An Inquiry into Student Math Self-Efficacy,
As Told from the Perspective of Ontario Secondary Teachers

By

Chi Zhang

A research paper submitted in conformity with the requirements
For the degree of Master of Teaching
Department of Curriculum, Teaching and Learning
Ontario Institute for Studies in Education of the University of Toronto

Copyright by Chi Zhang, April 2017
Abstract

While the Growing Success document released by the Ontario Ministry of Education in 2010 demonstrates Ontario’s commitment to enhancing student learning through assessment, there has been little investigation into how it is being received among secondary math teachers, and what effect it has on students’ math self-efficacy. As an exploratory study, this study sought to better understand how Ontario secondary math school teachers are working to foster self-efficacy among their students through assessment methods. Through semi-structured interviews, teachers were found to understand student math self-efficacy to be intimately tied to student learning skills. With regards to assessment, formative feedback was identified by teachers as a means through which self-efficacy and learning skills could be fostered. Teachers also noted the importance of building positive student perceptions of assessment, and of teaching students to perceive failure in a productive light. These findings imply that teachers are moving away from the traditional use of assessment of learning, to include that of as and for learning. Furthermore, secondary teachers’ concerns about students’ abilities to self-assess and self-regulate their learning suggest that students are not being sufficiently equipped with these skills in their earlier years. In light of these findings, Ontario schools can work to improve student math self-efficacy by making greater efforts to foster learning skills among their students.

Key Words: secondary math teacher, assessment strategies, student self-efficacy, Growing Success, math self-efficacy
**Acknowledgements**

I wish to thank my Heavenly Father for always being good to me, my parents for their unconditional love and support, my friends for their sincere encouragement, my Cohort 263 peers who walked with me through this process, and my instructor Lee Airton for guiding me through this step by step.
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>ii</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>iii</td>
</tr>
<tr>
<td>Chapter 1: Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.0 Research Context</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Research Problem</td>
<td>3</td>
</tr>
<tr>
<td>1.2 Purpose of the Study</td>
<td>3</td>
</tr>
<tr>
<td>1.3 Research Questions</td>
<td>4</td>
</tr>
<tr>
<td>1.4 Background of the Researcher</td>
<td>4</td>
</tr>
<tr>
<td>1.5 Preview of the MTRP</td>
<td>6</td>
</tr>
<tr>
<td>Chapter 2: Literature Review</td>
<td>8</td>
</tr>
<tr>
<td>2.0 Introduction</td>
<td>8</td>
</tr>
<tr>
<td>2.1 Understanding Math Self-Efficacy</td>
<td>8</td>
</tr>
<tr>
<td>2.1.1 Role of personal experiences in the formation of math self-efficacy</td>
<td>8</td>
</tr>
<tr>
<td>2.1.2 Role of social experiences in the formation of math self-efficacy</td>
<td>10</td>
</tr>
<tr>
<td>2.1.3 Factors affecting formation of self-efficacy</td>
<td>11</td>
</tr>
<tr>
<td>2.2 Effects of Math Self-Efficacy</td>
<td>12</td>
</tr>
<tr>
<td>2.2.1 Math engagement</td>
<td>13</td>
</tr>
<tr>
<td>2.2.2 Math performance</td>
<td>13</td>
</tr>
</tbody>
</table>
### Chapter 4: Teacher Perceptions of Math Self-Efficacy

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0 Introduction</td>
<td>30</td>
</tr>
<tr>
<td>4.1 “He Just Doesn’t Understand Why”: Teacher Perceptions of Math Self-Efficacy</td>
<td>30</td>
</tr>
<tr>
<td>4.2 Assessment as Means of Improving Learner Self-Efficacy</td>
<td>33</td>
</tr>
<tr>
<td>4.2.1 “It’s like watching kids play video games”: Assessment that is accessible to all</td>
<td>34</td>
</tr>
<tr>
<td>4.2.2 “We talk about it”: Formative feedback as means of improving self-efficacy</td>
<td>36</td>
</tr>
<tr>
<td>4.2.3 “Give control back to your students”: Fostering student ownership</td>
<td>38</td>
</tr>
<tr>
<td>4.3 Shaping Student Perceptions of Assessment</td>
<td>40</td>
</tr>
<tr>
<td>4.3.1 Failure as productive of learning</td>
<td>41</td>
</tr>
<tr>
<td>4.3.2 Assessment as part of the learning process</td>
<td>42</td>
</tr>
<tr>
<td>4.4 Conclusion</td>
<td>44</td>
</tr>
</tbody>
</table>

### Chapter 5: Implications

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 Introduction</td>
<td>46</td>
</tr>
<tr>
<td>5.1 Overview of Key Findings</td>
<td>46</td>
</tr>
<tr>
<td>5.2 Implications</td>
<td>47</td>
</tr>
<tr>
<td>5.2.1 Broad: The educational community</td>
<td>48</td>
</tr>
<tr>
<td>5.2.2 Narrow: My professional identity and practice</td>
<td>49</td>
</tr>
<tr>
<td>5.3 Recommendations</td>
<td>50</td>
</tr>
<tr>
<td>5.4 Areas for Further research</td>
<td>51</td>
</tr>
<tr>
<td>5.5 Concluding Comments</td>
<td>52</td>
</tr>
</tbody>
</table>
Chapter 1: Introduction

1.0 Research Context

Being mathematically competent is an important skill in many real-life situations. It is needed in daily matters such as calculating time, and plays a central role in a math-centered careers such as engineering. To adequately prepare students “for their future roles in society... [and to] equip them with essential mathematical knowledge and skills” (Ontario Ministry of Education, 2005, p. 3), the Ontario curriculum requires students to complete three math credits in order to obtain their high school diploma (Ontario Ministry of Education, 2016). To further enhance students’ learning experiences, the Ontario education system has been undergoing an assessment reform, moving beyond assessment of learning to encompass an assessment ideology that is of, for, and as learning (Ontario Ministry of Education, 2010). The province’s commitment to enhancing student learning through assessment is commendable as it is consistent with research (e.g., Ramdass & Zimmerman, 2008), and supported by theory (e.g., Bandura, 1995).

In his self-efficacy theory, Bandura (1995) posits self-efficacy as “beliefs in one’s capabilities to organize and execute the courses of action required to manage prospective situations... [which in turn] ...influence how people think, feel, motivate themselves, and act” (p. 2). Math self-efficacy, for the purpose of this study, refers to one’s beliefs in their capability to apply mathematical thinking and skills. A person with poor math self-efficacy does not believe that they are mathematically competent, while a person with high math self-efficacy believes themselves to be very capable of attaining success in mathematics. These beliefs have been found to be significant predictors of math performance (Ashcraft, 2002; Parker, Marsh,
In Ontario, the annual EQAO math assessment is one way in which the Ministry of Education collects data on the math skills of students in grades 3, 6, and 9 (Klinger et al., 2008). Questionnaires are administered upon completion of the test, which includes questions on students’ attitudes towards math. The results of the 2012 assessment (Hinton, 2014) show that 64% of the students who met the provincial standards in the grade 9 academic stream identified themselves as being good at math, compared to 12% of the students that did not meet the standards. The gap was smaller in the grade 9 applied stream, where the numbers were 55% and 18% respectively. According to this data, it appears that a significant portion of grade 9 students in Ontario lack confidence in their mathematical ability.

Furthermore, despite Ontario’s commitment to enhance student learning through assessment, it has not been reflected in student math performances. An analysis of the results of the 2012 Programme for International Assessment (PISA) administration—an international initiative by the Organization for Economic Cooperation and Development (OECD) to assess the achievement of 15 year-olds in the areas of math, science, and reading—show that while Ontario teens performed above the OECD average, math performance has been on a decline since 2003 (Brochu, Deussing, Houme, & Chuy, 2013). The downward trend has also been observed among grade 8’s in the math component of the Trends in International Mathematics and Science Study (EQAO, 2012). From a theoretical perspective, in light of the Ministry of Education’s commitment to student-centered assessment, math students should be experiencing an increase in their self-efficacy and in turn, math performance. However, students do not appear to be feeling particularly confident in their mathematical abilities and Ontario math scores are experiencing a
decline.

1.1 Research Problem

Since 2010, as detailed in the *Growing Success* policy (Ontario Ministry of Education, 2010), the Ontario education system has committed to assessment practices that further student learning. In particular, assessment is to be “ongoing, varied in nature, and administered over a period of time to provide multiple opportunities for students to demonstrate the full range of their learning” (p. 6). Research on assessment has shown a strong connection between teachers’ assessment practices and student self-efficacy (van Dinther et al 2014; Liang 2010; Harlen & Crick 2003). However, there is a lack of research on this subject in the Ontario context. While *Growing Success* demonstrates Ontario’s commitment to enhancing student learning through assessment, there is a little investigation into how it is being received among math teachers, and to what effect it has had in the math classroom.

In light of the downwards trend in math performance at the intermediate and senior levels, despite the changes in policy with respect to assessment, a qualitative study may shed light on whether, and how, the *Growing Success* policy is being implemented in the Ontario secondary school math classroom, and to what effects on students’ math self-efficacy.

1.2 Purpose of the Study

The purpose of this study is to explore how Ontario secondary school math educators are working to foster self-efficacy among their students through their assessment practices. This study seeks to add to the literature concerning math self-efficacy and assessment by providing a qualitative perspective through in-depth interviews. To do so, I interviewed a sample of these
teachers about: their understanding of math self-efficacy and its significance; their strategies of fostering self-efficacy in students, with a specific interest in assessment methods, and the perceived outcomes of these strategies; and, finally, teachers’ perceptions of *Growing Success* (Ontario Ministry of Education, 2010) and its effects. Lastly, this study hopes to identify effective and ineffective strategies for fostering self-efficacy in students, and to provide practical steps for teachers to consider in their own practice.

1.3 Research Questions

The main question sought to be answered in this study is: How are Ontario secondary mathematics teachers working to foster self-efficacy in students through their assessment practices? In order to deepen the study’s engagement with this question, the following sub-questions also guided the study:

1. How do these teachers understand and perceive math self-efficacy?
2. What assessment strategies are they reportedly using to foster student self-efficacy, and to what perceived outcomes?

1.4 Background of the Researcher

It is necessary to begin my background with a brief description of my family and social upbringing, as they play a key role in how I perceive myself and the decisions that I make. When I was young, my family immigrated to Canada. This move signified a clean slate, as my parents had to rebuild a life from scratch. This included re-entering college, changing careers, and
building a new support group. For me, this meant growing up with occupied parents who had little time to oversee my academics. However, this did not lead to an oversight of academics on my part. On the contrary, so to not add to my parents’ burdens, I was motivated to work harder to achieve academic excellence in all subjects. I knew that they wanted me to do well, and so I took it onto myself to not let them down. For the most part I was successful, at least in terms of academic achievement.

Even though I was a well-rounded student, as I advanced in my academic career and was given the option of choosing my own courses, I found myself drifting to math. I opted to take additional math courses in high school after the compulsory three were fulfilled, and continued to pursue a minor in math as a part of my undergraduate degree. I attribute these decisions in part to my grandfather, who did math problems with me for fun and planted in me the seeds of a love for math. However, I believe that my attitude towards mathematics was also shaped by the perceptions of others. Being Chinese, I was subject to the stereotype that I was naturally good at math. Not only did my peers expect me to do well, my parents also reinforced the idea that I had to excel because of my ethnicity. I still remember a conversation I had with my father regarding my math marks, which had been too low because “being Chinese I should be getting above 90%”. As such, I internalized these beliefs and grew up expecting high mathematic achievements.

Indeed, I generally excelled in the subject and enjoyed it. However, I found that when math was brought into my conversations with peers, it was nearly always followed by groans and complaints. There appeared to be numerous negative associations that came with the subject. Though I cannot fully relate to these sentiments, I recognize that my attitude towards math and decisions relating to it were shaped by my perceptions of my mathematic ability. As I took more math classes in my academic career, my perceptions of math and my mathematical ability began
to waver. I no longer enjoyed all of my math classes. In particular, I dreaded learning statistics as I repeatedly scored much lower than was my norm for a math course. After those experiences, I did not take any more courses in statistics as I did not want to “fail” again—of which I was certain, should I give it another try. As such, I understand how perceptions of mathematical ability may shape how one approaches the class. As a math teacher, I want to change the perceptions of math as an impenetrable subject and help my students to see the applicability and meaning of math.

My experiences as a math student have shown me the power of past experiences in shaping attitudes and future decisions, and has also enhanced, as a researcher, my understanding of the process of self-efficacy. However, my career as a math student has been primarily characterized by high math self-efficacy, which may hinder me from fully understanding the realities of students with low math self-efficacy, and in turn how teachers recognize and respond to it. At the same time, my inexperience with low math self-efficacy may also be beneficial to my study, as my awareness will allow to approach this subject with more humility and care. Rather than making assumptions of what math self-efficacy looks like and how it is formed, I will be relying on literature and the participants of this study as sources of knowledge and understanding.

1.5 Preview of the MTRP

To respond to the research questions, I conducted a qualitative research study, using purposeful sampling, where I interviewed three teachers about their assessment strategies for fostering self-efficacy among math students. In Chapter 2, I review the literature in the areas of math self-efficacy and assessment, and discuss the gaps in the literature. Next, in Chapter 3, I elaborate on the research design that was used in this study. In Chapter 4, I report my research
findings and discuss their significance in light of the existing research literature, and in Chapter 5, I identify the implications of the research findings for my own teacher identity and practice, and for the educational research community more broadly. I also articulate a series of questions raised by the research findings, and point to areas for future research.
Chapter 2: Literature Review

2.0 Introduction

In this chapter I review the literature in the areas of math self-efficacy and assessment. I start by outlining the theoretical framework on self-efficacy and its position in the context of math education. Next, I review research on the effects of math self-efficacy. From there, I examine literature on the role of assessment and its relationship to self-efficacy. Finally, I point out the gaps in the literature.

2.1 Understanding Math Self-efficacy

Bandura’s (1995) self-efficacy theory posits that self-efficacy plays a powerful role in influencing “how people feel, motivate themselves, and act” (p. 2), a claim that has been generally supported by research (Linnenbrink & Pintrich, 2003; Kisantas, Cheema, & Ware, 2011). According to the theory, self-efficacy is shaped by a combination of personal and social experiences: mastery experience, physiological state, vicarious experience, and social experiences (Bandura, 1995). Within the context of math education, these sources were found to be valid sources of math self-efficacy among students from middle school to university (Campbell & Hackett, 1986; Cordero et al., 2010; Lopez & Lent, 1992; Usher & Pajares, 2009). In this section, I review the research on the roles of personal experiences, social experiences, and other factors in the formation of self-efficacy.

2.1.1 Role of personal experiences in the formation of math self-efficacy

The theory of self-efficacy (Bandura, 1995) asserts that a person’s self-efficacy towards a particular matter is influenced by the results of past related experiences, or mastery experiences.
However, due to differences in expectations and other factors, the same result may influence students in different ways. A student expecting a 60% on an assignment may be ecstatic with a 75% and experience a subsequent lift in self-efficacy, while a student expecting a 90% may have the opposite reaction. The impact of mastery experiences on math self-efficacy may be observed when a grade 8 student expresses a boost of confidence in her mathematic abilities because, even though she was not a strong math student, she has been steadily improving in her mathematic performance (Usher, 2009). In fact, among all of the 8 students interviewed by Usher, “strong academic performance seemed to go hand-in-hand with confidence” (p. 289). Students with high math self-efficacy all made references to positive experiences with math, while students with low self-efficacy spoke of low marks or the difficulty of math. Usher’s in-depth interviews suggest that math students may look heavily to past experiences as grounds for how they feel about their math capabilities.

A number of quantitative studies have also documented the significant correlation between mastery experiences and self-efficacy (Campbell & Hackett, 1986; Lopez & Lent, 1992; Yurt, 2014). In particular, Lopez and Lent’s (1992) series of surveys administered to 50 high school students shed light on the predictive power of mastery experiences on math self-efficacy at the secondary level. Multiple regression of the data point to mastery experiences as the largest contributor to variance in self-efficacy among students. At the undergraduate level, a study by Campbell and Hackett (1986) found task performance results to have a direct effect on math self-efficacy. A student’s personal experiences with math are therefore powerful sources of information from which math self-efficacy may be built.

Another personal source of information which may shape self-efficacy is physiological state. Students may use their physiological state as a point of reference to determine how they
feel towards a particular matter. Physiological state has been found to be significantly related to math self-efficacy at the high school level (Lopez & Lent, 1992), although there was little discussion in that study on how or why this relationship may be significant. Usher’s interviews (2009) may shed light on the intricacies of this relationship. Students with high math self-efficacy attempted to alleviate the discomfort of cognitive dissonance through the acquisition of new skills, while students with low math self-efficacy interpreted their state of emotional arousal as affirmation of their incompetence and self-efficacy beliefs. Consequently, depending on how they interpret their physiological state and respond to it, students may experience an enhanced or diminished math self-efficacy.

2.1.2 Role of social experiences in the formation of math self-efficacy

According to self-efficacy theory (Bandura, 1995), social experiences are as significant as personal ones in the shaping of one’s self-efficacy. In particular, *vicarious experience* refers to the learning that occurs through observation of others’ experiences. A person’s belief in their own capabilities may be affected after observing a social model attempt something similar. For students, these people may be teachers, parents, and peers. Of interest to note is that a person’s pre-existing self-efficacy beliefs influence how one interprets their observations. In their interviews, Usher (2009) found that students with high math self-efficacy tended to observe their peers through a competitive lens, while those with lower self-efficacy observed with a sense of inferiority. The former students would want to outperform their peers, while the latter group of students would feel even more incapable of math success as they found no commonalities with those who had attained it. In these ways, observing the successes and failures of other people may shape students’ perceptions of their own abilities.
The last source of self-efficacy identified in the self-efficacy theory (Bandura, 1995) is *social persuasions*, which refers to the power of feedback in influencing the ways in which a person perceives themselves. The effects of the feedback may vary with the status of the social model and the relationship that one has with them. The opinion of a person who is more respected and valued may play a larger role in the way a student views themselves. In the case of a small group of grade 8 math students interviewed by Usher (2009), positive feedback from parents and teachers contributed to an increased math self-efficacy. In a study that examined the effect of teaching strategies on math self-efficacy among fifth grade students, Siegle and McCoach (2007) found that feedback that was specific and performance-focused was particularly effective. As such, how a teacher responds to their students can enhance or undermine a student’s perceived math self-efficacy.

### 2.1.3 Factors affecting formation of self-efficacy

While much of the self-efficacy research has been consistent with self-efficacy theory, there is variance in terms of the degree to which mastery experiences, vicarious experiences, physiological state, and social persuasions have been found to shape self-efficacy. In a study of the sources of self-efficacy conducted on 263 grade 6 students in Southeastern United States, Usher and Pajares (2006) found that, while all four factors were predictors of academic self-efficacy, effects were the strongest for mastery experience. Van Dinther and colleagues’ study (2014) of first year teacher candidates, however, did not confirm such findings, suggesting a need for further research on the relationship between age and education level, and self-efficacy formation.

The significance of the sources of self-efficacy is further varied when factors such as gender and race are accounted for. Girls appeared to be more influenced by mastery experiences
and social persuasion, while boys’ academic self-efficacy was predicted more by mastery and vicarious experiences (Usher & Pajares, 2006). Self-efficacy of men seems to be more responsive to intervention than women (Cordero et al., 2010). African American students’ academic self-efficacy was most strongly predicted by mastery experiences and social persuasion, whereas academic self-efficacy among White students was predicted by mastery experience and physiological state (Usher & Pajares, 2006). Furthermore, Pajares and Kranzler (1995) also found that while African-American students in their study tended to have lower self-efficacy than White students, they were also more over-confident about their capabilities, and often overestimated their ability to correctly answer math questions.

The variations in findings demonstrate that self-efficacy is shaped by a myriad of forces that interact and relate to each other in different ways. Student self-efficacy is shaped by a complex combination personal and social experiences, whereby the extent of their influence may vary on the basis of age, race, and gender. This is of significance because, as I discuss in the next section, a student’s sense of math self-efficacy has been found to play an important role in the level of student math engagement and achievement.

### 2.2 Effects of Math Self-Efficacy

Research on the effects of math self-efficacy has been largely consistent with self-efficacy theory. According to self-efficacy theory, math self-efficacy should be a significant factor in math achievement. Indeed, positive math self-efficacy has been found to increase students’ motivation to engage in mathematics (Pantzaria & Philippou, 2015), enhance math performance (Pajares & Kranzler, 1995), as well as explain the role of factors that have been previously associated with math achievement (Kisantas et al., 2011). In this section, I review the literature on the effects of math self-efficacy on math engagement and math performance.
2.2.1 Math engagement

Bandura (1995) identifies self-efficacy as a key factor in cognitive motivation as “people motivate themselves and guide their actions anticipatorily by the exercise of forethought” (p. 6). A person’s beliefs about their capabilities project onto their expectations of future performances, which in turn influence their motivation to engage in such actions. In the context of mathematics, studies (Campbell & Hackett, 1986; Pantzaria & Philippou, 2015) have shown that students are more likely to be motivated to learn math when they feel confident in their abilities.

The immediate effect of failure on math self-efficacy and task interest was shown in a study conducted by Campbell and Hackett (1986). Undergraduate students were randomly placed in either a “success” and “failure” group. Those in the success group were given a simple math task, while those in the failure group were given questions that were much more difficult. In addition to showing elevated math self-efficacy after completing the math task, students in the success group also expressed a greater level of task interest. Similar results were found in Pantzaria and Philippou’s (2015) study of grade 6 students in Cyprus, which showed a high positive correlation between a student’s math self-efficacy, and their interest and performance in mathematics (p. s405). Consistent with theory, research suggests that when students perceive themselves competent at math, they may be more likely to be interested in it and want to engage in it.

2.2.2 Math performance

The annually administered EQAO is one means through which the Ontario Ministry of Educations gathers data on the math performances of grade 3, 6, and 9 students across Ontario. After completing the assessment, students are asked to complete a questionnaire, part of which asks for their attitudes towards mathematics. Pang and Roger’s (2013) analysis of the 2011 grade
9 EQAO math assessments demonstrated a positive relationship between attitudes toward math and math achievement: “[t]he coefficients were almost equal in the two courses for confidence about answering questions in each of the math strands; students who felt confident answering the questions outperformed those who felt less confident by 0.674 (academic) and 0.676 (applied) standard deviations” (p. 16). Similarly, the Ontario report of the Trends in International Mathematics and Science Study (EQAO, 2012), in which 4756 grade 8 students participated, showed a “strong positive relationship between enjoyment and confidence about learning mathematics and mathematics achievement” (p. 2). While math self-efficacy was not explicitly measured in these studies, the questions asked touch upon math self-efficacy, which is the degree of confidence to which a student feels capable of performing math skills and thinking.

The positive relationship between math self-efficacy and math performance has been observed in a number of studies around the world (Pajares & Kranzler, 1995; Parker et al., 2014; Parsons, Croft, & Harrison, 2009; Usher, 2009; Yurt, 2014;). After having 329 American high school students complete a series of measures on general mental ability, math self-efficacy, and math performance, Pajares and Kranzler’s (1995) path analysis found a direct effect of math self-efficacy on problem solving performance, even when general mental ability was controlled for. The results of Yurt’s (2014) study of students in Turkey attributed 59% of change in mathematics achievement, determined by end-of-year grades, to math self-efficacy (p. 166). Parker, Marsh, Ciarrochi, Marshall, and Abduljabbar’s (2014) longitudinal study on Australian youth suggest that math self-efficacy has long term influences beyond math performance. Their follow-up surveys of students from the 2003 Australian PISA sample over the course of 7 years found math self-efficacy of students at age 15 to be a predictor of university entry and math achievement in their final year of high school.
The wealth of studies documenting the relationship between math self-efficacy and achievement suggest that the relationship is a cyclical one. Mastery experiences play a significant role in the formation of self-efficacy (Campbell & Hackett, 1986). In turn, a person’s beliefs of their own abilities may influence their actual ability to do mathematics.

2.2.3 Mediating effects of math self-efficacy

Aside from its direct influences on math achievement, math self-efficacy also mediates the effects of other variables. In Pajares and Miller’s (1994) study of the math self-efficacy of 350 undergraduate students, “the important finding to emerge was that students' judgments about their capability to solve math problems were more predictive of their ability to solve those problems than were other variables found by previous research also to be strongly related to math performance.” (p. 200). Their findings question the role of gender in math performance by showing that the gender differences in math performance “were largely due to the influence of self-efficacy… for gender had a direct effect only on self-efficacy…” (p. 193). Likewise, in their analysis of the 2003 American PISA results and questionnaires, Kisantas, Cheema, and Ware (2011) also found the achievement gap between high school males and females to disappear once self-efficacy was accounted for. Furthermore, the authors noticed a decrease in achievement gaps among races, particularly between minority and White students, which highlights the social construction of race. To lessen the impact of social constructs, such as race or gender, on math performance, math teachers need to pay greater attention to fostering math self-efficacy among students.

Furthermore, self-efficacy may also mediate the effect of teaching strategies on math performance. Fast et al. (2010) found that a caring, but challenging classroom environment
contributed to the math performance of grade 6 students in California through fostering positive and accurate self-efficacy among students. The students’ beliefs in their mathematic capabilities were enhanced when it was perceived that their teachers were committed to their math learning, which in turn influenced the students’ math performance. While factors such as gender, race, and teaching strategies have been found to be correlated to student math performance, it appears that math self-efficacy is the key mediating factor. Math self-efficacy has been found to have significant effects on students’ level of engagement and in turn, their level of achievement and performance. In the next section, I consolidate these findings and examine its implications in the practice of teaching. In particular, I explore the relationship between assessment practices and self-efficacy.

2.3 Assessment and Self-Efficacy

Assessment is defined by the Ontario Ministry of Education (2005) as the process of “gathering information ... from a variety of sources that accurately reflects how well a student is achieving the curriculum expectations in a subject” (p. 17). From a theoretical perspective, assessment, a combination of mastery experiences and social persuasion, should affect self-efficacy. Research findings have been supportive of this, and further suggest that the effects of assessment on academic performance may be explained and enhanced through self-efficacy (Fast et al., 2010; van Dinther et al., 2014).

2.3.1 Formative assessments

Formative assessments are assessments “that take place during instruction in order to provide direction for improvement for individual students and for adjustment to instructional programs for individual students and for a whole class” (Ontario Ministry of Education, 2010, p. 147). They are important because it is through them that teachers and students gain an
understanding of where students are in their learning. Furthermore, when such assessments are authentic to the students’ lives, students’ self-efficacy towards the subject is enhanced (van Dinther et al., 2014). When students see meaning in the assessment and how it is related to actual practice, they feel empowered to take on future tasks. To foster positive self-efficacy, teachers need “to tune the authenticity level of the learning experience, the structure of the situation and the supervision of the students to the complexity of the task and to the students’ competence developmental level” (van Dinther et al., 2014, p. 344).

Assessments need to be in line with student needs and capabilities. In interviews with intermediate/senior math teachers in Ontario, Suurtamm (2010) found that when teachers made efforts to scaffold their assessments and to walk their students through the problem at hand, students felt more confident in being able to solve the problem. During this process, one strategy is to ask students to articulate their knowledge, and then to summarize their comments. This way, teachers are able to confirm that they have correctly interpreted their students’ words. This also allows the teacher to capture confusion and identify the source of their students’ difficulties, and to address them. Formative assessments, when carried out with care and purpose, may become mastery experiences that enhance student self-efficacy.

Research on the implementation of formative assessments in the Ontario math classroom have been inconsistent. While qualitative studies on math teachers’ assessment practices show that assessment strategies are in line with Ministry requirements (Suurtamm et al., 2010; Volante & Beckett, 2011), Mendaglio’s (2015) review found that “formative assessment has only been adopted at a surface level in Ontario” (p. 16). Unlike the Finnish education system, where there is an almost complete absence of high-stake tests, the Ontario curriculum places a greater emphasis on testing than is advocated for in curriculum documents and may undermine
assessment for learning (Mendaglio, 2015).

2.3.2 **Teacher feedback**

Teachers are important social models for their students, whose thoughts and opinions may powerfully shape how students view themselves. In exploring how teacher feedback affects self-efficacy, van Dinther et al. (2014) administered questionnaires to Dutch first-year student teachers. Students expressed high self-efficacy when teacher feedback was perceived to be understandable, learning-focused, and linked to the task. Similarly, in their literature review on the power of feedback, Hattie and Timperley (2007) found feedback to be “effective to the degree to which it directs information to enhanced self-efficacy…such that attention is directed back to the task and causes the students to invest more effort or commitment to the task” (p. 95).

Feedback, when directed to the task at hand, allows students to clearly recognize things they can do to improve their performance. Rather than attributing successes or failures to stagnant qualities, students believe that they are able to change results through effort. As such, teachers need to be careful of unclear and undeserved feedback, as the former “fails to clearly specify the grounds on which students have met with achievement success (while the latter) increases outcome uncertainty and can lead to increases in self-handicapping strategies” (p. 95).

Nevertheless, while these authors advocate for the importance of feedback to the task at hand, Usher’s (2009) interviews with middle school students suggest that expressing confidence in the students’ person is also important and may prevent students from disbelieving in themselves. A student, in particular, attributed a lack of faith in him from others as a reason for him being shut down towards math. Students also shared experiences of how comments by math teachers have both encouraged or discouraged them. Furthermore, it was not only the content of the feedback that may make an impact, but also the manner in which it was given: “[a]lthough he
was careful to point out that Ms. Matthews, his teacher, did not overtly discourage him, her impatience with his questions made him ‘feel low about what (he) can do’” (p. 301). The attitude and manner in which a teacher gives feedback is also a form of feedback: “[s]tudents who perceived their teachers to be more caring, challenging, and mastery oriented experienced increased levels of math self-efficacy” (Fast et al., 2010, p. 735). Through their words and tone, teachers are creating a learning environment which may serve to enhance or undermine student self-efficacy.

2.3.3 Self-assessment

Self-assessment is assessment as learning. When students self-assess, they are partaking in a “process by which the student gathers information about and reflects on his or her own learning ... [it] is the student’s own assessment of personal progress in knowledge, skills, processes, or attitudes. Self-assessment leads a student to a greater awareness and understanding of himself or herself as a learner” (Ontario Ministry of Education, 2007, p. 1). Rather than assessing themselves with all-encompassing terms such as “smart” or “dumb”, students remove their capabilities from their person to review their strengths and weaknesses. Through this process, students can gain a sense of autonomy over their abilities and identify means through which they may improve and work towards their learning goals (Hattie & Timperley, 2007).

When students self-assess, they are engaging in self-regulated learning: a “self-controlled cycle of processes designed to enhance a student’s goal attainment and sense of agency” (Ramdass & Zimmerman, 2008, p. 20). Furthermore, in a study of first year undergraduate students, Cordero, Porter, Israel and Brown (2010) found that those who underwent a 15-minute self-persuasion intervention, which consisted of giving a rationale as to why they would be successful in math classes after completing a challenging math task, demonstrated significantly
higher levels of math self-efficacy. Developing a rationale that envisions success in math appears to be important in fostering self-efficacy beliefs. By self-assessing, students learn to identify learning goals, needs, accomplishments, and strategies for success; thereby inadvertently perceiving themselves as capable of attaining success.

Research suggest that assessments play an important role in shaping student self-efficacy. Formative assessments that are carefully scaffolded and authentic to students’ lives enhance self-efficacy; teacher feedback cue students as to how they should perceive their abilities; while self-assessments allow students to monitor their progress and plan accordingly.

2.4 Conclusion

This review of research on math self-efficacy affirms the validity of Bandura’s (1995) self-efficacy theory in identifying the sources and effects of math self-efficacy. Mastery experiences, vicarious experiences, physiological state, and social persuasion shape math self-efficacy in various degrees, which in turn affects factors such as math engagement and performance. Self-efficacy has also been shown to mediate the effects of a number of factors, such as assessment, on math achievement.

However, there is little research on the development and effects of math self-efficacy in the Canadian context. Furthermore, existing research on math self-efficacy in Canada has been primarily quantitative, using data collected from large scale questionnaires. Such methods are useful for understanding prevalence, but not the process. Research has also been largely student-centered, with a lack of research on the role of teachers in the formation of student self-efficacy. In the case of math self-efficacy, more qualitative research is needed in order to understand teachers’ perceptions of student math self-efficacy, its development, and effects on learning and performance. In particular, there is a lack of literature on the role of assessment in the
development of self-efficacy in the math classroom, and to what effects. This study seeks to fill the gaps in the literature by investigating Ontario math teachers’ assessment strategies for fostering self-efficacy in their students.
Chapter 3 – Methodology

3.0 Introduction

In this section, I discuss the methodology which guides and informs this study. I start by defining and justifying the qualitative approach to this study and, in particular, the use of qualitative interviewing. I then give a description of the data collection process, including brief bios of the study’s participants, as well as an overview of the data analysis process. Lastly, I discuss the ethical implications of the methodology, as well as its strengths and weaknesses.

3.1 Research Approach & Procedures

Creswell (2011) defines qualitative research as the “collection of data in a natural setting sensitive to the people and places under study, and data analysis that is both inductive and deductive and establishes patterns of themes” (p. 44). Key to this definition are its philosophical underpinnings: the ontological belief that reality is subjective and can only be constructed through experience. Furthermore, findings that are gathered under a controlled environment are inauthentic to the lived experience. As such, to fully understand a topic, qualitative researchers believe it is necessary to investigate the experiences of those who have partaken in it, or have been impacted by it. Qualitative research is well-suited to explore open-ended questions, as researchers are often given a level of flexibility in which they may adapt questions and probe their participants for greater detail (Mack, Woodsong, MacQueen, Guest, & Namey, 2005). Qualitative research is generally used to explore a social problem, empower individuals or groups or people, or to develop theories (Creswell, 2011).

As an exploratory study, this study sought to better understand how Ontario secondary math school teachers are working to foster self-efficacy among their students through assessment methods. An additional purpose of this study was to investigate teachers’ perceptions of Growing
Success (Ontario Ministry of Education, 2010) and its effectiveness in fostering students’ math self-efficacy. In order to study this, insight needed to be gained in regard to how teachers understand and respond to student math self-efficacy. However, teachers’ experiences are highly subjective and may influence their practice in different ways. Rather than finding absolute answers and making broad generalizations, this study was simply curious about patterns and themes that may emerge from the data. A qualitative approach was the most appropriate approach as it allows for a flexibility in the research process not provided by the quantitative approach. The focus of this study was to gain deeper insight into the experiences of math teachers.

3.2 Instruments of Data Collection

Qualitative interviewing is a means of data collection in which information is gathered from a dialogue between the participant and researcher. The extent to which the interview is predetermined and the rigidity with which the interviewer follows a predetermined script categorizes an interview as either unstructured, semi-structured, or structured (DiCicco-Bloom & Crabtree, 2006). Questions are generally open-ended and allow participants to delve into their personal experiences. The structure of the interview shapes the type of information that is gathered. An interview that is less structured allows the participant more control over the discourse, which may allow researchers to encounter ideas they would not predicted should they have predetermined the direction of the interview.

As a data collection method which sought to more deeply understand the experiences of teachers – that is, their subjective understanding – qualitative interviewing may have been the best avenue of inquiry (Seidman, 2013). This study used semi-structured interviews to collect data, in which participants were asked “a set of predetermined open-ended questions, with other
questions emerging from the dialogue” (DiCicco-Bloom & Crabtree, 2006, p. 315). Questions were developed in correspondence with the research objectives of this study. Interviews were recorded and were approximately 60 minutes long. After a few questions on their teaching experiences, participants were asked about their understanding and perception of self-efficacy, such as: “Can you tell me about a time when you have observed a student express a lack of faith in their ability to succeed at math? What term would you use to describe this?” Participants were then asked about their assessment strategies and its effects, and finally their perceptions of the Growing Success (Ontario Ministry of Education, 2010) policy. Throughout the interview, to get clarification or further details, questions have been rephrased and participants have been asked to elaborate their responses. See Appendix B for full outline of the interview guide.

3.3 Participants

In this section, I outline the sampling criteria and sampling procedures. I also present a brief bio of the participants of this study.

3.3.1 Sampling criteria

The sampling criteria are as follows:

- A minimum of eight years of teaching experience.
- Experience teaching different grade levels and streams of math.

At the time of the interview, the participants of this study were certified secondary school math teachers with at least eight years of teaching experience in Ontario. The minimum requirement of eight years of teaching experience was to ensure that participants have had at least two years of teaching experience prior to the publication of the Growing Success (Ontario Ministry of Education, 2010), and are able to reflect on its influences, if applicable, on their teaching practice. To ensure that participants have had experiences teaching students with
varying levels of math self-efficacy, participants were required have a wide range of experiences teaching in students from different grades, academic streams, and backgrounds. In particular, participants were required to have taught, grades nine, ten, or eleven math, as math classes are still mandatory at these levels.

3.3.2 Sampling procedures

In contrast with quantitative research, in which the focus is often on statistical significance, qualitative research is more concerned with saturation: that is, with rich and insightful data. Due to the specificity and depth of information that is of interest in qualitative research, collection of data is often time consuming and difficult. In consideration of these challenges, some common sampling procedures of qualitative research include, but are not limited to: purposeful sampling, snowball sampling, and convenience sampling. Purposeful sampling refers to the sampling process through which participants are sampled based on “preselected criteria relevant to the research question” (Mack et al., 2005, p. 5). Snowball sampling – a type of purposeful sampling – is the gathering of participants through referrals. Convenience sampling is when participants are recruited based on their accessibility to the researcher.

To access “key informants in the field who can help in identifying information-rich cases” (Suri, 2011, p. 67), participants in this study were recruited through means of purposeful and snowball sampling. These methods were used to ensure a level of quality in the data that would be gathered, and that participants would be able to give insight into the object of study. Participants were first accessed through a contact with rich experience in the field of math education. I also contacted several math departments in hopes of reaching out to more potential participants. Additional contacts were also made through various persons who had connections
to math educators. In the end, three math teachers were willing to participate in this study.

3.3.3 Participant bios

Carol is a math teacher at an independent high school in the Greater Toronto Area. She has over ten years of teaching experience, all of which have been in her current school aside from one year of teaching abroad. Her primary teachable is math, although she is also qualified to teach chemistry. She has experience teaching grade 9 to 12 math courses. However, applied courses have not been a part of that experience as they are not offered at her school. At the time of the interview, she was teaching academic math for the grade 9 and 10 and levels, and Grade 12 Calculus and Vectors.

Nathan has been teaching for almost ten years. He pursued math and computer science in his undergraduate program, after which he obtained a Bachelor of Education and became qualified to teach math and science at the intermediate and secondary level. Since then, he has been teaching at his current high school within an Ontario school board. Nathan has taught academic, mixed, and gifted math across grades 9 to 12. At the time of the interview, he was teaching 10 Academic Math and Grade 12 Calculus and Vectors.

Jackie is a retired teacher that is currently working as a math coordinator, facilitator, and coach. Prior to retirement in 2013, she taught secondary math and economics for almost 30 years. During that time, she also acted as a math coach, assessment coordinator, and social studies and humanities coordinator. With regards to math-teaching experiences, she has taught academic and applied math for grades 9 and 10, as well as Grade 11 Functions and Grade 12 Calculus.

3.4 Data Analysis

This study employed a deductive approach to qualitative a data analysis. Upon completion, interviews were transcribed and coded. The coding process involved several cycles,
from the initial splurge to the refinement of codes, which are “labels and for units of meaning to the descriptive or inferential information complied during a study” (Miles & Huberman, 1994, p. 56). Throughout this process, “memos” were kept to organize thoughts, reflect on the process of analysis, and to “tie together different pieces of data into a recognizable cluster” (Miles & Huberman, 1994, p. 73). These memos allowed the researcher to make sense of an often overwhelming task. After the transcripts had been coded, they were then analyzed of emerging patterns, and codes were placed into appropriate categories. Finally, these categories were interpreted for meaningful themes that answered the research questions.

3.5 Ethical Review Procedures

Interviews are a form of qualitative research in which participants are directly involved in the research process. As such, the interview environment, the questions they hear, the answers they give, and the way their information is recorded all need to be scrutinized to guarantee a research process that is ethical and that protects the rights of the participants. From the beginning, participants in an interview have the right to informed consent. To prevent participants from placing themselves in undesirable situations, researchers need to convey the purpose of the study faithfully and honestly. Participants were given the option of withdrawing from the study, and not feel penalized for doing so (Lichtman, 2013).

During the course of the interview, the researcher may be tempted to direct the conversation so that the participant gives answers that are desirable to the researcher. In this study, however, it was important that the dignity of the participants were honored, where their experiences and sharing were valued (Seidman, 2013). In interviews, researchers should also be careful of topics which may be sensitive and intrusive. The topic of this study, however, is generally not considered to be sensitive, and participants were able to answer all of the questions.
At the same time, the researcher may face ethical dilemmas when the participant discloses information which is unlawful. In the context of this study, possible ethical dilemmas may occur when the educator discloses information of abusive practices.

Another ethical risk associated with qualitative interview research is the issue of anonymity. Special care was taken to avoid including information in their writing which may give away the participant’s identity. This may include their names, work locations, distinct accomplishments, etc. Attention was also given to how the information was stored. To prevent a leak or loss of information, passwords were signed to confidential files (Creswell, 2007). These precautions were taken for the interview process of this study.

3.6 Methodological Limitations and Strengths

Qualitative interviews are powerful tools through which researchers may gain detailed information about their research topic, insights which may not be easily observed (Mack et al, 2005). Participants are free to talk and give answers that are meaningful and relevant to them. Semi-structured interviews also allow interviewers the flexibility to probe or repeat questions to gain additional information. For this study, qualitative interviews provided valuable insight into teacher’s perceptions of student self-efficacy and their response. It also allowed teachers to give their thoughts in regards to *Growing Success* (Ontario Ministry of Education, 2010), a perspective that has yet to be heard in educational research.

However, while qualitative interviews allow for rich and focused data, the data is not generalizable. Furthermore, due to the subjective nature of the responses, there is a limit to the extent to which the interviewer may understand the participant’s experiences and responses. At this point, it may be necessary to repeat or clarify the meanings of the respondents’ answers (DiCicco-Bloom & Crabtree, 2006). This leads to another potential limitation of qualitative
interviews: that the researcher may, consciously or unconsciously, influence participants’ responses. This may take the form of a pause, a frown, a word, or a leading question. The researcher’s presence alone may exercise influence over the type of answer given, or the way in which it is worded. Interviewees may interpret actions from the researcher to be cues as to what the researcher want to hear, or the interviewee may be conscious of how their answers are interpreted and be inclined to give socially acceptable answers (Roulston, 2010). It would be difficult to identify when the respondent is being honest and when they are dishonest.

3.7 Conclusion

In this section, I justify the methodology that is used in this study. A qualitative approach is best suited for the purpose of this study, as it seeks to gain insight into teacher experiences. Data will be collected through semi-structured interviews. While there are ethical considerations and limitations to this methodology, interviews are sufficient for the purpose of this study. As an exploratory study, qualitative interviews open the door to a greater understanding of teachers’ perceptions of student self-efficacy and their assessment practices, which may then act as a stepping stone for future studies. To ensure quality of data, participants will be recruited through purposive and snowball sampling. The data will then be analyzed through a transcribing and coding of the interviews, the findings of which are presented in the next chapter.
Chapter 4: Research Findings

4.0 Chapter Introduction

This research project sought to gain a deeper understanding of how Ontario secondary math teachers foster self-efficacy in students through their assessment practices. To gain a deeper understanding of this topic, I reviewed literature on the role of self-efficacy and its effects, as well as teachers’ assessment strategies. I conducted semi-structured interviews with 3 secondary math educators, who were recruited through the snowballing method. In this chapter, I analyze my interviews for prevalent themes and present the main findings that were obtained. In particular, I hope to shed greater light onto the topic at hand by discussing 1) teacher perceptions of self-efficacy, 2) how teachers reportedly use assessment as means of improving self-efficacy and 3) the importance of shaping student perceptions of assessment. Findings are also analyzed for convergence and divergence in relation to the existing body of literature on the topics of self-efficacy and assessment. Finally, I conclude this section by providing a summary of the key findings.

4.1 “He Just Doesn’t Understand Why”: Teacher Perceptions of Math Self-Efficacy

To gain deeper insight into how teachers foster self-efficacy in their students, it would be useful to first understand how teachers perceive it. The teachers in this study unanimously saw math self-efficacy as something that is intimately tied to the student’s abilities to self-assess and self-regulate their learning. In their discussion of self-efficacy, teachers agreed that a student’s evaluation of their potential to succeed in math is closely associated with whether or not they have the skill set to move them forward. In sharing his experiences supporting a student with low self-efficacy, Nathan observed that:
He just doesn’t feel very smart. He just doesn’t understand why he can’t do it. That happens a lot with math, where you just have a lot of kids who are just like ‘I don’t get it, why am I so bad at this?’ and then they get this idea that (they’re) just bad at math.

To Nathan, student self-efficacy was more than whether or not this student felt confident in his mathematic ability; it also entailed his response to his struggles with a mathematical concept. This student, faced with a challenge in his learning, responded with defeat, which in turned was interpreted by Nathan to be a sign of low self-efficacy. However, there was a clear distinction between the teacher’s understanding and the student’s understanding of the situation. Nathan’s student interpreted his struggles to be evidence of his mathematic incompetency. This reportedly led him to give up easily without seeking additional help or practice. Nathan, on the other hand, rooted the student’s struggles in his inability to understand why he was struggling. Unable to accurately assess his own learning, the student came to the conclusion that he is someone who is “just bad at math”. Nathan, however, believed that it was the student’s assessment of himself that prevented him from possessing higher self-efficacy.

Carol’s description of a student with high self-efficacy provides another insight into how teachers perceive student self-efficacy:

I think the students who have (high) self-efficacy are the ones that sit down, make a concerted effort individually to do their homework and then are able to decipher whether or not they know it, and then they do something about it…So, it’s not just recognizing that they don’t get it, but also what do they do to teach themselves.

In her description, Carol identified a number of learning strategies a student could employ to help them understand a topic. Similar to Nathan, she drew attention to the importance of self-assessment, or the ability to accurately identify gaps in their learning. However, once that has
been identified, Carol believes that students also need to be able to self-regulate, or to organize their learning in a purposeful way to enable themselves to reach a goal.

Although past experience was noted as an important source of student self-efficacy, these two teachers also pointed out that students may continue to experience defeat if they do not have the skill set to move themselves forward. Interestingly, there was no mention among the teachers of the necessity of student math skills. Rather, learning skills was a common thread throughout the interviews. Students were believed to have low self-efficacy not because they were bad at math but because they did not know how to better their math abilities. Nathan spoke of how “[students] haven’t been taught that skill of ‘I’m behind, hence I’m going to work really hard to try and catch up’. For a lot of the kids, [it’s] ‘I’m behind, I don’t care’.” Carol made similar observations in noting how students, unable to figure out how to improve their learning, would often project past failures onto their present circumstances which “sets the tone for the rest of the year”. Participants believed that students with low-efficacy would choose avoidance because they do not have the necessary learning strategies to progress their learning.

In relation to the literature, these teachers’ understandings of student self-efficacy complemented Bandura’s (1995) self-efficacy theory and studies on its application in the context of math learning (Campbell & Hackett, 1986; Cordero et al., 2010; Lopez & Lent, 1992; Usher & Pajares, 2009). In particular, the teachers’ discussion on the influence of student math experience on their math self-efficacy echoed the findings in Lopez and Lent’s (1992) study of high school math students, including the positive correlation found between mastery experience and math self-efficacy. The data also echoes Usher’s (2009) findings on how students interpret their discomfort with cognitive dissonance in different ways—students with high self-efficacy will try to alleviate it through more work while students with low-self-efficacy will interpret it an
as affirmation of their poor math skills. Likewise, teachers in this study also observed student perceptions as an influential factor in their level of math self-efficacy. With regards to research on assessment, teachers’ perceptions of math self-efficacy as strongly connected to students’ self-assessments skills is congruent with findings from Ramdass and Zimmerman’s (2008) study on the effect of self-correction training on student attitudes and learning. Also consistent with their study was the recognized need for students to be trained in learning strategies.

While the theory of self-efficacy does not identify self-assessment and self-regulation skills as significant factors in its development, teachers seem to understand them as closely related concepts. Teachers’ perceptions of self-efficacy direct the strategies they use to foster it in their students. The next section will discuss these strategies in greater detail.

4.2 Assessment as Means of Improving Learner Self-Efficacy

Perceiving self-assessment and self-regulation skills to be crucial components in the formation of learner self-efficacy, the teachers in this study used a number of assessment strategies to help their students to foster these skills. However, to achieve this effectively, teachers believed that assessments, first and foremost, needed to be accessible to all students. Assessments that recognized and built on existing student competencies encouraged students to persevere in their learning. Teachers also used feedback to provide students with direction in their learning and to model for them effective uses of self-assessment and self-regulation. Lastly, teachers discussed the significance of assessments that allow room for student-directed learning. While teacher support is an important part of learner self-efficacy, teachers recognized the need to give students the opportunity to take ownership of their learning. This section will examine these strategies in greater depth in an attempt to better understand how math teachers seek to foster student math self-efficacy through assessment.
4.2.1 “It’s like watching kids play video games”: Assessment that is accessible to all

In their discussion of student self-efficacy, a strategy commonly mentioned by the teachers in this study was to make assessment accessible to all their students. That is, the teachers believed that all students, regardless of their mathematical ability, should be able to find an entry point in the assessment all the while being challenged in their thinking. Jackie likened the process to that of designing video games, which seeks to motivate players to continue playing by ensuring that they always achieve a certain level of success. Likewise, a teacher can also motivate their students to continue in their studies by making sure that they are always able to attain success in the classroom. A teacher who makes their assessments accessible to all also ensures a certain level of success for each of their students.

To illustrate her point, Jackie shared an experience she had with a student whose struggles in math were so great that the math department discouraged her from taking any more senior math courses. Disappointed with the lack of support from the department, Jackie herself spent many hours during lunch and after school to support her. This student would later study math at a graduate level:

She said to me that what worked for her was that I recognized her entry point. I made the mathematics accessible to her dependent on her readiness and her natural way of learning. So, I think it’s really important that we recognize that all of our students come in at varying levels of ability, with different entry points, with various levels of understanding, and various ways that I can build and develop that understanding.

Jackie expressed confusion over why the math department took the position that they did as she observed the student to be extremely bright and very capable in mathematics. Her willingness to see the students’ strengths might have been a reason. Rather than being fixated on the students’
weaknesses and what she did not know, it was important to Jackie that she identify the students’ capabilities and to build on them instead. While it may have been an easier route to give the student a generic assessment and immediately dismiss her abilities, Jackie took the time to figure out what this student already understood. As many studies have shown (e.g., Campbell & Hackett, 1986; Lopez & Lent, 1992; Usher, 2009) and which Jackie also understood, building on past successes can be an extremely effective way of breeding further success and math self-efficacy.

In demonstrating the power of assessments when they are effectively scaffolded to the students’ abilities, Jackie’s story also shows the importance of knowing your students. The teachers in this study referred to a number of strategies to gauge student learning, including but are not limited to: conversations, observations, exit tickets, and diagnostics. Regarding formative assessments, Nathan expressed the belief that every assessment can and should be used for this purpose so that the teacher is always gathering information on how students are doing. In a similar fashion, Carol spoke of how the process of knowing one’s students should be continuous and constant: “it’s about being proactive and having the information so I know exactly what it is I need to work with the student on so that they have what it needs to be successful”. Much like the teachers in Suurtamm’s (2010) study on math teachers’ assessment practices, research participants also used assessments to inform them of how to proceed with their teaching. The teachers recognized that in order help students attain success, they had to know the students well enough to get them there.

Also consistent with the findings in Suurtamm’s (2010) study was how these teachers used a variety of assessment strategies to more accurately assess student learning. For example, Carol took a particular liking to conversations because she believed that they allowed students
who “thought they were bad at math a different avenue to express themselves mathematically”. She recognized that some students were stronger as verbal communicators and that they would be better able to explain their thinking that way. It was important to her that she gave those students the opportunity to do that. These conversations not only allowed her to better understand her students and in turn provide them with more appropriate support, it also validated different forms of mathematical reasoning. Students who “thought” they were bad at math now reportedly see that they are capable of much more than they gave themselves credit for.

Diversified assessment strategies may make math more accessible to students who think in different ways while ongoing assessments allowed these teachers to gain a more accurate understanding of student abilities and scaffold future instruction more appropriately. Put together, diversified and ongoing assessment practices allowed teachers to make math accessible to each student and ensure that they are always able to achieve a certain level of success.

4.2.2 “We talk about it”: Formative feedback as means of improving self-efficacy

However, while teachers spoke to the importance of being sensitive to students’ varying entry points, designing accessible assessments, alone, may not suffice in terms fostering student self-efficacy. Students need also be given proper guidance in terms of how to progress in their learning. In this respect, teachers in this study showed an immense faith in the potential of formative feedback to guide student learning and, in turn, improving self-efficacy. In particular, their descriptions of effective feedback supported the findings in Hattie and Timperley’s (2007) review of the impact of feedback on learning and achievement, which identified 1) direction to the task at hand and 2) offering means of improvement as characteristics of effective feedback.

Teachers in this study always mentioned feedback in conjunction with a specific task. Nathan, for instance, gave an example of how he would give verbal feedback upon returning a
quiz. When a student leaves a blank quiz, he would make sure to sit with them individually and to identify with them what they could or should have done. It was important to him that he doesn’t just “hand [the quiz] back and that’s the last we talk about it…you have to hang out with me and we’re going to go through this.” Nathan used the quiz as an opportunity to invite the student into a conversation with him and in effect to co-assess their learning. Rather than being a passive recipient of the teacher’s feedback, the student was reportedly able to take part in the assessment process and engage in reflexive thinking. Furthermore, sitting with the student during this process allowed Nathan to model for the student effective thinking and assessment strategies enabling the student to not only hear the feedback but also see it in action. To Nathan, the quiz was not an end to a conversation, but the start of one that can be used to powerfully support student learning.

This sentiment was also echoed by Carol who always made sure to leave written feedback on her tests:

I think what is more beneficial is the feedback you give on the test. So if you actually take the time to write feedback or comment on the things that the student needs to work on, I think that’s where students have more power to make changes and to improve.

To Carol, feedback is considered to be more useful than a test mark because it provides students with direction. With constructive feedback, an assessment of learning also becomes an assessment for learning. Her use of the word “power” shows that while the teacher is the source of the feedback, students may also be empowered by it. Formative feedback can offer students, previously struggling with a topic or at loss for what they need to do, guidance for how they may improve. These teachers saw feedback as a powerful tool in shaping student learning by
providing students with information on their learning status and direction for future improvement. In effect, they seek to foster student self-efficacy by modelling how to assess and regulate learning. A limitation is that it can only point students to success; whether they proceed in that direction is up to them.

4.2.3 “Give control back to your students”: Fostering student ownership

Teacher feedback, no matter how detailed and constructive, remains teacher-directed. As such, while all the teachers in this study recognized how they may and do play an active role in the development of student self-efficacy, they also emphasized the importance of independent learning. In the words of Nathan, self-efficacy is ultimately grounded in the student’s ability to “figure their own stuff out”. As such, fostering self-efficacy in their students also meant teaching their students to rely on themselves and to take ownership over their learning. This, however, is often a struggle for many students. In those situations, Nathan would respond by taking matters into his own hands:

I [would] really have to prod and see what it is they’re misunderstanding and what are the skills that they’re missing, and how [I can] fill those gaps, [and] how [I can] lead in them in the right direction.

Through his words, it is evident that he is still ultimately in control and directing the learning process. Upon recognizing the student’s struggles with self-assessment and self-regulation, he would take it upon to himself to perform those skills for them.

Carol and Jackie, however, cautioned against this as it may actually do a disservice to the students by robbing them of the chance to take ownership of their own learning. Carol emphasized the need for teachers to:
give the control back to your students. If your students are able to be independent and to learn independently, work collaboratively, [and] self-correct their work, rather than always relying on you, I think it gives the students much more ownership of their learning.

Carol recognized that, in order for students to learn independence, they have to be given the opportunity to exercise it. Her current classroom design, a flipped classroom, allows ample opportunities for students to direct their own learning. Most of the class’s videos, tutorials, and practice sheets are housed online and students are allowed to go through the material “not only at a different pace, but in a different order”. Students are responsible for their own learning and it is up to them to review concepts that they feel they are struggling with. Student ownership is reportedly also developed through the use of self-assessments, where students mark their own quizzes and decide what their next step should be. Carol, the teacher, is there only to support their learning. In comparison to the more teacher-centered approach she took prior to this, Carol found her students working better in a classroom culture where they are given multiple options and allowed to work at their own pace.

Jackie’s classroom while she was still teaching, though not flipped, was intentionally designed to be a “thinking classroom”. Jackie would begin each unit with an overarching question that the class would return to throughout the unit. The assessment piece was given at the start of the unit and students would be able to return to their answers at any time to make appropriate corrections or additions. In this way, students were given opportunities to monitor and regulate their own learning, which was also found by Ramdass and Zimmerman (2008) to be an effective way of honing self-efficacy. Like Carol, it was important to Jackie that she gave her
students more control over their learning by providing them with opportunities to make their own decisions.

It appears that, while it may be tempting for teachers to intervene when their students are struggling and to tell them what it is they need to do, students would not be able to grow effectively as a learner. They may continue to rely on the teacher when they are stuck on a topic or question, not knowing how to move ahead independently. To foster student math self-efficacy, teachers in this study believed in allowing and encouraging students to assess their own learning and to proceed in a way that they feel is appropriate. Although it may be difficult to carry out in practice, giving opportunities for student-directed learning can be very effective for nurturing learner self-efficacy. Students, however, may not take advantage of these opportunities if they do not recognize its value or are afraid of failing. As I discuss further in the next section, these teachers also reportedly tried to develop student self-efficacy by shaping their perceptions of assessments.

4.3 Shaping Student Perceptions of Assessment

In their descriptions of student self-efficacy, teachers repeatedly identified the powerful role of perception in how students responded to math. A fixed mindset that perceives failure to be the end of a journey, for example, was believed to discourage students from persevering in face of challenges. Similarly, a student who perceives marks rather than learning to be the end goal of assessment would be more likely to view themselves as being bad at math if they receive a low mark. In this section, I discuss how the teachers in this study sought to improve student math self-efficacy through shaping student perceptions of assessment. In particular, I focus my discussion on how teachers framed failure as conducive to learning and assessment as a part of the learning process.
4.3.1 Failure as productive of learning

As discussed in Chapter 2, students may experience low math self-efficacy as a result of negative experiences with. In congruence with Pantzaria and Phillipou’s (2012) findings on sixth grade math students, fear of failure was identified by the participants as a negative experience that discouraged students from engaging in math. Likewise, teachers in this study pointed out how students often carried experiences from the previous year into the current class. Having performed poorly or below personal expectations in their previous year, students may become discouraged from continuing their mathematic pursuits. Recognizing this, teachers sought to shape student attitudes towards mathematics by shaping how they perceive failure.

While Pantzaria and Phillipou’s (2012) findings focused on the negative effects of failure, some participants in this study also believed in their potential to be a positive influence. Jackie, in particular, saw failure to be an important part of the learning process for its ability to gear students thinking. Failures can help students to identify which strategies are more useful and which are less so, propelling them to be better mathematicians and thinkers. A student with high self-efficacy would not fear failure but embrace it:

Let them experience some failure, and see that it can be productive…I think that we have to give our students time to kind of muck about with what it is that they’re learning, to see that they’re not always going to get it right at the very beginning, but over time they’ll be able to figure it out if they persevere and they work hard, and they possess the habits of mind of a good mathematical thinker.

Jackie noted that many teachers, for positive intentions, are afraid for their students and to allow them experience a certain degree of failure. From her words, it appears that this may be counter-productive as students become robbed of the opportunity to see how failure may be productive.
Rather, to Jackie, teachers can foster learn self-efficacy by instead giving students the freedom to “muck about” and to encourage them to take risks. While noting the importance of scaffolding assessments so that students are able to attain success, Jackie also warns teachers to be careful of sheltering their students too much. To Jackie, always getting the right answer right away is not an effective way of nurturing strong math self-efficacy as it is rooted in circumstance; the student may easily waver once they encounter a challenging problem. On the other hand, students who attain success despite their failures can gain confidence in their math abilities because they persevered.

Campbell and Hacket’s (1986) study of the effects of failure on student self-efficacy found elevated math self-efficacy among students who experienced success rather than failure. While not diverging from this finding, Jackie’s perspective suggests that failure, framed as being productive to mathematical learning, can also elevate learner self-efficacy. Carol’s experiences supported this when she noted how her students experience an increase in confidence levels when they channel their frustration in a positive way and eventually become successful. Teachers need to foster a safe environment where students can experience failure in a productive way, viewing it not as an end result but as a part of the learning process.

4.3.2 Assessment as part of the learning process

Though closely related, perceptions of failure and perceptions of assessment are not the same. A student may not be afraid of answering a question incorrectly but rely on marks as an indicator of their math abilities. Regarding the latter, all the teachers in this study indicated that students have a tendency to learn for the assessment rather than the other way around, which in turn prevents them from reaching greater depths in their learning. Students often concerned themselves more with getting the “right answer” as opposed to understanding how to arrive there.
As such, research participants believed that shaping students’ perceptions of assessment was an important step in furthering student learning. In Jackie’s words, students should see assessments as “invitations to learning rather than as judgements of how much learning has taken place”.

Carol also believed that students should perceive assessment as “more of a journey than just the one destination of the test”. When students focus too much on marks, they may over-rely on them as a reflection of their mathematic ability. In contrast, when students are less marks-driven, they tend to be more willing to make a mistake and to take the time to correct it. The strategy Carol used was to give “so many assessments that are not for the marks” that the students do not ask anymore. They recognized that learning, not the marks, was the focus of Carol’s class. Jackie also did this by showing the students that the purpose of assessment was ultimately to support them: “I was gathering evidence of learning in a formative sense, so that I could frame new questions if I needed to and new tasks if I needed to”. Both teachers showed their students that their learning was the primary goal of their assessments.

Similarly, Nathan believed that students would learn better if they saw assessments as learning tools rather than evaluations. Even though the students might not see it that way, “it’s important to press that upon them”. However, though Nathan expresses that “it would be nice if the quizzes didn’t count for their marks”, his actual practice may send a conflicting message. To get students to “take it seriously”, Nathan would make sure his students understood that their assignments would get marked. He was concerned that the students would not care about it otherwise. There is irony in this situation in that while he may have been successful in getting his students to care about the assessments, they may be caring only about the marks and not the learning.
While the primary and secondary teachers interviewed for Volant and Beckett’s (2011) study also experienced a tension between their ideal classroom and actual practice, the source of their tensions differed. The teachers in their study were torn between their desire to give assessment without grades and the practical need to produce grades for reports. Their tension was due to the conflict between what they believed to be the ideal learning scenario for their students and their professional duty to produce grades. Nathan experience of tension, on the other hand, was stemmed in the belief that though assessments without grades would benefit students by allowing them to see assessments as learning tools rather than evaluations, they would also lead students to becoming unmotivated to work. While Jackie and Carol were able to put their ideals to practice, Nathan’s concerns about student motivation prevented him from implementing them in the classroom.

Nevertheless, all the research participants agreed on the importance of student perception in shaping their learning. To engage in deeper learning, for these teachers students need to recognize that failure can be conducive to their learning and that assessment is not the end of learning. Naturally, self-efficacy can be nurtured as students learn to adopt a growth mindset in which failure is just a part of the process.

4.4 Conclusion

In my analysis of the interview data, teachers were found to perceive self-efficacy as closely related to students’ abilities to self-assess and self-regulate their learning. They believed that in order for students to develop higher math self-efficacy, they also needed to possess these skills. With regard to the role of assessment in fostering learner self-efficacy, teachers emphasized the importance of knowing the students’ abilities. This would allow teachers to design assessments that are accessible to all their students, where every student would be able to
find an entry point. This was important for student self-efficacy as it magnified their competencies rather than weaknesses. Teachers also used feedback as means of fostering self-efficacy, which allowed them to provide students with guidance on how to progress in their learning while also modelling for them how to assess and regulate it. Ultimately, however, teachers recognized the need for students to be accountable for their own learning. Rather than directing their learning for them, they observed that self-efficacy could be nurtured when students are given the opportunity to take ownership over it. Lastly, I discussed the importance teachers placed on fostering a growth mindset in their students. Teachers sought to develop student self-efficacy through framing students’ perceptions of failure and assessment.

These findings may contribute to existing literature by offering insight into Ontario teachers’ experiences and opening discussion to potential ways in which student math self-efficacy may be fostered among Ontario schools. The connections drawn by these secondary math teachers between student math self-efficacy and mastery of learning skills suggest that the latter may an important factor in the development of self-efficacy in Ontario students. Furthermore, the faith demonstrated by the teachers in this study in the power of assessment to build student self-efficacy, and their diversified use of assessments reflect views and practices that are in line with Growing Success (Ontario Ministry of Education, 2010). In the next chapter, I will delve deeper into the implications of these findings, provide recommendations for future practices, and suggestions for future research.
Chapter Five: Conclusion

5.0 Chapter Introduction

I start this chapter with an overview of this study’s key findings and their significance. I then move on to discuss the implications of these findings in the broader educational community as well as in my own practice. Afterwards, I provide recommendations for policy makers and schools, and identify possible areas for future research. In the final section, I conclude this chapter and study with a brief discussion on my growth as a researcher and teacher.

5.1 Overview of Key Findings

This study sought to examine secondary math teachers’ perceptions of student self-efficacy and the ways in which they use assessment as means of fostering it in their students. My analysis of interviews with three experienced math teachers showed that teachers perceive student self-efficacy to be closely related to students’ abilities to self-regulate and self-assess their learning. That is, a student’s math self-efficacy is perceived to be rooted in their possession of these learning skills. While this relationship was not discussed in depth in Bandura’s (1995) theory of self-efficacy, this finding was supported in Ramdass and Zimmerman’s (2008) experiment which found self-correction training to positively shape student attitudes towards math learning.

With regards to teachers’ assessment practices, accessibility of assessments was found to be an important consideration for teachers. Teachers believed that each student should be able to find an entry point in an assessment if it is to effectively build their math self-efficacy. To achieve this, teachers pointed to formative assessments as a powerful way of gaging student understanding and ability. Like the teachers interviewed in Suurtamm’s (2010) study of teachers’ assessment strategies, the teachers in this study regularly conducted assessments for learning in
order to design assessments that were accessible to all students. Teachers also used formative assessments for assessments as learning. Formative assessments in the form of conversation or feedback were used by teachers as opportunities to model self-assessment and self-regulated learning, as well as provide students with direction for future learning. With respect to assessment strategies, teachers noted the importance of allowing space for students to direct their own learning. By designing assessments that gave room for students to monitor themselves, teachers gave students the opportunity to take ownership of their own learning and to develop self-efficacy by building independence.

Lastly, teachers believed that student perceptions of assessment contributed significantly to their perceptions of their math ability. In perceiving the purpose of assessment of be primarily of their learning, students may also view “failure” of such assessments to be a reflection of their math ability. In order to more effectively use assessments as a means of nurturing student math self-efficacy, teachers in my study drew attention to the need for students to understand the necessity of failure in the learning process. By presenting failure in a productive light, teachers were able to encourage students to take risks in their learning. In seeing assessments to be a part of the learning process rather than the end, it was believed that the students would also come to understand their own learning as a journey.

5.2 Implications

These findings have several implications for the educational community and my own practice. I begin my discussion with a look at the implications of this research on the broader educational community. Next, I articulate the implications of these findings on my own practice and beliefs as a teacher.
5.2.1 Broad: The educational community

In their descriptions of their assessment strategies, the emphasis placed on formative assessments by all three research participants imply that math teachers are moving away from the traditional use of assessments as of learning, to include that of as and for learning. This suggests that the Growing Success document (Ontario Ministry of Education, 2010) has been implemented to a certain level of success as teachers are relying on informal methods, such as conversations and observations, as means of understanding their students, and using descriptive feedback to support student learning. Teachers are also giving opportunities for students to demonstrate their learning in a variety of ways, using assessment methods that appear to be increasingly student-centered and aligned with the Ministry’s expectations as outlined in Growing Success (Ontario Ministry of Education, 2010). However, students’ perceptions of assessments were identified by the teachers to be a hindrance to student math self-efficacy. This suggests that while secondary math teachers are changing their assessment practices and goals, students continue to perceive assessments in math to be of their learning, rather than for it. In view of this discrepancy, it appears that, while teachers are coming to embrace Ministry policy regarding assessment, it has yet to be fully understood by the student population.

Furthermore, the teachers’ perceptions of student self-efficacy as rooted in mastery of learning skills also have several implications for the broader educational community. The secondary teachers’ lament over their students’ abilities to regulate and assess their learning suggest that students are not being sufficiently equipped with these skills in their earlier years. This in turn suggests that students may not receive enough instruction at the junior and intermediate levels with regard to these skills. Considering that the majority of students
identified themselves in the 2012 EQAO questionnaire (Hinton, 2014) as not being good at math, ineffective instruction in learning skills may be commonplace across Ontario classrooms.

A potential explanation for this may be a lack of awareness on the pressing importance of these skills, as well as a lack of instruction on how teachers may develop them in their students. While these skills are identified in Growing Success (Ontario Ministry of Education, 2010) to be important factors in student achievement, and explicitly recognized in the 21st Century Competencies document (Ontario Ministry of Education, 2016) to be “essential educational outcomes for ongoing success” (p. 16), the possible gap between policy and practice may be due to educational trends that push these issues off the radar. In light of declining math performance among Ontario youth (Brochu, Deussing, Houme, & Chuy, 2013), a preoccupation with mastery of math content might have resulted in an oversight of the importance of learning skills. Furthermore, in trying to address newer concerns such as equity and wellbeing, schools may be organizing a number of professional development sessions on these topics, while issues regarding learning skills take a backseat. As such, students’ experiences of low math self-efficacy may be in part due to schools not recognizing the importance of training teachers to foster learning skills in their students.

5.2.2 Narrow: My professional identity and practice

As a teacher-in-training, I enter my practice with deeper understandings of student math self-efficacy. In particular, I recognize that students’ attitudes toward math, their math learning, and their mastery of learning skills are intricately interconnected. Previously attributing declining Ontario math performance to ineffective teaching of content, I now perceive and approach the teaching of math in a more multi-faceted way. While I still value thorough and clear teaching of math content, I also believe in the importance of transferrable skills, which underlie students’
abilities to learn and succeed. Committed to a pedagogy that supports student learning, these findings will shape my teaching focus as well as my teaching practice.

A central focus of my teaching is to increase student ownership of their learning and mastery of learning skills. Following the footsteps of my research participants, I seek to achieve this by giving my students ample opportunities to self-assess and to monitor their own learning. This can take the form of peer discussions, formative assessments, and regularly reminding students of the overarching goal of the unit. Recognizing that this may be more effectively achieved in collaboration with other teachers, I will also communicate regularly with colleagues to identify student strengths and weaknesses in order to better understand areas of need. I believe that the development of student learning skills is a holistic experience which cannot be delegated to one classroom, and that it is important to work with other teachers to collectively design learning plans so that students are able to learn and practice these skills across different contexts.

5.3 Recommendations

One recommendation for fostering student mastery of learning skills is for schools to commit to a long term plan of focusing on one skill per semester. Rather than leaving the burden to individual teachers who recognize this need, the school can make a concerted effort to develop a single targeted skill in their student population. Schools can identify four to six important skills and repeat this cycle of skills every couple of years. With a united vision, teachers from different departments can build appropriate and relevant strategies that give students opportunities to practice these skills across subject matters. To improve collaboration and communication among staff regarding this matter, schools may also designate time in staff meetings and professional development days for this purpose. Lastly, publically announcing the targeted skills through platforms such as the school newsletter or school posters can also increase awareness of learning
goals among parents and students. Being informed gives parents the opportunity to support their children, while by being informed the students themselves can understand the expectations and in turn monitor their progress.

The Ontario Ministry of Education also has the power to identify pressing concerns and to unify schools in responding to these needs. While learning skills were identified to be important factors to student success, the links between mastery of learning skills and achievement were, however, only briefly mentioned in the Growing Success document (Ontario Ministry of Education, 2010, pp. 10-14). Considering the potential impact of learning skills on student success, the Ministry of Education may consider drawing greater attention to this issue in the second edition of the document, by providing clearer expectations and more detailed guidance. The document currently focuses primarily on diversified and authentic assessments of student learning, which appears to be successfully understood and applied by teachers in their practice. It is suggested that the document devote greater attention to the significance and process of assessing learning skills in its next edition.

5.4 Areas for Further Research

While this study was able to gain greater insight into teacher perceptions of student math self-efficacy, the study’s focus on teacher perceptions is also a limitation. A quantitative approach may be informative in assessing the accuracy of teachers’ perceptions and investigate how the development learning skills may affect student self-efficacy. Observations of math classrooms may also shed light on the realities of teaching and assessment practices as well as student attitudes towards math. Research scholars may provide a more complete understanding of student math self-efficacy by examining students’ math learning experiences, and the role of
self-regulation and self-assessment skills in this process. Interviews with students may enrich this research by giving voice to the students’ experiences.

Furthermore, the focus of this study on secondary math teachers lead to questions of whether or not junior and intermediate math teachers have similar experiences. It would be meaningful to conduct interviews with math teachers of younger grades, and to compare their understandings of assessment and self-efficacy. Scholars may look into whether these teachers also perceive a connection between self-efficacy and learning skills, as well as how learning skills are being integrated into their lessons and to what effect. As such, another potential area of research is to investigate teachers’ perceptions of learning skills in the Ontario classroom, and how it is being taught and assessed.

5.5 Concluding Comments

Though I began this research project with a curious and inquisitive mind, I now realize that I also carried with me a number of assumptions about the math learning process. While I previously attributed my high math self-efficacy to being surrounded by math lovers and high math expectations, I now recognize that it was also due to the people in my life who taught me to regulate and assess my own learning. As a child, I was taught to wrestle with math questions and to not ask for help right away, a practice which shaped my approach to learning and in turn my math self-efficacy. This project allowed me make connections I may not otherwise have made, understandings which now inform my practice.

I also take away from this project the wisdom of teachers who have seen and experienced much more that I have, allowing me to learn from their practices and to enrich my own. From the findings of this study, I have been warned against prioritizing content over process, and will now make a concerted effort to teach learning skills. In closing, I hope that the experiences of the
teachers in this study will provide guidance for teachers who are seeking to improve their practice, and that in turn more students will come enjoy the math learning journey and perceive math through a more positive lens.
References


http://www.edu.gov.on.ca/eng/literacynumeracy/inpire/research/studentselfassessment.pdf


https://www.edu.gov.on.ca/eng/policyfunding/growSuccess.pdf


Appendix A: Letter of Signed Consent

Date:

Dear ______________________________,

My name is Hannah Chi Zhang and I am a student in the Master of Teaching program at the Ontario Institute for Studies in Education at the University of Toronto (OISE/UT). A component of this degree program involves conducting a small-scale qualitative research study. My research will focus on how teacher use assessment as means to build student self-efficacy in the math classroom. I am interested in interviewing teachers who have a wealth of experience teaching students from a variety of grade levels, streams, and backgrounds. I think that your knowledge and experience will provide insights into this topic.

Your participation in this research will involve one approximately 60 minute interview, which will be transcribed and audio-recorded. I would be grateful if you would allow me to interview you at a place and time convenient for you, outside of school time. The contents of this interview will be used for my research project, which will include a final paper, as well as informal presentations to my classmates. I may also present my research findings via conference presentations and/or through publication. You will be assigned a pseudonym to maintain your anonymity and I will not use your name or any other content that might identify you in my written work, oral presentations, or publications. This information will remain confidential. Any information that identifies your school or students will also be excluded. The interview data will be stored on my password-protected computer and the only person who will have access to the research data will be my course instructor.

You are free to change your mind about your participation at any time, and to withdraw even after you have consented to participate. You may also choose to decline to answer any specific question during the interview. I will destroy the audio recording after the paper has been presented and/or published, which may take up to a maximum of five years after the data has been collected. There are no known risks to participation, and I will share a copy of the transcript with you shortly after the interview to ensure accuracy.

Please sign this consent form, if you agree to be interviewed. The second copy is for your records. I am very grateful for your participation.

Sincerely,

Hannah Chi Zhang

MT Program Contact:
Dr. Angela Macdonald-Vemic, Assistant Professor – Teaching Stream
Consent Form

I acknowledge that the topic of this interview has been explained to me and that any questions that I have asked have been answered to my satisfaction. I understand that I can withdraw from this research study at any time without penalty.

I have read the letter provided to me by Hannah Chi Zhang and agree to participate in an interview for the purposes described. I agree to have the interview audio-recorded.

Signature: ________________________________

Name:(printed) ________________________________

Date: ________________________________
Appendix B: Interview Protocol/Questions

Introductory Script: Hello, my name is Hannah Zhang, and am currently a student in the Master of Teaching Program at OISE. Thank you for agreeing to participate in this research study, and for making time to be interviewed today. At a part of the MT program, I am working on a research project that examines the role of assessment strategies in fostering self-efficacy in secondary school math students. Through my study, I hope to better understand how teachers use assessment as means to build student self-efficacy in the math classroom, and to find out how teachers like myself may improve the math learning experience. I am going to ask you about your own experiences in teaching math, your observation of students, and your assessment strategies. This will take approximately 60 minutes of your time. Thank you again for agreeing to be a part of this study. I want to remind you that you may refrain from answering any question, and you have the right to withdraw your participation form the study at any time. This interview will be audio-recorded. Please take a look at the consent form, and let me know if you have any questions.

Participant background:

1. How long have you been teaching, and where?
2. What education, training, or other qualifications do you have?
3. What courses are you teaching at the moment?
4. What courses have you taught in the past?

Their math classroom:

5. Can you walk me through a typical day in your classroom?
6. How do your students usually respond to math class?
   a. Emotions
   b. Words
   c. Actions

7. If I was observing your classroom, what would assessment look like?
8. What effects do you see assessment having on your students’ learning?
   d. Students’ attitudes
   e. Students’ performances
   f. Positive effects? Negative effects?

9. What do you believe assessment should accomplish?
Understandings and perceptions of self-efficacy:

10. How do you use assessment to foster student self-efficacy (or another term used by participant)?
11. [this question asks them to speak about *all* their students and is too broad → I think the next one does a better job of this same idea]
12. Can you tell me about a time when you observed a student express a lack of faith in their ability to succeed at math? What term would you use to describe this?
13. How would you define the term ‘self-efficacy’ as it relates to mathematics?
14. Why do you think some students have higher math self-efficacy (or the term the participant uses) than other students?
15. What if any differences do you perceive in the self-efficacy of students in locally developed, applied, academic, and enriched math classes?
   g. What effects, if any, do you see this to having on the students?
      i. Student effort
      ii. Assessment results
      iii. Grades
      iv. Homework completion

Growing Success (Ontario Ministry of Education, 2010):

17. Can you give me an example of what assessment for learning looks like in your classroom? Assessment of learning? Assessment as learning?
18. What effects do you perceive the strategies in Growing Success (Ontario Ministry of Education, 2010) to have had (or will have)?
   h. How about on student self-efficacy?

Conclusion

19. Do you have any advice for beginning teachers who are committed to fostering self-efficacy through means of assessment?

Closing script: Tape is off
Thank you again for your participation. Do you have any questions for me? My contact information is on your copy of the consent letter, please feel free to contact me if any questions arise.