then it trickles down to the schools, and then to the teachers in the classrooms. The interview participants acknowledged that the system is currently organized in a top-down manner, which is corroborated by the document analysis as well.

Based on the interview and document analysis of the contingencies of curriculum and policy change, it would be most effective for the Ontario education system to change its curriculum and policy development structure. The education system is organic, with complex and fluctuating conditions, so it is imperative to assign responsibilities based on expertise. As teachers have direct experience in the classroom, their knowledge and insights are invaluable to curriculum and policy reform. There should be an integration of values and priorities between the Ministry, people within the school board, and people within school boards including teachers, regardless of time constraints or political agendas. Even though roles and responsibilities are

segmented, these education actors should be revered equally for their work and provided with equal opportunity to contribute to the curriculum development process. To build a deference narrative, teachers' input should be transparent in public-facing documents, such as news releases and PPMs. In addition, teachers should be encouraged to develop curriculum and policies at the local level, as teachers in Ontario have created education programs and courses that were adopted at the provincial level in the past (Bascia et al., 2014), which indicates their capability for innovations.

An example of an innovation that was described in the interviews is the guided math program, which was conceptualized by the teachers at Tulip Street Junior Public School. This program was created in response to the FFM strategy. During guided math, students are divided into groups and assigned to different stations to complete a specific activity. The classroom teacher will lead one of those stations. Groups rotate everyday so that the teacher have a chance to lead small group-instruction with each group. Teacher colleagues touch base with each other during grade-level meetings to discuss what is working and how to improve the program. These kinds of initiatives and spaces to innovate provide teachers with the autonomy to respond to mandated changes using their own ideas and judgement.

There are a few components of the current education system that work effectively. For example, most of the interview participants are satisfied with the structure of the curriculum. This might be because of its language, such as 'use a variety of strategies', or 'use judgement to assess in accordance to categories', where there is the use of broad descriptors which provides flexibility. In addition, the TDSB encourages collaboration between board representatives and teachers (Toronto District School Board, 2014) which is key to creating an efficient education system.

Most importantly, it is crucial in the education system to consider teachers' sensemaking and how they will enact, respond, and work with changes. It is essential to build an effective environment where teachers feel valued enough to use their judgement and be willing to accept certain approaches, pedagogies, and changes because they trust the system as well. It has to be a bidirectional relationship of reverence.

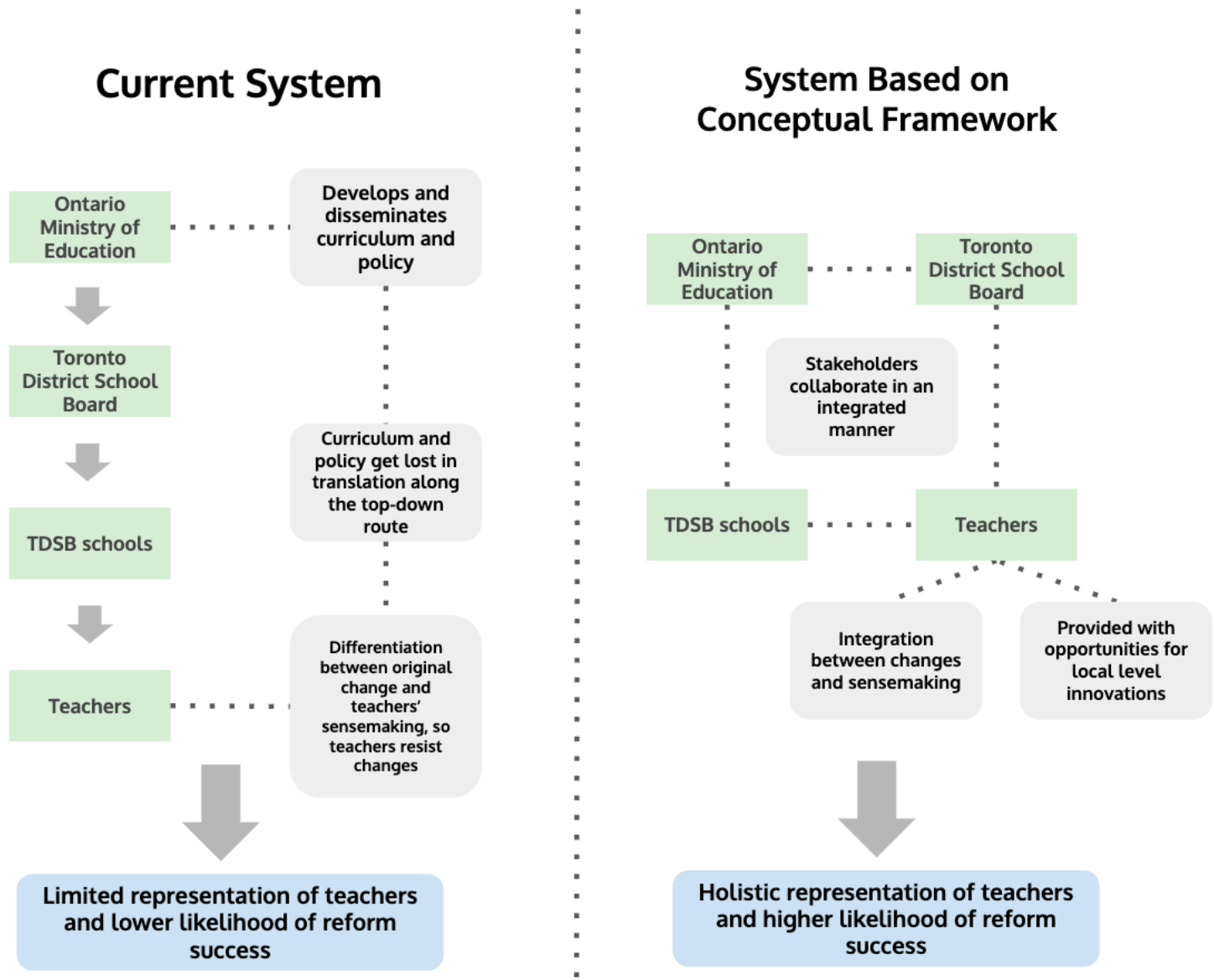


Figure 3: Comparison of Current and Potential Systems

Chapter 6: Conclusion

6.1 Contributions

In this section I delineate the theoretical, empirical, and practical contributions this study makes to the education policy field.

6.1.1 Theoretical contributions. The conceptual framework of this study integrates two theories to explore the bidirectional relationship between micro-level sensemaking and macro-level processes of an organization. Both systems are complex and intricate in nature. As exemplified by this study, it is important to consider the interaction between the two; studying either phenomena in isolation will not provide a holistic picture. In this particular context, reform processes cannot be understood without exploring teachers' sensemaking and vice-versa. This type of exploration carries significant implications for how responsibilities should be distributed, how stakeholders should be treated and portrayed, and whether there is the need to rework organizational structures.

6.1.2 Empirical contributions. This study extends the line of research on education reform, math reform, and teachers' experiences. It is an original contribution as it is the first study that explores the nexus between these dimensions within the context of Ontario. This study furthers the discourse on including teachers in reform processes and finding ways of doing so. The results from this study also carry significant implications on the discourse of how education systems should be organized: based on the findings, the organization of the education system is contingent on the congruent alignment between curriculum and policy development processes, and teachers' input and representation.

6.1.3 Practical contributions. Given the topical context of math curriculum and policy changes in Ontario, the results from this paper calls for scholars and education stakeholders,

including the Ministry of Education, school boards and school administrations, to collaborate and discuss the issue of teacher underrepresentation. This is imperative because outcomes of the implementation of the newly revised version of the Ontario math curriculum is dependent on teachers' attitudes and responses to it. Most importantly, the decline in teacher input and rising deprofessionalization can lead to adverse consequences for teacher wellbeing as well as strain the relationship between teachers and policymakers. A key contingent is mutual respect of all professions within the education system.

6.2 Limitation

An apparent limitation of this study is the small sample size. I limited my sample size to eight participants because of time constraints and to increase the likelihood of getting my proposal approved by the multi-jurisdictional ethics process. However, a small sample size does not equate to a reduced quality of data; the robustness of a study depends on the types of questions being asked, the approach to analysis, and the resources to support the study (Merriam, 1998). My study had an interview protocol which was approved by my thesis supervisor, the University of Toronto Research Ethics Board and the Toronto District School Board External Research Review board. In addition, I conducted a thorough analysis of the interview data and used document analysis to corroborate the interview data.

6.3 Future Research

Future studies should increase the scope of participants to include teachers who have been in the profession for a longer period of time. Perhaps through this approach one will find participants who were consulted to some capacity during previous curriculum and policy development and revision processes. This would provide an opportunity for comparison between previous and current development practices. A larger sample can be drawn through a different

research design from this study, including the use of a mixed-methods approach such as triangulation through qualitative interviews and surveys.

Future studies should also explore the voices of other stakeholders in education as well, such as politicians and public servants. It would be valuable to gain insight on how individuals in government perceive curriculum and policy changes and how those perceptions intersect with educational and political priorities. Most importantly, students' voices should be considered in this field of research. Students are the direct recipients of curriculum and policy; their voices are imperative in understanding how they perceive their experiences and the education changes being made, which can help inform future changes.

An intriguing area for further exploration is the problematization of math education. The ORMS, FFM, and 2019 math curriculum revision were undertaken to solve the issue of declining EQAO math scores. EQAO tests, like other standardized tests, are not flexible nor are they accommodating in nature. This calls into questions whether the test itself is flawed. Future studies should investigate whether EQAO tests and other forms of standardized testing are reliable metrics for problematization. Moreover, this line of inquiry can shed light on the purposes of problematization, including whether it is in good faith for the betterment of education, to fulfill political agendas, or other purposes.

Lastly, this study provides in-depth insight on how teachers' math confidence impacts choices and practice. Future research should further explore other dimensions of teacher confidence including the relationship between teacher confidence and effectiveness of decision-making, as mentioned in Chapter 5.2.3.

6.4 Concluding Remarks

It has truly been a privilege to explore teachers' voice through firsthand accounts. I am including an excerpt from Kyle's interview which made me believe that my study was impactful.

I would say yes they [teachers] should be consulted. The format of how the consultation happens should be up for debate. I don't know if I need to be called into a town hall to offer my thinking on things. People should be doing research projects, like yourself, getting feedback from teachers that way. (Kyle)

As the education system and political priorities continue to evolve, it is essential that we continue to revere the voices of teachers whether it's through research, policymaking, or direct communication. Regardless of differentiated priorities, we cannot let teachers' voices get lost in the process of education change.

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Appendices

APPENDIX A: LETTER OF INTRODUCTION AND INTENT FOR SCHOOL PRINCIPAL

[printed on OISE letterhead]

[date]

[Name of principal]

and address]

Dear [name of principal],

I am a Master of Education student at the Ontario Institute for Studies in Education - University of Toronto. I am writing to seek your permission to conduct research at [name of school]. My research interest is regarding teachers' experiences with changes to math curriculum and policy. Specifically, I am exploring how teachers perceive these changes and the roles they believe to have to both create and implement these changes in their teaching practice.

If you agree to allow the study to move forward in your school, I will set up a meeting with you to discuss the details of this study and address any questions you may have. I plan to interview between three to five teachers at your school between mid-October to the end of November 2018.

All interviews would require the teacher to sign an informed consent form indicating that they understand that their participation is voluntary in the interview, and that they can withdraw at any time from the study without any consequences. Participants will not be compensated, and this is explicitly indicated on the letter of informed consent for teachers. The study involves the use of an interview protocol in which participants will be asked about their opinions and perceptions on teaching math, and their experiences with curriculum and policy changes related to math. The interviews will last no more than 45 to 60 minutes and take place in a setting identified by the teacher. I hope to have the interview digitally recorded, but the teacher may decline, in which case written notes will be taken. They will have the right to refuse to answer any questions and to withdraw from the study at any time, including after four weeks from the interview. The participants will not be judged or evaluated and at no time will be at risk of harm.

The participants will be provided with a copy of their transcriptions within two weeks after their interview, and they will be able to add any further information or correct any misinterpretations. The information gathered from the interviews will be kept in strict confidence and stored at a secure location. All information will be reported in a way that individual persons, schools, and communities cannot be identified. Pseudonyms will be used in place of the participants' and schools' names. All data collected will be used for the purposes of a Master's thesis and perhaps for subsequent research articles and public presentations. Once my thesis is completed, I will contact you and all the participants with information on how to access the thesis paper. You are free to provide me with any feedback on my thesis. All raw data (i.e. transcripts, field notes) will be destroyed five years after the completion of the study. The Research Ethics Board of the University of Toronto may have confidential access to data to help ensure participant protection procedures are followed. If you wish, you can contact the Research Ethics Board if you have any

concerns about how the research is being conducted.

If you agree, please sign this letter below and return it in the envelope provided. If you have any questions, feel free to contact me at (647) 571 5089 or at tanjin.ashraf@mail.utoronto.ca. You may also contact my supervisor, Dr. Nina Bascia at nina.bascia@utoronto.ca. Finally, you may contact the U of T Office of Research Ethics for questions about your rights at ethics.review@utoronto.ca or (416) 946 3273.

Please let me know if I can answer any questions.

Sincerely,

Tanjin Ashraf

Master's Candidate, Leadership, Higher and Adult Education

OISE/University of Toronto

I give my permission that the study of teachers' experiences with changes in math take place at this school.

Signed: _____ Date: _____

Please keep a copy of this form for your own records.

APPENDIX B: LETTER OF INFORMED CONSENT FOR TEACHERS

[printed on OISE letterhead]

[date]

Dear teacher,

I am a Master of Education student at the Ontario Institute for Studies in Education (University of Toronto). I am conducting a study on how changes in the math curriculum and policies impact and shape teachers' experiences. The purpose of this study is to provide teachers with an opportunity to share their perspectives on how these changes affect them, what their role is in these changes, and any changes they would wish to see in the future.

I would like to interview you about your experiences teaching math and your perspective on the changes that are made to math curriculum and policy in Ontario. There are no known risks to participating in this research. Your participation in this study is voluntary and you will not be compensated. Your participation in this study will contribute to the work on the voices of teachers in the education system. The study involves the use of an interview protocol in which you will be asked about your opinions and perceptions on teaching math and the curriculum and policy changes related to math. To offer you a clear understanding of the interview structure and the study itself, I will provide you with the interview protocol and an additional document with background information before the interview.

The interviews will last no more than 45 to 60 minutes and take place in a setting identified by you. You may at any time refuse to answer a question or withdraw from the interview process. I hope to have the interview digitally recorded, but you have the right to decline, in which case written notes will be taken. I ensure that your participation in the study will be kept confidential, and at no time will value judgments be placed on your responses nor will an evaluation be made of your effectiveness as a teacher.

The interview would require you to sign this informed consent form indicating that you understand that your participation in the interview is voluntary, and that you can withdraw at any time from the study without any consequences. The information gathered from the interviews will be kept in strict confidence and stored at a secure location. All information will be reported in a way that individual schools and persons cannot be identified. A pseudonym will be used in place of your name. All data collected will be used for the purposes of a Master's thesis and perhaps for subsequent research articles and public presentations. All raw data (i.e. transcripts, field notes) will be destroyed five years after the completion of the study.

You will be provided with a copy of your transcription within two weeks after the interview, and you will be able to add any further information or correct any misinterpretations. Within two weeks of receiving your transcription, you may request that any information whether in written form or audiotape, be amended or eliminated from the study. Finally, you are free to ask any questions about the research and your involvement with it and may request a summary of findings of the study. I will contact you to let you know when the thesis paper will be available to read, and feel free to provide me with any feedback. The Research Ethics Board of the

University of Toronto may have confidential access to data to help ensure participant protection procedures are followed. If you wish, you can contact the Research Ethics Board of the University of Toronto if you have any concerns about how the research is being conducted.

If you agree, please sign this letter below and return it in the envelope provided. If you have any questions, feel free to contact me at (647) 571 5089 or at tanjin.ashraf@mail.utoronto.ca. You may also contact my supervisor, Dr. Nina Bascia at nina.bascia@utoronto.ca.

Finally, if you have concerns, you could contact the Office of Research Ethics at the University of Toronto, at

Office of Research Ethics
(416) 946 3273
email: ethics.review@utoronto.ca

Thank you in advance for your participation.

Sincerely,
Tanjin Ashraf
Master's Candidate, Leadership, Higher and Adult Education
OISE/University of Toronto

By signing below, you indicate your willingness to participate in the study, that you have received a signed copy of this letter for your records, and that you are fully aware of the conditions above.

Printed name: _____ Date: _____

Signature: _____ School: _____

Please initial if you agree to have your interview recorded _____

Please initial if you agree with have your interview audiotaped: _____

Please keep a copy of this form for your own records.

APPENDIX C: TEACHER INTERVIEW PROTOCOL

Tell me about your teaching experiences

- How many years have you been teaching?
- What subjects have you taught in the past?

Tell me about your experience teaching math

- How long have you been teaching math?
 - Which other schools or places have you taught math?
- How do you create math units and lessons?
 - What approaches do you use to teach math (e.g., inquiry-based learning)?
- Describe your experiences teaching math in relation to the Ministry and the board.
- Describe your experiences teaching math in relation to your co-workers and as an individual.
- Do you believe following the math curriculum and policies is mandatory? Why or why not?

Tell me about your experiences with mandated changes in math curriculum and policy

- What changes in math curriculum and policy have you experienced in the past 20 years?
 - How have those changes impacted you (e.g. pedagogy, philosophy of teaching, etc.)?
- How do you think math curriculum and policy changes are transmitted from the Ministry of Education to the classroom? Or from the board level as well?
- Are there any school guidelines for implementing changes in math curriculum and policies?
 - Were there any guidelines at your previous schools?

Regarding teacher representation when mandated changes are made

- Are you aware of any changes currently being discussed or being implemented?
- How do you think you would feel if future changes are made, and how would that affect your current teaching practices?
- Have you ever been consulted on curriculum or policy changes?
- How often do you think teachers are consulted before, during, or after changes are made to math curriculum and policy?
- Do you believe teachers should be consulted on education changes? Why or why not?
- Do you think teachers have a significant role in making education changes, or should have a significant role in making changes? Why or why not.
- When/if math changes are made, do you think teachers' responses have a role in its outcome (e.g., success or failure). Why or why not.
- Are there any changes you wish to see in math curriculum or policies?
 - If so, what are they and why?

Is there anything else you would like to add?

APPENDIX D: BACKGROUND INFORMATION FOR TEACHERS

Mandated changes: Also known as external approach or top-down change, mandated changes are defined as changes initiated by the state, that are transmitted by the government or school-district to schools, with the expectation that teachers will implement them (Clement, 2013). Within the context of Ontario and this study, mandated changes refer to any changes to **curriculum, curriculum policies, and other polices related to math.**

An example of a change in curriculum: The revised edition of the Ontario Curriculum Grades 1-8: Mathematics, which was introduced in 2005 (Ontario Ministry of Education, 2005).

An example of a change in curriculum policy: In September 1997, The Ontario Ministry of Education introduced a mandated math curriculum for Grades 1-8 (Ministry of Education and Training, 1997). To the present day, the Ministry of Education expects teachers in public schools to follow these mandated guidelines (Kajander and Holm, 2013).

An example of a policy related to math: In 2016, The Ministry of Education implemented a policy through Policy/Program Memorandum 160, where school boards across the province are required to provide three hundred minutes of math instruction per week (Ontario Ministry of Education, 2016).

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