The Role of Instructional Coaching for Professional Learning in Elementary Mathematics: A Multi-Case Study

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2019

Abstract

This study examines how instructional coaching shapes teacher learning in elementary/intermediate mathematics education. Coaching is an initiative that is currently being implemented in a large Ontario Board of Education to address the teaching and learning needs in mathematics education. This multi-case study, with a cross-case analysis examines the perceptions of five elementary and intermediate teachers and four instructional coaches who have participated in instructional coaching specific to mathematics.

The overall impression of instructional coaching from the participants’ perspectives was a positive one. Instructional coaching as a form of professional learning adhered to many of the components that are deemed to be important for effective professional learning environments of taking place over time, embedded in the teachers’ practice, self-directed, and relevant (Desimone, 2009). The teachers took an active role in their learning by choosing and determining the focus of the coaching sessions, and at the end of the study, commented about how they were incorporating aspects of the instructional coaching learning into their mathematics practice. The
instructional coaches also commented about the work having impact, emphasizing the importance of choice and working with teachers who had elected to participate in the instructional coaching initiative.

The major findings from the study are: (1) perceptions of the instructional coaching vary amongst the superintendents, administrators and teachers; (2) instructional coaching is an effective means of professional learning; (3) it is evident that the teachers perceived that their mathematics program was positively impacted by the work that took place with their instructional coach; (4) instructional coaching has a transient nature to it because there were many changes in personnel, which meant that some schools were working with various instructional coaches since the program was first introduced; and (5) instructional coaching has the ability to make school-wide change, through the work done with collaborative inquiry groups, as well as individual teachers.

Findings from the study may inform how instructional coaching is implemented in school districts. The hiring practices of how coaches are selected and assigned to various schools need to be considered.
Acknowledgements

I am passionate about teaching and learning, and I feel fortunate this is embedded in many aspects of my life. Being able to pursue postgraduate studies was a privilege and would not have been possible without the support of many people along the way.

Firstly, I would like to thank my supervisor, Doug McDougall. I appreciated how gracious you were about agreeing to work with me. Your ability to ask pointed questions helped me to focus my research. I learned so much from you, as well as the graduate student group that you organize and facilitate. I would also like to thank my committee members, Carol-Ann Burke and Clive Beck. I was inspired by your teaching, and was very grateful that you both agreed to direct me through this process. I would also like to thank Mary Reid and my external examiner, Olive Chapman whose thoughtful feedback helped to make my dissertation better. I admire all of you for the work that you do.

None of this would have been possible without my participants. Thank you for sharing your time, and opening up your classrooms and professional practice to me. I learned a great deal from all of you.

I would also like to thank my writing group: Elizabeth Rosales Cordova, Janice Van Dyke, and Eveline Houtman. Also to Lena Coutts and Rebecca Quintana who were part of the group at various points. Countless hours were spent working together. Thank you for your wisdom and friendship.

To my parents, John and Mary-Lou Middleton, thank you for always having faith in me. During this long process, I could always count on your support when juggling the demands of parenting, teaching and researching. To my children, Simon and Jeremy, I know that there were many times you needed me and I would be in the midst of writing and totally engrossed in what I
was doing. Thank you for your patience! Lastly, to my partner in life, Chris Jeens. You made all of this possible by your unwavering belief in me. Thank you for being my biggest fan. You help me to fulfill all of my dreams and I love you.
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CHAPTER ONE - INTRODUCTION

This multi-case study seeks to understand how instructional coaching shapes elementary and intermediate teachers’ professional learning in mathematics. Chapter One examines the current educational landscape of mathematics in Ontario, describing the research context. The research problem and overarching research questions are included, concluding with a description of the significance and relevance of this study.

1.1 The Research Context

We live in an era of globalization and technological change, where information abounds, and schools are focused on how to effectively prepare children for the knowledge economy (O’Sullivan, 1999; Sahlberg, 2007; Volante, 2013). Countries around the world are responding to the complexity of educating in the 21st century (Golding, 2017), and a “global education reform movement” is shaping educational policies in many countries (Harris, 2011; Sahlberg, 2010).

Inherent in the global education reform movement is an emphasis on the results of learning, favouring standardized assessments (Sahlberg, 2010; Volante, 2013). Standardized testing occurs at global and local levels. Schools “around the world are experiencing tougher and more consequential accountability structures purporting to improve teaching and learning” (Sahlberg, 2010, p. 46). At the international level, under the umbrella of The Organization for Economic Cooperation and Development (OECD), The Programme for International Student Assessment (PISA) administers standardized testing, thereby ranking and comparing countries’ results. The PISA tests are administered every three years, with approximately 65 countries participating. With the recent publication of PISA results, concerns about the mathematical performance of Canadian elementary and secondary students are articulated in the media, as
well as from Ministries of Education (Brochu, 2014; Brochu, Deussing, Houme & Chuy, 2012; Taylor, 2000). Canadian PISA scores in mathematics rank high when compared to other countries, but when compared from year to year, there has been a steady decline (Volante, 2013).

Canada also participates in the Trends in International and Mathematics and Science Study (TIMSS), which administers tests every four years to over 60 participating countries. The fact that Ontario student scores in mathematics have plateaued over the past decade is cause for concern. TIMSS results also indicate that Canada overall competes highly when compared internationally, but student results in Ontario have not improved since 2003 (Volante, 2013).

In Canada, provinces have jurisdiction over education, and most provinces administer standardized testing (Volante, 2013). In Ontario, the Education Quality and Accountability Office (EQAO) administers tests to students in grades three, six and nine in literacy and numeracy. The data is then published, classifying and comparing school boards.

Another implication of the global education reform movement is that educational policies are being influenced by economic rationales (Magrini, 2013). The fact that The World Bank and The Organization for Economic Cooperation and Development (OECD) research and publish recommendations about educational policies illustrates how economic interests are influencing education (Roberston, 2012). OECD (2012) claims that “raising average scores on the PISA by 25 points over the next 20 years would lead to an increase in the gross domestic product (GDP) of more than 3.74 trillion dollars by 2090” (p. 5).

International testing and the reporting of the scores create a narrative about a country’s education system (Campbell, 2017). When examining Canada, Campbell (2017) notes that “this global narrative is largely being created, communicated, and interpreted by international
agencies, such as the OECD, outside of Canada, yet with considerable influence currently for educational policies and practices being developed and adapted within Canada” (p. 5)

Education is increasingly designed around competencies enabling productive citizens to contribute to the economy. This has implications for mathematics and sciences as they are positioned as being essential competencies that countries need in order to compete in the present technological age. There is a focus on enhancing science, technology, engineering, and mathematics (STEM) education in order to be innovative and competitive for the 21st century (Atkinson, 2012). It is important to note that “mathematics has become a gatekeeper to many economic, educational, and political opportunities” (Anderson, 2007, p. 9).

Due to the pressures of standardized testing at both international and local levels, combined with the focus on mathematics and sciences as being essential for competing in a global economy, there is a heightened emphasis on mathematics teaching and learning. The publication of international and provincial tests has led to public concern about student achievement in mathematics (Brochu, 2014; Dion, 2014; Stack, 2006).

Newspapers have published articles emphasizing the need for teachers to have better mathematical content knowledge, citing statistics about how many teachers are enrolled in additional mathematics qualification courses to address these deficiencies (Reevely, National Post, 2015). These newspaper articles are only a fraction of others that exist, articulating the message that mathematics reform is needed, and that teachers must make professional changes as a response to this urgent matter (Dion, 2014; Simmt, 2015; Stack, 2006; Stokke, 2015).

What is being expressed in the media regarding the concern about Canadian students’ decline in standardized mathematics scores is echoed by Ministries of Education in Canada as “Ministers of Education agreed in July 2013 that numeracy was a key priority and that
provinces and territories would work together to identify and share best practices” (Brochu, Deussing, Houme & Chuy, 2012, p. 47). As a response to the declining student scores in this subject area, many Ontario school boards are intent on improving student learning (Dion, 2014). This has led to the formation of the Ontario Numeracy and Literacy Secretariat to address the needs of math and literacy for 21st century learning with the goal “to have 75% of Grade 6 students reaching the provincial standard in reading, writing and math” (Ontario Ministry of Education, 2018).

In the spring of 2016, the Ontario Ministry of Education announced a $60 million investment under the Renewed Math Strategy (Ontario Ministry of Education, 2016). This strategy mandates that schools schedule at least sixty minutes a day for mathematics instruction. The strategy also includes one professional development day to be allocated to mathematics instruction, and that each school have three lead teachers to act as mathematics specialists.

Resources are also being offered to parents to support mathematics learning at home (Ministry of Education, 2016). Subsidies specific to additional qualification courses for math only are also being offered to elementary teachers (Ministry of Education, 2016). What this strategy did not recognize is that many teachers already teach the required hour of mathematics. This announcement creates the illusion that teachers have not been dedicating enough time for mathematics instruction.

1.2 Math Reform Context: A Focus on the Classroom Teacher

With the regular reporting of problematic mathematics test scores, and the need for better STEM education, it is interesting to note how teachers are being positioned in this discourse. When OECD publishes the following, “the quality of an education system cannot exceed the quality of its teachers” (Campbell, 2017 p. 4, citing Barber & Mourscheid, 2007),
teachers become the focus for improving educational systems. In regards to mathematics education, lack of content knowledge and pedagogical content knowledge are often offered as explanations, leaving teachers targeted to compensate for this gap (Ball, 2003; Brochu, 2014; Jarvis, 2016). Many teachers are having to teach math in fundamentally different ways than from how they were taught (Suurtramm & Graves, 2007). This leads to tension around pedagogical practices. How teachers respond to these pressures is worthy of investigation.

The situation becomes more complex when adding the layer of discourse and debate that exists around mathematics teaching and learning. Currently, in the area of mathematics, there exists a dichotomy about how mathematics content and curriculum should be delivered to students (Schoenfeld, 2004; Stokke, 2015). At one end of the spectrum is the way in which mathematics has traditionally been taught. This ‘traditional’ method of mathematics learning includes rote memorization of basic math facts, carrying out procedures, and using algorithmic approaches to solve mathematical problems. Conversely, problem-based approaches to mathematics teaching and learning are also being espoused. Inherent in this approach is that math is learned in collaboration with other students, using rich and relevant mathematical problems, emphasizing understanding as opposed to getting the right answer (Boaler, 2008; Jarvis, 2016).

The tension that exists in current thinking about mathematics teaching and learning is articulated by Kent (2014):

Sustained purposeful problem posing requires teachers to make substantial changes to traditional views of mathematics curricula. They must shift their approach to teaching mathematics from a model of content coverage guided externally (i.e. textbooks and pacing guides) to local decision making based on the students’ thinking and potential connections to the big ideas. Most teachers find this task daunting and are unwilling to completely let go of a final product - such as the standard algorithm. (p. 214)
In the realm of mathematics teaching and learning, there exists an opinion that a reconceptualization about mathematics pedagogy needs to occur in order to prepare students for the 21st century (Golding, 2017; Jarvis, 2016; Stokke, 2015). Teachers will need to respond to mathematics reform by engaging in professional learning. Within this arena, there are multiple challenges: making professional learning meaningful, bridging the gap that exists between professional knowledge and practice, and understanding the change process. As argued by many scholars researching the field of professional learning, initiatives targeted to help grow teachers’ practice need to be relevant, sustained over time, embedded in the day to day challenges that teachers encounter, and need to work in collaboration with others (Hoban, 2002; Jarvis, 2016; Opfer & Pedder, 2011). The fact that instructional coaching incorporates these features is the reason why coaches are being used as the instrument for attempting to bring about this change. The framework for instructional coaching fits with a body of evidence supporting meaningful professional learning (Knight, 2011; Marzano & Simms, 2014).

The word “coach” conjures images of athletic coaches working with sports teams and individual athletes. While this is the most common association of coaching, the role of the coach has expanded and applies to business, and more recently within education to support the work of teachers and administrators (Knight, 2012; Marzano & Simms, 2014). Coaching, in its application to education, is a new discipline that requires research to understand its effectiveness (Grant, 2006; Marzano & Simms, 2014).

One way in which coaching is enacted is through peer coaching, whereby educators coach one another through observation, sharing ideas, resources and reflections (Joyce & Showers, 1995; Knight, 2011). Data coaching examines data from various sources (report cards, standardized tests), and creating action steps based upon the findings of the data (Knight, 2011).
Another form of coaching prevalent in education is cognitive coaching, aimed at educators’ thinking processes to improve practice (Costa & Garmston, 1994; Knight, 2011). Literacy coaching is targeted to enhance students’ reading, writing, and communication skills (Knight, 2011; Toll, 2005). More recently, instructional coaching (Knight, 2012) is now being applied to the practice of mathematics in education (Larsen, 2012).

Currently, in many boards of education in Ontario, instructional coaches are being utilized to support elementary teachers’ professional learning in mathematics. The role of an instructional coach is to co-plan, co-teach, debrief (West & Cameron, 2013) and provide resources specific to mathematics. In some schools, instructional coaches help teachers navigate a ministry mandated inquiry initiative whereby teachers work in small groups to address an area of student need in mathematics. Collectively, the teachers create action research projects to address the mathematical challenges that their classes are experiencing. The role of the instructional coach is to work with individual teachers and collaborative inquiry groups for teacher learning specific to elementary mathematics.

1.3 Problem Statement

My study is situated within overlapping realms: mathematics education, professional learning, and instructional coaching. The essence of the problem can be understood by contextualizing the current issues within the world of mathematics education. Due to decreasing international scores in mathematics, ministries of education across Canada are responding with initiatives and curriculum to address this gap. However, polarized views exist about how to educate students in mathematics: traditional methods versus problem-based learning.

The research problem is complex, meshing mathematical reform within the broader framework of professional learning, specifically instructional coaching for teacher learning in
mathematics. My study attempts to understand how instructional coaching, as a type of professional learning shapes the mathematical practice of elementary teachers as they respond to reform initiatives.

1.4 Purpose of the Study

This case study examines the experiences of five elementary teachers and four coaches who have worked together to co-plan, co-teach and debrief lessons in mathematics. The goal of the study is to better understand how this form of professional learning shapes mathematical learning for elementary and intermediate teachers by asking the following questions:

1. What are the perceptions of coaches engaged in mathematics instructional coaching?
2. What are the perceptions of teachers engaged in mathematics instructional coaching?
3. How has instructional coaching influenced or shaped teachers’ mathematical practice?

1.5 Significance of the Study

The overarching research purpose is to provide insights about professional learning in mathematics. By exploring the experiences and perceptions of teachers and coaches who have participated in instructional coaching, the successes and limitations of the coaching model will be illuminated, thereby adding another layer of understanding about professional learning specific to this mode (instructional coaching), targeted to a specific domain (mathematics). The findings from this study can inform design and implementation of instructional coaching targeted to mathematics learning and teaching. In the process of documenting and representing the experiences of both the coaches and the teachers, their perspectives will be layered upon established professional learning principles, providing a different lens through which to view, and thereby enrich, concepts about teacher learning in mathematics.
1.6 Background of the Researcher

As a secondary student of mathematics, I decided that I was not a “math person”. My passion was reading and writing. Literacy and numeracy were polarized constructs. I believed myself to be a good English student, but not of mathematics. In mathematics, “there is a commonly held belief that some students simply cannot learn mathematics. They lack a math gene; it’s a fact of nature” (Hull, Balka & Miles, 2009, p. 57). Therefore, I took math courses until grade 12 and then dropped mathematics in grade 13, when I realized that math was not for me.

My challenge in mathematics was applying procedures to solve problems in which I did not understand the reason why those procedures resulted in a solution. In high school, my teachers demonstrated the procedures needed to solve mathematical problems, but I lacked the conceptual understanding, therefore, when having to apply the rules to problems that I was unfamiliar with, I floundered. This was more proof that I was not a “math person”. I graduated high school and majored in English, happily abandoning mathematics, not realizing that it would later become a passion of mine.

When I decided to become an elementary teacher, I was confident that I would be able to teach mathematics effectively. I completed my B.Ed. degree in 1995. At that time, I felt prepared to teach mathematics due to the fact that I understood the curriculum, and had textbooks to rely upon. I began teaching mathematics in ways that were similar to how I had been taught.

When I encountered students who were struggling with rote memorization of math facts, and who could not remember the order of procedures for doing long division, I began to
question my pedagogical approach, as well as my own conceptual understanding of the content that I was teaching. This caused me to reconsider how and what I was teaching.

The discomfort and dissonance in my practice became further entrenched when I began a tutoring business. Many of the students with whom I was working were struggling in mathematics, and I was hired to help them. While the parents often wanted me to focus on rote memorization of basic math facts, it became evident that the students needed a deeper conceptual understanding of numeracy and problem solving. Thus began my passion for mathematics.

I began to read about mathematics. Mighton (2003) debunked the myth about individuals possessing a math gene. The premise of his book, *The Myth of Ability*, is that all students are capable of learning complex mathematical concepts because intelligence is not a fixed entity, but something that can grow and develop when nurtured (Mighton, 2003). I began to envision possibilities.

More recently, I was influenced by Carol Dweck (2006), who questions intelligence as a fixed entity. I was intrigued about the impact of having a growth mindset, which Dweck (2006) describes as “the belief that your basic qualities are things you can cultivate through your efforts. Although people may differ in every which way – in their initial talents and aptitudes, interests, or temperaments – everyone can change and grow through application and experience” (p. 7). I wanted my students to envision themselves as writers, mathematicians, scientists, artists, poets, and historians, people who were not borne into a role, but develop into possibility. By incorporating growth mindset into my pedagogy, students were encouraged to struggle, to make mistakes, to persevere and challenge themselves, within a supportive environment, where I modelled learning with them.
I actively engaged in professional learning around mathematics, taking additional qualification courses and immersing myself in professional reading. Boaler’s (2015) book, *What’s Math Got to Do With It?* inspired my passion for teaching for conceptual understanding through problem solving. This led to reading many publications written by Marian Small who also advocates teaching through problem solving. As I became more engrossed in my mathematics programming, I was offered the chance to work with an instructional coach who was hired by my school district to support teachers with their mathematics practice.

Coaching was not a new concept for me. Ten years ago, when I became the principal of a small independent school, a former parent approached me to ask if I would like to receive executive (managerial) coaching sessions. Throughout my first two years as a principal, I benefitted from weekly coaching sessions. Those sessions provided me with the time and space for critical self-reflection to occur. While coaching allows one to be introspective, there are also elements of actualization and accountability. Because coaching requires action steps to be determined, as a means for moving forward, transformation occurs because ideas are put forth into action. Coaching can be a powerful agent of change.

When I applied to the Ph.D. program, I was interested in researching how the role of coaching could be used to help support private school administrators. Since registering in the program at OISE, I have made several changes. Firstly, I have switched from working in the private sector to the public school realm. Secondly, I have shifted my focus from executive coaching (leading) to instructional coaching (teaching). The board in which I am now working has made instructional coaches available to teachers, and I wish to explore how other teachers have experienced instructional coaching in relation to their mathematics professional learning and practice.
I am compelled to understand this phenomenon as a form of professional learning and its relationship to classroom practice in mathematics. Because there is not a great deal of literature about instructional coaching in the field of mathematics (Campbell & Malkus, 2011; Larsen, 2012), combined with my own experiences, I examined multiple perspectives and experiences about instructional coaching.

1.7 Limitations of the Study

The participants in my study consisted of four instructional coaches and five teachers, all employed within the same school district. Due to the small sample size, it is difficult to generalize the findings. Generalizability was not the goal of this study. The objective was to examine and document the experiences of the participants in order to add rich insights and inform implementation of instructional coaching programs.

1.8 Format of the Thesis

This thesis consists of five separate chapters. Chapter One includes an introduction to the research, explaining the research context, purpose, and significance. The overarching research questions are listed followed by an explanation of my personal background and why I am compelled to understand the phenomenon of instructional coaching as a means of professional learning in elementary mathematics.

Chapter Two examines the scholarly literature related to my research topic. The conceptual framework underpinning the study is described followed by a synthesis of literature related to elementary mathematics, professional learning, and instructional coaching.

Chapter Three describes and justifies the methodologies that will be used in the study. The recruitment of participants is included, followed by an explanation of the data collected and how it was analyzed. Ethical considerations are also included.
Chapter Four describes the cases individually. The cases are presented using the lens of professional learning as a means to illustrate the experiences of the coaches and the teachers.

Chapter Five includes a cross-analysis of the cases, emphasizing the mathematics practices of the coaches and the teachers. The chapter is also structured around the findings of the research questions posed in Chapter One. Chapter Five concludes with suggestions to consider when implementing instructional coaching as a means to support teachers in teaching and learning about mathematics.
CHAPTER TWO - LITERATURE REVIEW

2.1 Introduction to the Literature

This study seeks to understand how instructional coaching shapes elementary and intermediate teachers’ professional learning in mathematics. In a large board of education in Ontario, the professional learning focus on mathematics is being addressed by utilizing instructional coaches to work with individual teachers by co-teaching and co-planning, as well as supporting small groups of teachers via collaborative inquiry groups. Chapter Two begins with a description of the theoretical framework underpinning the study. This is followed by a review of the scholarly literature relevant to the study: elementary mathematics education, professional learning, instructional coaching, and the challenges inherent in both professional learning initiatives and instructional coaching. The chapter concludes with a brief summary about teacher change.

2.2 Theoretical/Conceptual Frameworks

2.2.1 Theoretical Framework: Constructivism

The theoretical framework for which this study is situated is constructivism as it applies to student and adult learning. In the act of naming the theoretical framework, it allows for insights about the researcher’s stance and the assumptions that the researcher may hold (Bloomberg & Volpe, 2012).

The theory of constructivism asserts that individuals construct their own meaning and knowledge (Shwandt, 2007). Constructivism incorporates the notion that “education is not an affair of ‘telling’ and being told, but an active and constructive process” (Dewey, 1916, p. 46). One way to conceptualize constructivism is to distill it into four principles (Beck & Kosnik, 2006). The first principle recognizes and acknowledges students’ prior learning. Students have
a variety of experiences that will influence and shape their construction of knowledge. To “gain deep understanding, students must link new learning to the ideas they already have, otherwise, they will simply learn verbalizations” (Beck & Kosnik, 2006, p. 18). This principle incorporates Piaget’s (1954) notion of assimilation, merging old with new bodies of knowledge (Ward, 2001).

The second component of constructivism recognizes that learning is linked to values (Beck & Kosnik, 2006). Education is not merely transmitting facts or “the act of one person’s ‘depositing’ ideas in another” (Freire, 1970, p. 158). When learning new concepts, individuals will have “views or opinions about it” (Freire, 1970, p. 160). Acknowledging diverse points of view and the values of others in the process of learning allows for the construction of knowledge to be more meaningful to individuals.

The third principle of constructivism recognizes the social aspect of learning (Beck & Kosnik, 2006). This principle acknowledges the importance of dialogue for constructing meaning. Students who can talk about their ideas with one another have the opportunity to critically interact about concepts. As students navigate content by theorizing, debating, and researching together, they are constructing their understanding and interpretations.

The fourth principle of constructivism incorporates the idea that learning needs to connect in a holistic way to individuals’ “attitudes, emotions, aesthetic experience and behaviour” (Beck & Kosnik, 2006, p. 23). Learning is not just a cognitive activity, separating subject domain and teaching in isolation from students’ feelings. Education is more than just learning facts and figures, but may inspire and transform in the hopes of helping to shape “young citizens who will care for the places in which they live and for the earth itself” (Noddings, 2003, p. 125).
Constructivism relates to adult learning, as well as how young children learn and acquire knowledge. Kantar (2014) conducted a literature review about constructivism as it applies to adult learning theory. While this literature review is from a specific domain (nursing), the principles can be generalized (Kantar, 2014). Four assumptions are inherent in constructivism. Prior learning is the starting point for adult learners, followed by learning as a social act, which occurs in collaboration with others (Kantar, 2014). Self-regulation is another component, involving reflection, self-assessment and monitoring of the learning activity (Kantar, 2014). The last principle of constructivism inherent in adult learning theory incorporates the notion of motivation, and that it is an important component which may be intrinsically or extrinsically oriented (Kantar, 2014).

### 2.2.2 Conceptual Frameworks

While this study is grounded in the theoretical framework of constructivism, two different conceptual frameworks are being utilized in this study. A conceptual framework provides a lens in which to design and analyze the research (Bloomberg & Volpe, 2012). To conceptualize the notion of professional learning, Desimone’s (2009) characteristics of professional learning opportunities is the lens in which instructional coaching, as a form of professional learning, is being utilized. Specific to mathematics education, McDougall’s (2004) Ten Dimensions of Mathematics Education Continuum applies to analyze the practice of the coaches and the teachers, examining how instructional coaching influences or shapes mathematics teaching and learning.

Within both the realm of professional learning and mathematics education, many conceptual frameworks exist that could have been utilized for this study. However, Desimone’s (2009) conceptual framework was chosen because of the specific “features of professional
development [that] are needed for improved student learning to be the outcome” (Boylan, Coldwell, Maxwell, & Jordan, 2018, p. 125). Desimone and Pak (2017) use this conceptual framework as a lens to consider instructional coaching as a form of professional learning.

In the realm of mathematics education, the Ten Dimensions of Mathematics Education Continuum was specifically chosen because of the breadth of mathematical activities that it outlines. The dimensions range from planning and programming, to assessment, as well as attitudes and communication. It is a comprehensive tool to use to consider instructional coaching as it applies to mathematics. These conceptual frameworks are described in detail later in this chapter.

2.3 Professional Learning in Elementary Mathematics

As a response to declining student scores in provincial and international standardized testing, many Ontario school boards are focused on improving student learning in mathematics (Bruce, Esmonde, Ross, Dookie & Beatty, 2010). This has led to Ontario Ministry of Education mandates such as the Numeracy Secretariat, and the Renewed Math Strategy. As explained in the first chapter, these mandates are occurring within the greater conversation about best practices in mathematics education. Two fundamentally differing positions are evident within this discourse about mathematics education. This debate can be understood as teaching mathematics using traditional methods that focus on rules and procedures versus problem based learning that is more process oriented, focusing on the application of mathematical thinking when solving problems (Schoenfeld, 2004; Stipek, Givvin, Salmon & MacGyvers, 2001; Vashchyshyn & Chernoff, 2016).

The Ontario Ministry of Education has taken a stance regarding best practices, emphasizing problem solving over rote learning. This is articulated in the Renewed Math
Strategy (2016), “Learning math results in more than a mastery of basic skills. It equips students with a concise and powerful means of communication. Mathematical language, structures, operations, and processes provide students with a framework and tools for reasoning, justifying conclusions, and expressing ideas clearly” (para. 15).

Teachers in Ontario are encouraged to teach by using rich, mathematical problems focused on mathematics processes. As stated by the Ontario Ministry of Education (2005), “problem solving is central to learning mathematics. By learning to solve problems and by learning through problem solving, students are given numerous opportunities to connect mathematical ideas and to develop conceptual understanding” (p. 11). Throughout the “past 25 years, ideas have changed regarding the nature of the mathematics students should learn, and the pedagogical approaches that best support their learning, with an increasing emphasis on inquiry-based methods that support the habit of mind needed for mathematical reasoning and flexible problem solving” (Goldsmith, Doerr & Lewis, 2014, p. 6). This positions teachers to have to teach mathematics in fundamentally different ways from how they were taught (Ball, Thames & Phelps, 2008; Cohen & Ball, 1990; Humphreys & Parker, 2015; Suurtamm & Graves, 2007). How teachers deal with this tension is worthy of investigation as “not enough is yet known about how to change the deeply entrenched beliefs about mathematical learning and teaching that are based largely on our own experiences as students” (Artzt, Armour-Thomas & Curcio, 2008, p. 5).

The current focus on mathematics has led to questions about the preparedness of elementary teachers to effectively teach mathematics (Ball, 2003). A commonly held premise is that more mathematics coursework will translate into better mathematics instruction, but “increasing the quantity of teachers’ mathematics coursework will only improve the quality of
mathematics teaching if teachers learn mathematics in ways that make a difference for the skill
with which they are able to do their work” (Ball, 2003, par. 3). This is echoed by Goldhaber and
Brewer (2000) who examined the mathematical test scores of over 5000 grade 12 students
finding that “only 8% of the standard deviation on student math test scores could be attributed
to the teachers’ having a master’s degree in math, with result for bachelor’s degrees in math
being similar” (p. 138).

Ball, Thomas and Phelps (2008) examine the work that mathematics teachers
do. Building on Shulman’s (1986) theory of “pedagogical content knowledge”, focusing on
what to teach (content) and how to teach it (pedagogy), Ball et al. (2008) argue that, in
mathematics, three domains of knowledge are required: common content knowledge,
specialized content knowledge, and knowledge of content and students. Ball et al. (2008) argue
that teachers need to have a deep understanding of the curriculum concepts which extends
beyond procedures and algorithms. Teachers also need to know how to effectively respond to
common student misconceptions, and how to elicit student thinking, revealing mathematical
concepts that may arise from various strategies. Borko & Whitcomb (2008), add other
components to the three domains of knowledge as outlined by Ball et al. (2008), by adding in
that knowledge of mathematical horizons, or the spectrum of mathematics is important, as well
as a comprehensive knowledge of the curriculum.

Understanding students’ prior learning, and their developmental needs are paramount in
order to plan tasks and lessons that are in the zone of proximal development (Vygotsky, 1978)
and provide the right amount of challenge for students (NCTM, 2008). How to equip teachers
to respond to these challenges enters into the realm of professional learning specific to
mathematics education.
2.4 The Ten Dimensions of Mathematics Education Continuum

Within the overarching theoretical framework of constructivism is a more specific conceptual framework that will be used as the lens for which this study is analyzed. I am using The Ten Dimensions of Mathematics Education Continuum (McDougall, 2004) to analyze the activities that the instructional coaches and teachers participate in while working together in mathematics education. The Ten Dimensions are listed below with a brief summary of each:

![Diagram of the Ten Dimensions of Mathematics Education Continuum](image)

**Figure 1: The Ten Dimensions of Mathematics Education Continuum**

(McDougall, 2004).
2.4.1 Program Scope and Planning

The program scope and planning dimension incorporates an understanding of the curriculum objectives of the mathematics curriculum, while making connections, when applicable, between various learning objectives (McDougall, 2006). In order to effectively program for the entire year, as well as plan for individual lessons, educators should be utilizing a variety of resources to illuminate specific concepts. Program and planning needs to incorporate the mathematical processes that include the following: problem solving; reasoning and proving; reflecting; selecting tools and computational strategies; connecting; representing; and communicating (Ontario Ministry of Education, 2005).

2.4.2 Meeting Individual Needs

The second dimension attends to the reality of the diverse needs that are present in most public school classrooms, ranging from students who are learning English, to students who may have individualized education plans. An effective mathematics program incorporates differentiation as a response to the varied needs of students. Differentiation can take the form of creating parallel tasks, whereby a problem is posed, but the numbers presented in the problem vary so that students are still required to solve the problem, but at different levels of difficulty (Van de Walle & Folk, 2005). Differentiation can also include creating various groupings of students to target specific concepts, and providing specific manipulatives for purposeful practice. Open-ended tasks are another effective way to differentiate instruction.

Open-ended problems usually have multiple ways that solutions can be reached. An example of an open question is, “Write the first five numbers of a shrinking pattern. What makes it a pattern?” (Small, 2016, p. 85). This question is different from providing students with a string of numbers to fill in that fit a pattern rule, such as 3, 6, 9, 12, _____, 18, 21, or
having students extend a pattern in which the pattern rule has already been established. The open questions allows for multiple ways to create a pattern, as long as it can be justified. Using open questions allows for multiple entry points for students to solve the problem. “Open questions incorporate flexible language to allow for a variety of responses. For example, descriptions such as ‘very big’ or ‘just a few’ allow for student interpretation” (Small, 2016, p. 5) so that several approaches and solutions can be accessed.

Educators use a variety of lesson styles, ranging from direct instruction, to guided groups, to discovery types of lessons (McDougall, 2004). Educators may need to explicitly teach a concept, or may need to work with a small group to support the learning of the particular set of students. Discovery or exploratory types of lessons often incorporate students learning through problem solving, providing students with various manipulatives or thinking tools with the intent of getting students to develop understanding of a specific concept.

### 2.4.3 Learning Environment

The learning environment is a factor that educators need to consider as a part of their mathematics program. This includes how students are grouped, as well as incorporating student voice and choice in planning and programming (McDougall, 2004). Teachers need to promote risk-taking behaviour, whereby students feel empowered to attempt problem solving tasks, make conjectures, and agree and disagree with their peers when reasoning their mathematical thinking. This means that:

> the teachers’ role is to create a spirit of inquiry, trust and expectation. Within that environment, students are invited to do mathematics. Problems are posed: students wrestle with ideas as they move toward solutions. The focus is on student actively figuring things out, testing ideas and making conjectures, developing reasons and offering explanations. Students work in groups, in pairs or individually, but they are always sharing and discussing. (Van de Walle & Folk, 2005, p. 19)
When grouping students, it is important for teachers to be cognizant of using mixed ability groups, and using open-ended tasks within the mixed ability groups. Boaler (2015) makes an argument for using mixed groupings based on her research, but states that the student group norms are taught to ensure that students are respectful towards one another within the mixed groupings. As Boaler notes (2015):

One of the most important goals of schools is to provide stimulating environments for all children – environments in which children’s interest can be piqued and nurtured, with teachers who are ready to recognize, cultivate, and develop the potential that students show at different times and in different areas. This can only be done through a flexible system of grouping that does not prejudge a child’s achievement and that uses multi-leveled mathematics materials that individual students take to their own highest level. (p. 119)

2.4.4 Student Tasks

In this dimension, teachers use different student tasks to teach. They could use rich tasks, utilize engaging ways to have students practice skills, as well as help students learn the ability to represent or model mathematical thinking (McDougall, 2004). Rich tasks have “multiple solutions and/or permits multiple solution strategies, students have increased opportunities to explain and justify their reasoning. If a task involves a simple operation and single solution, there will be little or no opportunity to engage students” (Ontario Ministry of Education, 2007, p. 2). Having students practice procedures and skills needs to occur in engaging ways. The use of games can be one way for students to develop numerical fluency. The ability to represent mathematical thinking is also a part of designing student tasks because “ideas can be expressed with symbols, charts, graphs, and diagrams” (Van de Walle & Folk, 2005, p. 8), as well as by using manipulatives to explore mathematical concepts.

Modelling and representing mathematical concepts allows for students to be more active in the learning process (Butler Wolf, 2015). In fact, “modeling in the math classroom can
increase student engagement, increase students’ depth of understanding, and provide opportunities for investigation, contribution, and success for all learners” (Butler Wolf, 2015, p. 10). When given concrete items during mathematics classes, the learning becomes more applicable to everyday experiences (Butler Wolf, 2015).

2.4.5 Constructing Knowledge

The fifth dimension is about constructing student knowledge utilizing instructional approaches, as well as by questioning. One instructional strategy that incorporates a constructivist approach is the use of Number Talks.

Number Talks are used by teachers to promote numeracy as “students are asked to communicate their thinking when presenting and justifying solutions to problems they solve mentally. These exchanges lead to the development of more accurate, efficient, and flexible strategies” (Parish, 2011, p. 198). This practice incorporates a specific protocol. Students are given a series of questions to be solved mentally. The questions are formulated in a targeted way to build specific computational strategies.

It is essential in a Number Talk approach is that the students are responsible for explaining their thinking about how they arrived at a solution (Parrish, 2010, 2011). The questions are presented one at a time, and are listed in a way to emphasize specific strategies. Below is an example of a Number Talk series of questions for a grade two class with the intent of getting students to make tens to solve the addition questions.

9 + 1
9 + 1 + 4
9 + 5
9 + 8
(Parrish, 2010, p. 128)
When presenting the string of questions to the students, they are encouraged to find more than one way to solve the problem. This leads into a discussion of multiple ways that solutions can be reached, with students constructing and communicating their ways of finding solutions (Humphreys & Parker, 2015).

Questioning is another part of supporting constructivism in a mathematics program. As described by Krpan (2013), “Effective questioning is critical for encouraging deep, insightful mathematical discourse” (p. 26). Questions that are open and demand that students do more than just respond with solutions, but also explain their solutions provides an opportunity to further entrench conceptual understanding.

2.4.6 Communicating with Parents

The sixth dimension is focused around parent communication (McDougall, 2004). Educators are encouraged to share their mathematics program with parents beyond grades on a report card. There are multiple ways that educators can communicate student learning through Twitter, blogging, sharing Google documents, as well as informal notes in agendas or phone calls home. The benefits to communicating regularly with parents allows for “awareness [which] will enhance parents’ ability to discuss schoolwork with their child, to communicate with teachers, and to ask relevant questions about their child’s progress. Knowledge of the expectations in the various grades also helps parents to interpret their child’s report card and to work with teachers to improve their child’s learning (Ministry of Education, 2005, p. 5).

2.4.7 Manipulatives and Technology

The use of manipulatives and technology make up the eighth dimension (McDougall, 2004). Classrooms should have a variety of manipulatives that students can choose from to explore concepts, as well as to represent mathematical thinking. The manipulatives, or thinking
tools, should be easily accessible and entrenched into the mathematics program. By “engaging with manipulatives allows teachers and students alike the opportunities to behave and think mathematically as they jointly become aware of patterns, make conjectures, compare results and provide explanations” (Suurtamm & Graves, 2007, p. 81).

Technology should be used purposefully as a part of instruction, or as a means for students to build mathematical thinking. There are many websites and programs that students can access to practice specific skills that are curriculum based. Virtual manipulatives are also available, such as geoboards, fractions slips and place value blocks. “Technology contributes to teaching and learning in the mathematics classroom in numerous ways: by enabling easier communication, by providing opportunities to investigate and explore mathematical concepts, and by engaging learners with different representational systems which help them see mathematical ideas in different ways” (Suurtamm & Graves, 2007, p. 59).

2.4.8 Students’ Mathematical Communication

Students’ oral and written communication in mathematics education is critical as it gives students the ability to reflect and refine their ideas, as well as a means to make arguments and conjectures, while also exploring connections (Ontario Ministry of Education, 2005). Oral communication provides teachers with a means of assessing students’ understanding, as well as misconceptions (Chapin, O’Connor, & Canavan Anderson, 2013). Talking about concepts also improves memory of ideas constructed (Chapin et al., 2013). Discourse promotes the development of social skills, vocabulary, as well as reasoning skills (Chapin et al., 2013).

One means of developing oral communication in mathematics is using Number Talks. This type of instruction promotes oral communication because students are required to justify their solutions. Using Number Talks also provides an opportunity for teachers to reinforce
mathematical vocabulary. The Number Talk resource includes sentence stems, which can be used to assist students with their oral responses. The sentence stems provide a framework for students to have meaningful dialogue with their peers.


I agree with ____________ because ________________.

I do not understand ____________. Can you explain this again?

I disagree with ____________ because ____________.

How did you decide to ________________? (p. 21)

Another type of instructional strategy reinforcing effective oral communication is referred to as talk moves. Number Talks are based on a resource and follow a specific protocol, however talk moves include a few strategies with the intent of building conceptual understanding. These include providing students with time to think through a problem before a solution is revealed. Students are also encouraged to talk to each other about their thinking which provides the students an opportunity to explore ideas amongst one another rather than being told how to solve a problem using a specific, teacher-directed procedure.

Talk moves are based upon the following principles:

• Make thinking visible by asking probing questions so that students elaborate their thinking.
• Teach academic vocabulary.
• Use mathematical examples or problems that challenge students’ thinking.
• Shift the discourse from being teacher-centered to being more student-centered.
• Provide a risk-taking environment so that students are comfortable sharing their ideas and strategies. (Ritchhart, Church & Morrison, 2011)

Written communication of mathematics must be done in a meaningful way, getting students to elaborate on their solutions by justifying the answers. Math journals provide an
opportunity for students to reflect on mathematical concepts, and also an opportunity to make connections between mathematical concepts. Writing in mathematics requires “examples and support as they [students] develop effective writing skills in mathematics. We must be sure to provide them with time to practice and become comfortable communicating mathematically” (Krpan, 2013, p. 82).

2.4.9 Assessment

Assessment is generally thought of as diagnostic, formative and summative, but the Growing Success document (Ontario Ministry of Education, 2010) shifts thinking of assessment as actions for learning, as learning and of learning. Therefore, teachers should be continuously assessing students for prior knowledge, in which to plan and program effectively. Assessment practices should include self-assessment so that students participate in the process, and assessment of learning includes descriptive feedback and suggestions for further learning.

In order to fully understand students’ knowledge of concepts, teachers should utilize various pieces of student work (Kulm, 2013), or triangulation of evidence, including conversations, observations and student samples of work (Cameron & Gregory, 2014). Assessment should be continuous and provide various ways in which students can demonstrate their understanding of mathematical concepts using “a variety of assessment methods helps to ensure that all students have an opportunity to demonstrate their learning” (Suurtamm & Graves, 2007, p. 128). Learning goals and success criteria can be co-constructed, to increase student engagement, as well as making the objectives transparent to the students. Rather than giving marks for tests, feedback should be descriptive in nature, to support further learning.
2.4.10 Teacher’s Attitude and Comfort with Mathematics

The tenth dimension is focused around teachers’ attitudes and dispositions towards mathematics (McDougall, 2004). Despite what is known about neuroplasticity, which is the brain’s ability to change and grow (Ricci, 2013), individuals have beliefs that intellect is a fixed entity, rather than one that can grow. Dweck (2006) refers to these beliefs as fixed or growth oriented mindsets.

Teachers’ perceptions about intelligence have implications for students. Rattan, Good and Dweck (2012) examined how mathematics teachers, who believe in a fixed intelligence, perceived of the performance of their students. Teachers “holding a more entity [fixed] theory of math intelligence were significantly more likely to diagnose a student as having low ability based upon a single, initial poor performance…and were to engage in pedagogical practices that could reduce engagement with the subject, as compared with participants who held a more incremental [growth] theory” (Rattan et al., 2012, p. 735). Teachers’ attitudes about ability in mathematics can shape and influence how they teach and engage in assessment practices. Teachers’ attitudes about mathematics influence their students’ engagement (Roesken, 2011).

2.4.11 The Ten Dimensions and Professional Learning

The Ten Dimensions of Mathematics Education Continuum (McDougall, 2004) provides a comprehensive framework to examine the various components that teachers need to attend to in their mathematics practice. As teachers respond to educational reform, and professional development activities are utilized to address reform measures (Roesken, 2011), McDougal’s (2004) framework is also useful for analyzing how professional learning experiences address the various dimensions of mathematics education.
2.5 Professional Learning Conceptual Framework

Professional learning within the field of education can occur through many types of formal and informal processes (Kyndt, Gijbels, Grosemans, & Donche, 2016). Given the myriad types of professional learning opportunities that exist, Desimone (2009) makes a compelling argument to think about the core characteristics of professional learning opportunities. Desimone (2009) provides a conceptual framework for being able to study the effects of professional learning using these core characteristics. This conceptual framework is a useful lens for analyzing meaningful professional learning, and specifically instructional coaching. The core characteristics of professional learning that make up the conceptual framework are the following: content-focus, active learning, coherent, extending over a duration of time, and collective participation (Desimone, 2009).

2.5.1 The Content of Professional Learning Opportunities

The content of what is to be learned is a critical component to consider when designing professional learning opportunities. “To help teachers change their practice, we must help them to expand and elaborate their knowledge systems” (Borko, & Putnam, 1995). Teachers, who have a better understanding of the material that they are teaching, are more effective with instruction, practice and assessment (Desimone, 2009) and “focusing on content and/or how students learn that content is an important dimension of effective PD” (Desimone & Pak, 2017, p. 5). This finding is also supported by Katz and Dack (2013), who identify the benefits of articulating specific and clear learning goals.

When applying this component to mathematics professional learning, getting teachers to participate in working through problems helps to deepen their understanding of the content. By having teachers participate in problem solving activities, they envision teaching “less a matter
of knowledge transfer and more an activity in which knowledge is generated through making sense of or understanding the content, they begin to see their own role as teacher changing from a direct conveyor of knowledge to a guide helping students develop their own meaning from experiences” (Loucks-Horsley, Stiles, Mundry, Love & Hewson, 2010, p. 179).

2.5.2 Active Learning

Desimone (2009) argues that active learning is another core characteristic that makes up the conceptual framework of professional learning. Active learning builds upon constructivist theories of learning (Dewey, 1938), requiring the participants to be involved in the learning process by sharing ideas and opinions, and constructing their understanding of the content. Active learning is contrary to “‘sit-and-get’ learning…but rather, the learner engages in reading, explorations, investigations, problem solving, and discussions to make meaning of the content” (Loucks-Horsley et al., 2010, p. 182). The active approach to learning acknowledges the prior knowledge of the participants, recognizes that learning is more meaningful when discovered by the learners and provides opportunities for reflections of learning (Loucks-Horsley et al., 2010).

2.5.3 Coherence in Professional Learning

This part of the conceptual framework attends to the notion that the professional learning needs to be relevant, job-embedded and self-directed (Desimone, 2009). Professional learning evolving from Ministry and district initiatives needs to also take into consideration the reality of the classroom. Professional development programs that occur as isolated events can be disjointed and ineffective in application due to a lack of context or coherence (Fullan, 1982; Hoban, 2002). Choice of the participant should also be included as an important part of creating coherent professional learning opportunities (Beattie, 1995).
2.4.4 Duration of Professional Learning Opportunities

To ensure that professional learning leads to sustained change, time is a critical factor to consider (Campbell, 2017; Hargreaves & Shirley, 2009; Harris, 2011). Generally, the intent of one-shot workshops is to transmit knowledge in a short period of time. However, one-shot workshops have been proven to be ineffective for sustaining professional learning (Campbell, 2017). Desimone (2009) argues that professional learning should include a duration of time, such as a summer institute, or a term, and cites twenty hours as a minimum for professional learning opportunities to be optimized.

2.4.5 Collective Participation in Professional Learning

Another core characteristic that makes up the conceptual framework for professional learning is acknowledging that learning does not occur in isolation. Given the premise that a teacher is the primary influence for improving student achievement (Robinson, Horan & Nanavati, 2009), many professional development initiatives are targeted at teachers (Galluci, Van Lar, Yoon & Boatright, 2010; Elmore, 2004). However, focusing on the individual teacher negates the power of working collectively with other professionals, which has been documented to have a powerful impact on student learning (Campbell, 2017; Leana, 2011).

Social capital is a term used to express the value of people working together in collaborative and trusting relationships, resulting in positive outcomes. Leana (2011) conducted a study in New York City, involving 130 schools of approximately 1000 grade four and five teachers. This empirical study looked at test scores and factored in variables such as teacher knowledge in math, socioeconomic factors of the school community, and opportunities for teachers to work together in math. The study concluded that “students had higher gains in math achievement when their teachers reported frequent conversations with their peers that centered
on math, and when there was a feeling of trust or closeness among teachers” (Leanna, 2011, p. 33). People learn in social contexts and social capital recognizes the positive impact that collective efforts can result in for student and professional learning.

Communities of practice (Wenger, 1998) and professional learning communities (PLC) are models borne from the understanding of the social component of learning. Wenger (1998) defines communities of practice as having three distinct features: “mutual engagement, joint enterprise, and a shared repertoire” (p. 73). Mutual engagement implies a sense of membership, of those working towards a collective goal or a joint enterprise.

A shared repertoire is the result of “sharing meaning and resources that help to support and sustain the community” (Lotter, Yow & Peters, 2014, p. 2). Professional learning that incorporates collaboration amongst colleagues benefits the collective as “teachers are provided with the means and the time to reflect collectively on their teaching methods, and when they are able to share their teaching styles with each other, results improve and the act of teaching is transformed” (Diaz-Maggioli, 2004).

2.6 Mathematics Teacher Education

When considering ways to support elementary teachers with their mathematics practice, it is essential to apply the principle of constructivism, which asserts that one needs to build upon teachers prior learning (Kantar, 2014). Within the scholarly literature, as well as reported in the media, questions abound regarding elementary teachers’ content knowledge specific to mathematics. It is important to ask the following: what do elementary teachers already know about the content they are required to teach; and, what is that they need to know?

Pre-service elementary teacher education programs in mathematics are under scrutiny. Due to the fact that elementary teachers are generalists, they are required to teach all subject
matter, but are they adequately prepared to teach all subjects, specifically mathematics? The American National Mathematics Advisory Panel claims that preservice “elementary teacher education programs do not address the teaching and learning of mathematics in sufficient depth” (Ellington, Whitenack, Trinter, & Fennell, 2017, p. 129). This applies to the Canadian context as well, due to the fact that many provinces are reevaluating how elementary teachers are prepared to teach mathematics.

It is acknowledged that student teaching is the most important component of pre-service teacher education (Streiker, Adams, Cone, Hubbard & Lim, 2016). What becomes challenging is ensuring that student teachers get adequate supervision and feedback to maximize the student teaching experience. Recognizing that supervision of preservice teachers can be problematic, Strieker et al. (2016) conducted a year-long study involving fifteen university supervisors of pre-service teachers who had been engaged in 20 hours of professional learning specific to co-teaching and co-reflective processes. Elements of instructional coaching were part of the professional learning that the university supervisors received, specifically Knight’s (2007) framework of the principles of partnership to set the parameters for collegial co-teaching and debriefing sessions.

At the conclusion of this study, the authors found that adopting a coaching stance as a supervisor of pre-service teachers “played a significant role to enable our candidates to demonstrate self-directed and self-regulated learning” (Strieker et al., 2016, p. 1). When supporting pre-service teachers in their classroom practice, the coaching approach can empower teacher candidates to grow their professional practice.

Professional learning needs to connect with the teachers’ beliefs and attitudes of what it is they are required to learn, such as reform-based curriculum (Chapman, 2012). Teachers of
mathematics are having to teach in different ways from how they were taught (Ball, Thames & Phelps, 2008; Cohen & Ball, 1990; Suurtamm & Graves, 2007), which can lead to dissonance between beliefs and practice (Chapman, 2012). Attending to teachers’ attitudes and beliefs cannot be ignored when trying to implement changes to curriculum or instructional approaches.

For example, if the teachers hold beliefs compatible with the new curriculum, learning and implementing it are more likely to occur regardless of the approach to help them to accomplish this. However, if they hold conflicting beliefs or perceive barriers in implementing and enacting the curriculum, helping them to learn it will likely pose greater challenges for both them and the teacher educators and make application of it difficult. (Chapman, 2012, p. 264)

Understanding the importance that beliefs and attitudes have to influence teacher learning, it is important for coaches to be cognizant of teachers’ beliefs. How does a coach dig into teachers’ beliefs and attitudes? West and Cameron (2013) encourage coaches to look at various aspects of a teachers’ professional practice for evidence, revealing teachers’ belief and attitudes about student learning. This can be accomplished by examining the following: student tasks; the classroom environment as a physical space, as well as a place of community; student assessments; classroom discourse; and relationships with colleagues (West & Cameron, 2013). The coaches’ ability to better understand teachers’ beliefs and attitudes which are enacted in their practice will help them to navigate professional learning opportunities that the teacher can connect with. This attention to beliefs and attitudes “will help determine what the most productive, mutually aligned approach might be for coaching” (West & Cameron, 2013, p. 88).

2.7 Professional Learning Challenges

Much is known about how to create optimal professional learning initiatives that meet the criteria of what good professional learning should incorporate, however there still exists a gap between what it learned and practice. In fact, “Mathematics teachers across the Western world are faced with an expectation that they make significant change to their teaching, but
repeated attempts have shown little success” (Golding, 2017, p. 502). This is due in some part to what Piaget described as assimilation, “people change new information to fit with already existing beliefs, rather than changing the beliefs to the fit the information (Katz & Dack, 2013, p. 17).

A way to combat this inclination is to try and change the behaviours first, and then there may be a shift of beliefs. An Australian study collected data from over 3,250 teachers who had experienced approximately 80 professional development activities ranging from mentoring and coaching to workshops, conferences, seminars, webinars, and action research demonstrate the benefit of changing behaviors first before trying to change beliefs. After compiling the data, the researchers indicated that there were key elements that helped create influential professional learning is to have teachers try out new practices rather than trying to change their beliefs first. Teachers will be converted after they see the evidence of student learning (Ingvarson, Meiers & Beavis, 2005).

To create professional learning opportunities that incorporate a core characteristic of collective efforts (Desimone, 2009) can be challenging given the ways in which teachers work (Little, 1990). Teachers spend the majority of their time in classrooms and have little opportunity to teach with others, which has led to a culture of isolation and privatization. Teachers are accustomed to being the sole authority in their classroom (Hindin, Morocco, Mott, & Aguilar, 2007; Sisk-Hilton 2009; Bruce, Esmonde, Ross, Dookie & Beatty, 2010). Administrators, and by extension coaches, may be perceived by teachers as unwelcome in their classrooms as a dominant attitude amongst educators is that “pedagogy is the professional purview of the individual teacher and that intervention of a supervisor or principal is an intrusion on the teacher’s professional judgement and prerogatives” (Fink & Resnick, 2001, p.
3). Allowing others into the classroom can result in feelings of vulnerability and discomfort about the potential scrutiny that might result from the gaze of an “outsider”.

Another reason why resistance occurs is that teachers are considered knowledge workers (Davenport, 2005). Inherent in the work of teachers is thinking about their practice on many levels, such as curriculum content, assessment, reflecting on student learning, as well as planning for learning. Teachers are inherently resistant if their ideas are dismissed or considered to be under scrutiny. As a result, professional learning experiences need to value the ideas of educators and their existing knowledge (Knight, 2011).

Knight (2011) furthers this argument about the conditions required for professional learning as one that is humanizing. This means that teachers’ prior knowledge is valued, as well as giving teachers the power to have choice around professional learning opportunities.

Professional learning:

that dehumanizes its participants carries the seeds of its own failure. When a select few do the thinking for others, when teachers asking genuine questions are labeled resisters, when leaders act without a true understanding of teachers’ day-to-day classroom experiences, those dehumanizing practices severely damage teacher morale. (Knight, 2011, p. 8)

The organization delivering the professional learning takes place impacts whether the professional learning is optimized. Professional learning can also be negatively impacted by the school culture. As cited by Opfer and Pedder (2011):

Hollingsworth’s (1999) longitudinal study of primary mathematics teachers’ professional development demonstrated that teachers encountered difficulties in implementing new practices in their classrooms because of unsupportive conditions in their schools: a lack of coordination and leadership, little collegial activity, and no obvious commitment to professional development in mathematics. (p. 390)

2.8 Capacity Building within Schools
Research shows that one of the factors for enhancing student achievement is the teacher’s ability to provide effective instruction (King & Bouchard, 2011; Leithwood, Seashore Louis, Anderson, & Wahlstrom, 2004), therefore, it becomes a worthwhile endeavour to build capacity within school systems to support teachers with their content knowledge and pedagogy. School capacity can be thought of as the “collective power of an entire faculty to strengthen student performance throughout the school” (King & Bouchard, 2011; Newmann, King & Youngs, 2000).

King & Bouchard (2011) synthesized the work done by several researchers such as Darling-Hammond (2010), Fullen (2007), Loucks-Horsley, Stiles, Mundry, Love and Hewson (2010) and Wagner (2006) to highlight a framework for capacity building within educational institutions. The framework consists of five dimensions to build the capacity of educators to improve student learning. The five dimensions include: “teachers’ knowledge, skills and dispositions; professional community; program coherence; technical resources; and principal leadership” (King & Bouchard, 2011; Loucks-Horsley et al, 2010).

To build capacity within schools, professional development initiatives need to build upon teachers’ content knowledge and pedagogy. This means that the teachers use student work and the data generated from other sources to make informed, and reasoned conclusions about what is occurring in their sites of practice. “Teachers must be able to integrate knowledge of students, subject matter, and teaching context in planning units and lessons, carrying out instruction, assessing student work, and reflecting on practice” (King & Bouchard, 2011, p. 654). Reflection refers to both individual and collective reflections. Reflecting alone and with colleagues is a critical component of practice (Schön, 1987). Critical reflection is a core component in making teachers’ practice intentional and purposeful.
Teachers building upon their own professional knowledge should be a collective effort, thereby building a professional community of co-learners within a school environment. Collaboration is an important principle required for schools to build capacity. To create collaboration amongst group members, it is worthy to note the difference between congeniality and collegiality. As “congeniality is marked by relationships that are amiable and compatible but, more often than not are also conflict-and-risk-adverse” (Lieberman & Miller, 2008, p. 18). Collegiality, by contrast, recognizes and embraces the complexity of learning, and attempts to negotiate dissonance without simplifying (Ontario Ministry of Education, 2010). What may result is the establishment of “critical friends” (Day, 1999), thereby relationships that “are based upon practical partnerships entered into voluntarily, presuppose a relationship between equals and are rooted in a common task of shared concern” (p. 44).

The third dimension of King and Bouchard’s (2011) capacity building framework incorporates program coherence. This means that professional development activities are relevant, goal oriented and sustained over time (King & Bouchard, 2011). Program coherence includes the fourth dimension of providing technical resources to support professional learning (King & Bouchard, 2011). For programs to be realized, curriculum resources, books, computer software, as well as systematic supports need to be available.

The fifth dimension for building school capacity incorporates leadership. The role of the principal is critical for school success and improved student learning (Fullan, 2007; King & Bouchard, 2011). “Capacity building rests on school leadership, as principals collaborate with teacher leaders in common efforts and enable the leadership of others” (King & Bouchard, 2011, p. 656), often referred to as distributed leadership (Elmore, 2000; King & Bouchard, 2011; Spillane & Diamond, 2007).
As school districts initiate various professional development programs, attention to how they are designed to build capacity within schools is worthwhile to consider. Professional development initiatives are “more likely to reach goals and impact student learning schoolwide when they address multiple dimensions of school capacity, rather than focus only on developing individual teacher learning” (Loucks-Horsley et al., 2010, p. 118).

2.9 The Role of the Coach

Wise and Jacobo (2010) suggest that “the main purpose of coaching is to move from a ‘reactive’ environment to a ‘proactive’ one where the principal and staff spend more of their time reflecting and planning for future improvements” (p. 164). Some of the work that coaches do involve the following:

• creating school goals and teacher’s professional goals, using student data to determine areas of need,
• work with individual teachers or small groups of teachers to co-plan lessons or units of study,
• co-teach lessons with teachers,
• debrief and reflect with teachers afterwards to determine next steps,
• work with administrators to plan professional learning for professional activity days and staff meetings,
• foster relationships with the staff, keeping lines of communication open with teachers and nurture relations of trust and respect,
• document teacher learning, and
• communicate regularly with administrators so that they are aware of the work being done in their school. (West & Cameron, 2013)

2.10 How Instructional Coaching Fits within the Professional Learning Framework

In the context of this study, the focus of the coaching is on mathematics practice, working with elementary teachers. In theory, instructional coaching fits with the core components of the conceptual framework adopted from Desimone (2009) in that it is content-
focused, incorporates active learning, is coherent, extends over time, and involves collective participation (Desimone & Pak, 2017).

Instructional coaching is content driven because it involves teachers and coaches working together to understand mathematics reform at the macro level (Ministry and Board initiatives), and mathematical practice at the micro level (the classroom context). Coaching recognizes that teachers “need to focus their lessons on the big ideas, structures, and/or essential questions relevant to the domain under study. Teachers need to deeply understand those ideas and structures and learn to make them accessible to students” (West & Cameron, 2013, p. 11). The characteristics of coaching include being job-embedded so that the sessions are applicable to the role of the educator (Knight, 2009; Habegger & Hodansbosi, 2011).

A core characteristic of the professional learning conceptual framework is that educators need to be involved, and constructing their understanding of the material. Active learning is inherent in instructional coaching. Teachers who are being coached set the agenda and goals for their learning and coaching sessions (Robertson, 2008). Inherent in the coaching dynamic are “opportunities for teachers to observe, receive feedback, analyze student work, or make presentations, as opposed to passively listening to lectures” (Desimone & Pak, 2017, p. 4).

Instructional coaching attends to the needs of the educator within the classroom context, therefore it is a coherent form of professional learning, taking into consideration prior knowledge and the needs of teachers. As professional coaching involves adult learning, many of the principles about these programs are grounded in adult education theories. The underpinning of the coaching methodology lies in the principles of andragogy (Stober & Grant, 2006). The essence of andragogy is that learning is self-directed and goal-oriented. Within the
andragogical framework, adult learning needs to be relevant and practical and intrinsic motivators are more meaningful than extrinsic goals for learning (Stober & Grant, 2006).

Instructional coaching is set up to take place over time. For it to be effective, instructional coaching needs to be continuous so that action items resulting from coaching sessions can be followed up (Roberston, 2008). Habegger and Hodansbosi (2011) stated that coaching is “ongoing training that addresses the issues that they (teachers) face daily” (p. 36) in their school. As relational learning is inherent in the instructional coaching model, time takes on another meaning since time is essential for establishing a rapport, and trust. One of the findings from Campbell and Malkus’ (2011) study concluded that the coaches’ impact was much more significant after the first year. Time is an essential component to instructional coaching.

The coaching paradigm is collaborative by nature given that it is rooted in the theoretical framework of social constructivism (West & Cameron, 2013). Coaching is not done in isolation to one person, but in partnership with one another. Another commonality of coaching is that the coach is seen as a collaborator and does not have authority over the teacher, but partners with the educator (Knight, 2009; Robertson, 2008). In some schools, numeracy collaborative inquiry groups have been established as a collective effort amongst teachers to research or investigate an aspect of the teacher’s professional practice. Instructional coaches can support the learning of the collaborative inquiry group. This positions instructional coaches as being able to influence individual teachers, through co-teaching together, but also as a means to support change within the broader school context by working with groups of teachers. By engaging in supporting individual teachers, as well as groups of teachers, “coaching is alternately framed as a means for both systematic and individual reform” (Mangin & Dunsmore, 2014, p. 181).
2.11 Coaching Considerations

Various factors influence the effectiveness of instructional coaching initiatives. There are several key elements that are essential to the success of a coaching initiative (West & Cameron, 2013). There are also many factors that need to be considered which leads one to question how instructional coaching is being implemented so as to maximize the benefits.

One component required for instructional coaching to be successful is to have a supportive principal who takes into consideration timetabling and other structural supports to make the work of the instructional coach and the teacher(s) possible (Knight, 2007). Principals are intent on improving student learning in the schools where they work, however their role limits their ability to work directly with students given the myriad of tasks that are required of them (Duncan & Stock, 2010).

Principals’ influence is enacted by the culture that they foster or nurture in a school setting and they affect student learning in indirect ways:

people in formal leadership positions rarely have a great deal of interaction with students that is directed at learning. Instead, the effects of formal leaders are felt because...they create the conditions in which teachers are able to perform well in their classroom. (Leithwood & Jantzi, 2012, p. 15)

A school culture where risk-taking and professional learning are evident helps to foster this culture, and the school leader plays an important role for nurturing such an environment (Mangin & Dunsmore, 2014). A principal who takes the stance as an instructional leader reinforces the notion of the school as a learning site for all: students, teachers and administrators. Instructional coaches “impact will be magnified when she or he works in partnership with an effective instructional leader” (Knight, 2007, p. 32). How are principals prepared to partner with coaches?
Another important factor for establishing instructional coaching in a school is to clearly explain to the staff the role of the coach and the purpose for instructional coaching (West & Cameron, 2013). If the role of the coach is left ambiguous, staff may think of the coach as a resource consultant. However, coaching is working from a very different paradigm whereby the instructional coach responds to individual teachers’ needs and facilitates the learning rather than acting as the “expert” (Robertson, 2008). The partnership approach is critical to the success of a coaching relationship, however, how are teachers prepared to work with coaches?

Coaches may also be perceived as being linked to administration. As coaches should keep administrators apprised of what is happening in the school, teachers may be wary of having an evaluative gaze in the classroom. The role of the coach must be clearly defined so that teachers understand the partnership inherent in the coaching relationship, thereby resulting in less reluctance to work with an instructional coach (Knight, 2011). What do coaches do to ensure that the stakeholders understand the partnership approach to the coaching initiative?

Some obstacles exist in mathematics coaching that school districts should be aware of (Knight, 2009). As some “instructional coaches’ job-descriptions are often vague or nonexistent and because their schedules are more flexible than the schedules of others, they are often asked to do many clerical or non-instructional tasks” (p. 5). The instructional coaches’ time needs to be focused on coaching teachers and not on other things.

Lack of preparation is an issue that can create ineffective coaching. Coaches need to have knowledge of a multitude of resources, as well as an understanding of curriculum and effective pedagogical practices. Lack of professional learning to support the coaches can cause the coaching role to be less effective. “Due to the rapid scaling up of coaching models and a
dearth of training strategies, a lack of qualified coaches can” (Lowenhaupt, McKinney & Reeves, 2014, p. 742) be problematic.

In the school district where this study is situated, the instructional coaches are hired to work with grades ranging from kindergarten to grade twelve. The job postings for this position are advertised as Instructional Coach, K-12. Teachers from that school district can apply for this position. Teachers in Ontario are certified to teach in specific divisions, Primary/Junior, Intermediate, and Senior levels. Some educators may have additional qualifications that span across two of the divisions, such as Primary/Junior and Intermediate divisions, however most teachers in Ontario would not be certified to teach in all three divisions.

The fact that instructional coaches may be assigned to work in elementary and secondary schools can be problematic given how the content and pedagogical practices vary dramatically from one division to the next. Supporting a kindergarten teacher and a grade 12 mathematics teacher would require a different skill set from the instructional coach. Is it realistic to expect instructional coaches to be able to adapt to such a range of teaching contexts?

Another question worth considering is the openness of a teacher being coached from an educator who has experience teaching in a different division. How will a secondary mathematics teacher feel about being coached by an educator whose bulk of experience is in the primary/junior grades? As argued by West & Cameron (2013),“we need to become intentional and deliberate in the training, funding, and deployment of coaches across the system if we intend to get measureable, sustainable results“ (p. 23).

The notion of equity is another important factor to consider. Who gets coached and why? It is advised that coaches spend time working with teachers who have a learning or inquiry stance in their practice (West & Cameron, 2013) and are reflective teachers (Knight,
While instructional coaches may seek out teachers who are open to trying new approaches and who reflect deeply about their teaching, the coaching initiative is more effective when teachers choose to work with a coach (Knight, 2007). If a coach is working within a school where many teachers are eager to be coached, there is the risk of the coach being spread too thinly, but deciding who gets coached is something that principals and superintendents need to consider.

Lack of trust is also a major issue for creating a coaching relationship (Knight, 2009). Another obstacle around coaching is possible ambiguity about the status that one has when engaged in the interaction. If the teacher perceives that accepting coaching suggestions, or being a part of the coaching relationships jeopardizes his/her status, they may be reluctant to participate in coaching (Knight, 2009).

2.12 Teacher Change

One of the biggest challenges of designing professional learning initiatives is understanding how people respond to change (West & Cameron, 2013). The challenge is that many people may be too comfortable in their practice, unaware that change is even necessary. Coaches are “disheartened by the ever-present excuses that permeate a school culture defending the status quo. Their most pervasive lament is how the pressing demands on teachers’ time sabotage coaches’ ability to get time to talk, plan, and work with teachers” (West & Cameron, p. xvi). Instructional coaching requires change to occur at three different levels. The first being that teachers accept that they need to make changes to their instructional practice, combined with making changes to their schedule in order to make time for meeting with the coach, and then actually incorporating change to their instructional approaches (Jacobs, Boardman, Potvin & Wang, 2018).
Changing professional practice and beliefs can be challenging for several reasons. Lack of motivation is one factor that can inhibit teacher change (Hunzicker, 2004; Tam, 2015). Other reasons that may influence the change process are teachers’ perceptions of limited resources, time, or lack of professional knowledge (Beck, Czerniak, & Lumpe, 2000; Tam, 2015). Trying new practices and resources requires a risk-taking attitude. If individuals are averse to taking risks that differ from their professional practices, it could be an impediment to the change process (Tam, 2015).

Avoiding dissension with others can be another reason why educators stay fixed with practices (Tam, 2015). To counteract these inhibitors, school leaders need to create a culture of learning and of reflection intended to create an awareness of the need to change, grow and develop (Wong, 2010; Tam, 2015).
CHAPTER THREE - METHODOLOGY

3.1 Introduction

This chapter describes and justifies the research methodology that was selected to study how instructional coaching, as a form of professional learning, shapes mathematical teaching and learning for elementary and intermediate teachers. The study consists of three overarching research questions:

1. What are the perceptions of coaches engaged in mathematics instructional coaching?
2. What are the perceptions of teachers engaged in mathematics instructional coaching?
3. How has instructional coaching influenced or shaped teachers’ mathematical teaching and learning?

An explanation of why a qualitative research approach is appropriate for the inquiry is described. The case study methodology is outlined. The recruitment of the participants, data collection, data analysis and ethical considerations are described.

3.2 Qualitative Research

To determine whether to use a qualitative or quantitative approach to research, one needs to think about the purpose of the study, and the research questions being asked. Schwandt (2007) explains, “To call a research activity qualitative inquiry may broadly mean that it aims at understanding the meaning of human activity” (p. 248). It can also be understood as something that it is not: quantitative research (Schwandt, 2007). Quantitative research is generally utilized to prove or disprove theories using empirical evidence. Quantitative research attempts to understand a phenomenon by compartmentalizing the parts to see how the variables impact the whole (Merriam, 2012). Human experience, in all of its complexity, cannot be fully
represented by numerical data alone. “When we reduce people to statistical aggregates, we lose sight of the subjective nature of human behaviour.” (Bogden & Taylor, 1975, p. 4).

In contrast, qualitative research is used when trying to understand the complexity of a specific phenomenon in a holistic way, to see how all the parts work together (Merriam, 2012). This is furthered by Bogden and Taylor (1975), “The subject of the study, be it an organization or an individual, is not reduced to an isolated variable or to a hypothesis, but is viewed instead as a part of a whole” (p. 5), thereby a qualitative approach allows for a more holistic examination of what is occurring.

The purpose of this study is to understand mathematics professional learning in the context of instructional coaching, therefore, a qualitative research methodology is the best approach to use to understand the complexity of the phenomenon being examined.

3.3 Case Study

Case study, as a qualitative research method, can be conceptualized as “particularistic, descriptive, and heuristic” (Merrriam, 1998, p. 29). Particularistic means that the study focuses on a specific event, situation, program or process (Merriam, 1998); or what can be thought of as a “bounded system” (Creswell, 2007; Stake, 1995). A bounded system means that what is being investigated has “boundaries, often bounded by time and place” (Creswell, 2007, p. 244).

Instructional coaching is an example of a bounded system because the inquiry is specific to a place (school), time (the school year), and a program (instructional coaching). One then needs to think through the “unit of analysis” (Yin, 1984). Specific to this study, the unit of analysis is the instructional coach, consisting of the teacher(s) working with that coach. Within the unit of analysis, the instructional coaches and the teachers will provide their varying
perspectives and interpretations of how this method of professional learning shapes their understanding and practice in mathematics.

Case study as being descriptive means that “the end product of a case study is a rich, ‘thick’ description of the phenomenon under study... case studies include as many variables as possible and portray their interaction” (Merriam, 1998, p. 29). This study is designed to understand the learning that occurs when working with collaborative inquiry groups facilitated by an instructional coach. The data to be collected includes interviews, artifacts, documents, and field notes. By using a variety of data sources and asking open-ended questions during the interview process, a detailed and rich description of the phenomenon of professional learning in the area of mathematics will ensue.

Case study as heuristic means that it can “illuminate the reader’s understanding of the phenomenon under study” (Merriam, 1998, p. 31). My study is examining instructional coaching for the purpose of understanding it as a form of professional learning and how that shapes mathematics practices. While there is much written about professional learning in education, this study is examining a new approach (coaching) that has just recently been applied to professional learning in mathematics (Larsen, 2012). Hence, using case study to understand this phenomenon will add a new layer of understanding onto professional learning in elementary mathematics.

3.4 Multi-Case Study

This research incorporates multiple cases. The rationale for wanting to research more than one case arose from understanding that the implementation of instructional coaching varied within the school district. “Often the inquirer purposefully selects multiple cases to show
different perspectives on the issue” (Crewell, 2007, p. 74), therefore four cases are explored to provide a richer understanding of the phenomenon as enacted within the school district.

### 3.5 Participants

When selecting participants for the study, one needs to utilize “purposeful sampling” (Creswell, 2007). As a result, this study consists of four instructional coaches and five teachers who worked with the respective coaches. As participants were being recruited, it became evident that the instructional coaching role varied within regions of the school district. Therefore, I was purposeful in selecting instructional coaches who had different amounts of experience, and who worked with different superintendents. I also wanted to gather teachers who had a range of teaching experience. The instructional coaches and teachers were interviewed allowing for multiple perspectives regarding the coaching experience and how that shaped learning in mathematics.

The study is situated in the board of education where I am employed so professional contacts were used to locate instructional coaches who were willing to participate in the study. The instructional coach provided me with potential teachers who demonstrated interest in participating. I contacted the teachers and presented them with a letter explaining the purpose of the study and the benefits of participating in the study (see appendix A Information Letter and Consent Forms).

### 3.6 Data Collection

Data collection took place over a nine month period, beginning in March, 2017 and concluding in December, 2017. The data collected consisted of the following; (1) audio-taped interviews; (2) field notes which included classroom observations as well as meetings between
the coaches and the teachers; (3) artifacts such as lesson plans, resources, and assessment materials. Student work was not collected.

Each participant was interviewed two to three times during the nine-month data collection period. The interviews were intentionally scheduled to take place during the end of one academic year, and the beginning of the following year to investigate whether instructional coaching changed from one academic year to the next, and also to document how teachers’ planning and programming may or may not have been influenced by the instructional coaching experiences from the previous year. Three of the four cases continued from one academic year to the next, however, there was one exception because the instructional coach did not return to the role for the subsequent year.

The instructional coaches and the teachers were interviewed using semi-structured questions designed to elicit rich responses (see Appendices B and C Semi-Structured Interview Questions). The questions were designed to be of “an open-ended nature, in which an investigator can ask key respondents for the facts of the matter as well as for the respondents’ opinions about events” (Yin, 1984, p. 83). This meant that the interviews had specific types of information that participants were being asked, but the sequence of questions, or the wording might change based on the participant’s responses. The benefit of using semi-structured interviews allows “for comparable data across subjects” (Bodgan & Biklan, 2007, p. 104), but also allows for flexibility, providing opportunity for the “researcher to respond to the situation at hand, to the emerging worldview of the respondent, and to new ideas on the topic” (Merriam, 2009, p. 90).

As mentioned previously, two conceptual frameworks guide this study: Desimone’s (2009) components of effective professional learning and The Ten Dimensions of Mathematics
Education Continuum (McDougall, 2004). These conceptual framework are beneficial for thinking about instructional coaching from the perspective of professional learning, as well as the perspective of mathematics teaching and learning, and “acts as a guide for data collection, and analysis and interpretation of the findings” (Bloomberg & Volpe, 2012, p. 89).

While these conceptual frameworks shape the research, the components of each were not explicitly asked during the interviews. This was done intentionally so as to not lead the participants, but rather the questions were more open, to see how the participants experienced the dynamic of instructional coaching. As Bogdan and Biklen (2007) caution, “When the interviewer controls the content too rigidly, when the subject cannot tell his or her story personally in his or her own words, the interviewer falls out of the qualitative range” (p. 104).

Data collection also included field notes of classroom observations. The classroom observations occurred during mathematics lessons that had been designed or co-taught with the instructional coach, and field notes were taken.

When creating field notes during the classroom observations, I followed a protocol as described by Merriam (2009), in order to be thorough in my description of the events (see Appendix D Classroom Observation Protocol). Notes were made about the following features: physical setting, participants, activities, conversations, subtle factors, and my presence in the classroom environment (Merriam, 2009). I made notes about how the classroom was set up in regards to groupings of desks, anchor charts, and displays. Notes were taken regarding the participants, which included the number of students, the educators in the classroom, how the students were grouped, as well as the interactions that occurred amongst the participants.

During the lesson, I recorded the duration of time spent on various activities, the interactions that occurred, as well as who participated. I sat amongst various groupings of
students, listening to conversations that they had between themselves, as well as with their teacher(s) or instructional coach. I also paid attention to nonverbal communication, making note of gestures and body language. Understanding that the presence of the researcher can influence the setting, I tried to be unobtrusive, but also engaged when asked to. I conducted myself as an “observer as participant” (Merriam, 2009, p. 124), which meant that I was introduced to the class, and that I was available to clarify questions, but my main role was to observe and blend in.

Field notes were also made during planning and debriefing sessions that I observed between the instructional coaches and the teacher(s). I recorded the content of what was being discussed, and made notes about resources that were being used or referred to. I also noted the dynamics of the interactions, by noticing participation patterns and the nature of the interactions between the instructional coach and the teachers.

When possible, I also collected documents related to professional learning and mathematics, as well as documents pertaining to instructional coaching. In some cases, lesson plans were shared with the researcher, as well as resources that were being used during the coaching sessions. Student work samples were observed, but not collected.

3.7 Data Analysis

It is important to analyze the “first interview, the first observation, the first document read. Emerging insights, hunches, and tentative hypotheses direct the next phase of data collection, which in turn leads to the refinement or reformulation of questions” (Merriam, 1998, p. 151). As the data was collected, I analyzed it, looking for codes or themes as they pertained to professional learning and mathematics practices. This informed subsequent data collection so that I could probe more deeply into the experiences and perspectives of the participants. The act
of coding is making sense of the data being collected by “assigning some sort of designation to various aspects” of the data (Merriam, 2012, p. 164). Qualitative analysis software, NVivo was used to help with the coding process to illustrate an illuminate relationships and trends between the codes.

The interview transcripts, field notes resulting from classroom observations and notes related to the artifacts gathered were uploaded into NVivo. The data was then organized into codes based on the two conceptual frameworks: The Ten Dimensions of Mathematics Education Continuum (McDougall, 2004) and Desimone’s (2009) core components of professional learning. Nodes were also created inductively if there was a common theme that emerged amongst the participants that was not part of either conceptual framework. An example of that was the role of the coach and how that was perceived amongst the participants, as well as challenges of the coaching practice. Approximately 65 codes were created in NVivo. Each piece of data was then coded using the nodes, and quotations and memos were added during the coding process.

The interviews and the field notes of the classroom observations collected from March to November, 2017 were analyzed multiple times. The first round of analysis was done manually, looking for themes within each participant’s transcripts and the field notes. This first exploratory process allowed me to get familiar with the data and to gain insight about emerging themes (Miles, Huberman & Saldana, 2014). Once the transcripts were initially coded, I then used those themes and refined them. Many of the themes were reflected in the Ten Dimensions of Mathematics Education Continuum (McDougall, 2004), which then became the analytical framework to consider how instructional coaching shaped the participants’ practices in mathematics education. The conceptual framework consists of the following components:
program scope and planning; meeting individual needs; learning environment; student tasks; constructing knowledge; communicating with parents; manipulatives and technology; students’ mathematical communication; assessment; teachers’ attitude and comfort with mathematics (McDougall, 2004).

Given the broad scope of each of the elements of the ten dimensions, there are subcategories within each of the components, which are connected (McDougall, 2004). The data collected was organized using the subcategories as themes to capture the context and experience of the teachers and the instructional coaches.

Figure 2: Analytic Lens - Dimensions of the Mathematics Education Continuum

(McDougall, 2004)
After the interviews and classroom observations were coded, I began to examine relationships between specific themes. I identified which dimensions were heavily weighted with data. The dimensions are listed in order from the most to the least amount of data each contain by frequency of occurrence: constructing knowledge; student tasks; assessment; students’ mathematical communication; program scope and planning; meeting individual needs; manipulatives and technology; the learning environment; and teachers’ attitudes and comfort with mathematics. Teachers’ attitudes and their comfort with mathematics was mentioned infrequently by the participants, it is not included in the cross case analysis. Parent communication did not get mentioned at all by any of the participants. Please note the diagram of the analytic lens used to understand how instructional coaching shapes professional learning in mathematics.

It is important to note that there is overlap amongst the dimensions. Frequently there occurred bits of data that were coded several times. For instance, there were some examples of a teacher using a new instructional approach, which had been introduced by the coach, such as a Number Talks, but this data could also have been included in the theme of students’ mathematical communication, or student tasks, depending on the scenario.

3.8 Validity

The purpose of conducting research is to understand and represent the reality of the phenomenon under examination. However, this is challenging given that an “assumption underlying qualitative research is that reality is holistic, multidimensional, and ever-changing; it is not a single, fixed, objective phenomenon waiting to be discovered, observed, and measured” (Merriam, 1998, p. 202). Therefore, to capture the reality as accurately as possible, gathering
various data sources such as field notes, observations, Ministry and school district documents, combined with the interview transcripts allows the researcher to triangulate the data.

The role of the researcher is another factor that impacts the validity or reliability of a study. It is important for the researcher to be aware of assumptions that he/she may hold and how they can impact how the study is conducted and how the data is analyzed (Bloomberg & Volpe, 2012). One assumption that I hold, from a constructivist perspective, is the notion that the participants in the study will perceive of events in varying ways, based on their prior experiences, their identity, and how they mediate institutional mores. This challenges the researcher to ask open ended questions, to carefully listen to the participants’ perspectives, and to represent the experiences of the participants in order to illuminate the complexity of the research problem under examination (Bloomberg & Volpe, 2012; Crewswell, 2007).

Understanding underlying assumptions as a researcher has implications for how the research is analyzed. Researchers “recognize that their own background shapes their interpretation, and they ‘position themselves’ in the research to acknowledge how their interpretation flows from their own personal, cultural, and historical experiences” (Creswell, 2007, p. 21). Therefore, the researcher needs to be aware of subjectivity when analyzing and interpreting the research data. It also means bringing a consciousness regarding the values the researcher holds regarding the topic that is being studied (Bloomberg & Volpe, 2012).

This ability to look at the data from various sources and perspectives leads to a more comprehensive and valid interpretation of the data. “Member checking” (Creswell, 2007) is when the participants are provided with data, codes, and/or interpretations to gather their perspectives regarding the researcher’s analysis. The participants of the study were given transcripts to check for accuracy. Once the cases were coded, and significant themes appeared,
the cases were written up using the themes as a framework. The participants were provided with a draft of their case to check for accuracy of events and interpretations of those events and they were asked to send a note back either confirming accuracy or making corrections if necessary.

3.9 Ethical Considerations

The study was approved by both the University of Toronto and the school district’s Office of Research Ethics Board. The risks posed to the participants of this study were minimal because the participants agreed to participate in the study. Participants were informed of the option to quit at any time. Careful consideration was given to protect the identity of the participants, as well as the sites where the cases were situated, therefore pseudonyms were assigned to each participant. The location of the schools were also kept in confidence and identifiers of the location or of the participants was monitored so that the identity of the participants was kept confidential. The data and transcripts were kept in a locked cabinet.
CHAPTER FOUR – CASE STUDIES

4.1 Introduction

This chapter examines four case studies of instructional coaches and the teachers with whom they worked during the 2016-2018 academic years. Each case includes background information about the instructional coach, preparation for becoming a coach, the responsibilities inherent in the role, and teacher participation. The cases also include a description of the teachers’ professional experience, and their perceptions about how instructional coaching, as a form of professional learning, supports mathematics teaching and learning.

The teachers’ perceptions about the process of professional learning that occurred are organized using Desimone’s (2009) framework of the core characteristics of professional learning, which include content, active learning, coherence, duration and collective learning. Content is critical to consider when designing professional learning activities. Desimone (2009) also stresses that the learning be an active process, and that it is coherent and relevant for the recipients of professional learning. Another component of the framework emphasizes duration as being an important consideration, as well as the collective aspect of learning with others.

This chapter focuses on the perceptions of instructional coaching as a form of professional learning, and includes a description of the instructional coaching activities that occurred specific to mathematics education using the framework of the Ten Dimensions of Mathematics Education Continuum (McDougall, 2004). The chapter concludes with a summary of the instructional coaching experiences.

4.1.1 Instructional Coaching

Instructional coaching was introduced in 2013 in a large district school board in Ontario. Teachers working in this district school board could apply to become an instructional coach,
and, if hired, they were assigned to an area of the school district, commonly known as a “family of schools”. The instructional coaches report to the superintendent, taking direction from the principals of the schools where they are assigned.

Prior to the inception of instructional coaching, this district school board used resource teachers as a means to support educators in specific curriculum areas. Resource teachers were considered to have expertise, providing resources and advice about their specialized subject areas. In 2013, many of the resource teachers were phased out and replaced by instructional coaches.

This study examines four cases, which are comprised of the instructional coach and the teachers with whom they worked. Tracy coached Kathy; Linda coached Kirstin and Michelle; Mary coached Anne; and Mark coached Carrie. The teachers participating in this study are from different schools, and the instructional coaches represent different school families, and have had experience working with various superintendents.

**Figure 3: Role of the Participants**
4.2 The Case of Tracy

At the time of this study, Tracy had twenty years of experience working as a teacher in a variety of elementary, junior, and intermediate grades, including special education support roles. Tracy also had one year of working as an early literacy resource teacher before the inception of instructional coaching. Tracy was hired when the instructional coaching role was initiated by the board in 2013. Tracy was in her third year as an instructional coach when this study was first conducted. During the time that Tracy spent as an instructional coach, she worked in one family of schools, and reported to one superintendent for the first three years, and in her fourth year, a different superintendent was assigned to her family of schools.

Data collection for Tracy included two academic years, beginning in the spring of the 2016/2017 academic year and the fall of the 2017/2018 academic year. Data collection spanning from one academic year to the other was intentional, to determine continuity from one year to the next.

4.2.1 Preparation for the Role

The professional development that was provided to Tracy to prepare her for the role as an instructional coach included a focus on the process of instructional coaching, as well as workshops specific to mathematics. Three days of professional development occurred specific to West’s (2013) framework of instructional coaching as “co-planning, co-teaching and co-debriefing” (Tracy, Interview, March 29, 2017). Tracy also had a full week of workshops focused on mathematics at the primary, junior and secondary levels.

The exposure of instructional coaches to review mathematical content for all of the grade-level panels was because some superintendents in the board assigned instructional coaches to support both elementary and secondary schools. This was not consistent across the
school district as other superintendents assigned instructional coaches with experiences
teaching either elementary or secondary schools to only those schools that matched the
instructional coach’s teaching certification. Tracy noted that some instructional coaches who
had elementary experience expressed angst about supporting math at the secondary level.

Another form of training that Tracy experienced was with Small’s (2009) PRIME
resource, focusing on building knowledge about how children develop conceptual
understanding of number sense along trajectories of learning. The resource also includes
specific strategies to move students along the continuum. Tracy’s training with the PRIME
resource gave her the ability to become a facilitator to run professional development specific to
PRIME. However, this resource was restricted, meaning teachers were not allowed to keep the
PRIME kits unless they had received additional PRIME workshops that were being offered by
the school district.

Ongoing professional development was also provided on a continuous basis to support
instructional coaches. In Tracy’s family of schools, one day a week was left open so that
instructional coaches could meet or participate in professional development activities. Tracy
commented about the amount of learning opportunities that she was being offered,
acknowledging that teachers are only supposed to be in the instructional coaching role for three
years, with the opportunity to extend for another three-year term. The idea is that instructional
coaches go back into the classroom and build capacity within the schools where they are
teaching.

The advantage is that there is so much professional development for you as a teacher. I
mean the ideal is that there is always a certain amount of time and then you go back to
the classroom and that is the board’s hope. You do get time, and you do get resources
given to you, and you do get special training that helps you support all of the ideals that
the board is trying to build. For your own professional development, it is awesome.
(Tracy, Interview, April, 29, 2017)
4.2.2 Responsibilities

During the 2016/2017 academic year, the instructional coaches within Tracy’s family of schools worked with the superintendent to construct a framework that would elicit opportunities for coaching cycles (co-plan/teach/debrief) to happen on a regular basis over a period of time. Tracy was to follow the structure of working with one school every week, rotating schools on a weekly basis, and leave Fridays open for meetings and for professional development. Tracy was assigned to five schools; one secondary school, and four elementary and intermediate schools.

Because the secondary school was less inclined to schedule time with her, Tracy was working on a four-week cycle, supporting one school per week. Tracy structured her time so that she was co-planning and co-teaching with teachers on the same day. The next day would be spent looking at the student work and planning the consolidation, meaning taking the student work back into the classroom to highlight specific misconceptions, strategies or conceptual understanding to solidify the learning. After the consolidation took place, the following day would be spent debriefing the lesson with the teachers to determine next steps for planning and programming. Tracy tried to keep her Thursdays open as flexible days so that she could be available to other teachers at any school.

When Tracy was interviewed in September 26, 2017, preparing for the 2017/2018 academic year, a new superintendent had been assigned to Tracy’s family of schools. Because a framework already existed for the instructional coaches in that family of schools, their schedule or the assignment of schools did not alter, “He is going with what has already been happening so far and then we will go back and reevaluate again next year” (Tracy, Interview, Sept. 26, 2017). The 2017/2018 academic year was to be structured using the same cycle of working weekly with one school to co-plan, co-teach and debrief.
Tracy was asked about the coaching activities that she was involved in throughout all of the schools that she supported. She mentioned that her work involved co-planning, co-teaching and debriefing, and that through that cycle, she supported teachers in using problem solving and rich tasks as a way to teach the curriculum. Her attitude about that was:

I think that there is still some learning we need to do. In my opinion, that is part of the problem of using a rich task is that the teaching doesn’t happen up front, which is what we were traditionally doing. The idea is now, just let the kids have the experience, choose your work really carefully, pick your questions really carefully, and really highlight the big mathematical ideas that you want them to figure out, and then it will all come together. (Tracy, Interview, March 29, 2017)

Tracy also commented that she was working with teachers around assessment, and that she supported educators, “developing learning goals, success criteria to go with math assignments and then doing some moderation” (Interview, Tracy, March 29, 2017).

Tracy mentioned that another area that she consistently supported educators with was developing mathematical discussion in classrooms. This was achieved by “focusing on the talk moves…That was consistent throughout all of the classrooms. That was always more on my agenda or area of focus, building that math discussion” (Tracy, Interview, Sept. 26, 2017).

4.2.3 Perceptions of the Role

Having had experience as an early literacy resource teacher, Tracy commented that her training as an instructional coach incorporated a paradigm shift from the resource teacher model, which positions the resource teacher as an expert. Conversely, the instructional coaching model emphasizes the instructional coach as a co-learner. This shift of positioning the role of the instructional coach to a co-learner was not necessarily understood by the various stakeholders with whom Tracy worked.

When Tracy was initially interviewed for this study, she was in her third year as an instructional coach, having been hired during the program’s inception. Despite the fact that the
role was in its third year, Tracy felt that there still existed ambiguity about how the role was perceived:

I do not think that there is a common understanding [of the role]. My understanding from the board, and from what Lucy West said was we would be co-planning, co-teaching and co-debriefing most of the time, and that would be our work. That has not been the experience so far. I do not think that everybody has that shared vision. I think that sometimes superintendents get in the way of that, sometimes principals get in the way of that. I think we have all tried to share that with teachers as much as possible, but teachers are very reluctant to have people in their classroom to share their practice. So although that would be the ideal, are we there yet? Not for the majority I would say, and even if people have the understanding, they don’t necessarily use you that same way. They will still come and ask you for resources, they will ask you for your ideas, principals ask you to do “lunch and learns” or do staff meetings, all these stand and deliver type things, but still there is still hesitation with teachers to be open and accepting to sharing their practice. (Tracy, Interview, March 29, 2017)

As an early literacy resource teacher, Tracy believed that there was a common understanding of that role, and that it had a very specific vision and direction. She contrasted that with the instructional coaching role, observing:

I think that the clearer our vision and mission, and the more defined our role is, [administrators] are better able to understand it, they can use us better, superintendents can utilize us better and teachers will be more apt to use us because they also understand the value of what you can bring to them. (Tracy, Interview, Sept., 26, 2017)

Tracy felt that defining the role of instructional coaches and publicizing it more intentionally would improve the effectiveness of the instructional coaching role as a form of professional development.

4.2.4 Teacher Participation with a Coach

The principals of the schools where Tracy was assigned positioned instructional coaching as a choice that staff could participate in if desired. As part of the Renewed Math Strategy (Ministry of Education, 2016), schools were to designate teachers to act as math leads. Tracy commented about how this initiative helped her to make connections within schools
where she was assigned. Instructional coaches could then reach out to the designated Math Leads as potential educators to work with:

It helped that the Ministry mandated that you had to identify two math leads because that set up two specific teachers or people that should be willing to do that work with an IC [instructional coach] if that is the role that they’re going to take on. So we set up some criteria of a good Math Lead or a good person to work with the IC...what that would look like. We asked our superintendent to ask our principals to take an active role in planning all of that and what it would look like for the teachers. (Tracy, Interview, March 29, 2017)

When interviewing Tracy in September of the 2017/2018 academic year, she had to find new teachers to work with because many of the math leads with whom she had worked prior were at different schools or had different teaching assignments. One benefit to the fact that Tracy had been in the role for three years was that she was familiar at most of the schools. She noted that this familiarity meant that people were more willing to work with her:

I have the same schools and for a lot of my schools, Math Leads have dispersed. So they either got other jobs or they moved schools or math is no longer their program. That is kind of how it worked out. So in those schools I have identified new people who I can start with the co-teaching cycles with a math focus. The good part about that was that it was not hard to find the people as it seems that word of mouth by some people has led to other people coming to ask me if they can do that kind of work this year that I had done last year with somebody else. (Tracy, Interview, September 26, 2017)

Tracy made a comment that was about the important role that principals play for getting teachers to work with instructional coaches. Developing a positive, constructive relationship with the administrators of a school was an important factor. Tracy also noted that principals had the ability to create structures to support the work that teachers and instructional coaches were doing together. The structural supports include giving release time to the teachers so that they have additional time to spend outside of preparation periods, lunches and recesses to plan, co-teach and debrief. When reflecting on the role of the principal for impacting the work of instructional coaches, Tracy noted:
I mean [administrators] decide ultimately how we are going to be used in the school, and if we want teachers to be co-planning, co-teaching, co-debriefing, they have to set those structures up, they have to find those people who are willing to do that, and it is not fair to have an IC come in and say, ‘Just go around and find somebody’. Just knocking on people’s door randomly and saying, ‘Do you want to do this?’ does not, in my experience, has not worked very well. Especially, you might get the ‘one off, but in terms of long term, over a long period of time, you do not really make any kind of impact. (Tracy, Interview, March 29, 2017)

During the 2016/2017 and 2017/2018 academic years, Tracy worked with a math lead named Kathy who was willing to be a part of this study. Tracy and Kathy created a collaborative inquiry that included one of Kathy’s colleagues, named John (pseudonym). John was not a part of this study, but he was present during the classroom observations because he, Kathy, and Tracy co-planned, co-taught and debriefed as a triad.

**4.2.5 Kathy: Background Information**

Kathy was in her fifth year of teaching when first interviewed in May 5, 2017. Kathy was working at Hills Intermediate School with a population of approximately 500 students ranging from grades six to eight. In the 2016/2017 academic year, Kathy was teaching grade seven, and covering core subjects, such as mathematics, language, science, history and geography. When interviewed in the fall of the 2017/2018 academic year, Kathy was working at the same school, also teaching the same grade with her same grade level team.

Before transferring to Hills Intermediate School, Kathy’s experience included teaching grades six and eight. Kathy also had experience working in a special education behavioural class, with a wide spectrum of ability ranging from grade one to grade eight. As a result, Kathy had experience differentiating her program for a range of abilities. Kathy noted that it was beneficial that she had experience with teaching math in grade eight because she knew the concepts that grade seven students would need in order to prepare them for what they would be introduced to in grade eight. This gave her an understanding of the continuum of mathematical
concepts that students would need to progress their understanding, therefore she felt that this helped her to better prepare her students. Kathy did express some discomfort with teaching math, “I would say math is the subject that I used to feel the least confident teaching because it is not my own background” (Kathy, Interview, May 5, 2017). She welcomed the opportunity to work with the Tracy.

4.2.5.1 The Coaching Experience

Kathy began working with Tracy in the fall of 2016. Kathy was asked by her principal to work with Kathy:

I was kind of asked to be part of it. I would have volunteered myself anyway. I was interested in working with our IC. I did not have in mind that it would have been about math because I teach so many subjects. (Interview, May 5, 2017)

Kathy did not mind that her principal had encouraged her to work with the instructional coach because Kathy had already initiated contact with Tracy before the suggestion was made. Kathy was interested in an integrative approach, trying to create a holistic curriculum that would link different subjects together. Kathy’s principal provided a substitute teacher to cover Kathy’s classes so that she could meet with Tracy. It was also positioned by the administrators of her school that Kathy include another teacher in her grade level team when working with Tracy. John was invited to participate in a collaborative inquiry with both Tracy and Kathy.

When asked to define the role of the instructional coach, Kathy compared it to the experience that she had when she was first hired. The district school board offers an induction program to new teachers to support them in their early career. New teachers are paired with mentors, and are given time to work with that mentor. Structural supports are in place for the induction program as teachers are provided with coverage and are released from their teaching duties to pursue an inquiry project with their mentor. “I feel like I have gone through this
process before, but just not with an instructional coach. It felt very similar.” (Kathy, Interview, May 5, 2017)

Kathy also compared the role of an instructional coach to a resource person. She described an instructional coach as:

Somebody who has this wealth of knowledge from their background, and in a specialist area where they can share resources that they have collected, share their knowledge, as well as help to facilitate some sort of project or a lesson, or in our case, a collaborative inquiry where we have a goal in mind. (Kathy, Interview, May 5, 2017)

When beginning to work with Tracy and John, Kathy was open to focusing on other subjects besides math. At the initial meeting when Tracy, Kathy and John met to determine the goals for their coaching experience, it became apparent that math was to be the focus. John was an experienced teacher, therefore Kathy felt that it would be a good opportunity to learn from both of them:

To be able to focus on math ended up working out really well for me because this is my first year teaching this grade. It gave me an opportunity to work with another teacher who has also taught for several years in the math realm of things and is much more comfortable teaching it. So when it was presented to me, I looked at it as an opportunity to kind of be mentored by somebody else, not only by the IC, but also by my peer, my colleague. It seemed like an opportunity for me to grow in my own professional development in that field. (Kathy, Interview, May 5, 2017)

When working with their instructional coach, Kathy and John were limited to working on the subject of mathematics, however the team had choice within the realm of mathematics to determine a focus. Kathy recalls how this was explained to her by her administrators who said, “Do something that makes sense for your grade level. You will be able to meet periodically throughout the year, it is up to you when you want to schedule those meetings, just let us know” (Kathy, Interview, May 5, 2017). The coaching agenda was left open so that Kathy and John could determine what made most sense to support their students. Kathy noted that the
administrators of her school were supportive about providing release time so that triad could meet to co-plan, co-teach and debrief together.

The administrators at Kathy’s school allowed for choice about what the instructional coaching sessions were to focus on, which was also mirrored by Tracy’s approach when working with Kathy and John. The sessions spent with Tracy were relevant and embedded in Kathy’s practice. Kathy comments about this when describing how Tracy supported the work that she and John were doing:

I do not feel like there has ever been a time when she prescribed what we should be working on or told us what to do or came in with a lesson and said, ‘Here, I think that this is what we should do.’ It has always been very open ended. She will say, ‘Here are some really great resources. Here are some things that other schools have done. What do you guys think? Where do we want to go with this? What goals do we have in mind for this time?’ I think that that alone has been helpful because the other teacher and I know our students. (Interview, May 5, 2017)

Kathy and John decided that the focus for the coaching sessions for the 2016/2017 academic year would be about effective questioning:

We met then for the first time and were planning on meeting throughout the rest of the year to plan a specific lesson and teach it together and do a debriefing, a consolidation to see how it went. The very first time that we met we were not really sure what to focus on or where we wanted to go with it, but some of the things that we wanted to focus on were questioning, effective questioning to help provoke thought or to prompt [students] to do some of their own thinking to work through a problem. (Kathy, Interview, May 5, 2017)

To support Kathy and John, Tracy provided them with a resource, which included one hundred effective questions to provoke mathematical discussions. The team discussed which questions would actually get students talking and thinking about a concept rather than being told how to memorize a formula or to apply a mathematical procedure without conceptual understanding. When co-planning the lessons, the team asked the following questions: “What is our end goal by the end of the lesson? What do we want to get them [students] to do and what questions can
we ask to get them there?” (Kathy, Interview, May 5, 2017). Regardless of what mathematical strand the students were working on, the content of the instructional coaching time was devoted to deepening student understanding through the instructional strategy of provoking thought by questioning and discussion.

The questioning focus was evident during the May 10, 2017 co-teaching lesson that I observed. The lesson began with a provocation entitled “Which One Doesn’t Belong”. This resource can be accessed by a website and contains a series of frames that are split into quadrants. Within each quadrant is a number, symbol, or image that is related to a specific mathematical concept. The purpose of the visual is to prompt students to explain which of the four does not belong and justify their answers. The quadrants are designed in such a way that an argument can potentially be made to explain why any of the four do not belong. This provocation is often used as an introduction to a lesson to get students thinking and talking about a specific mathematical concept.

In the lesson observed, the provocation included four different fractions. The students were asked to explain and justify their thinking about which fraction did not belong and why. Students were challenged to find more than one fraction that they could argue did not belong. Moments elapsed before the discussion began to ensure that students were given time to process and think about the provocation. During this exercise, specific mathematical language was introduced and reinforced by Tracy, Kathy and John. Tracy began to record the terms being used during the discussion and she included definitions of the numerator, denominator, mixed fractions, proper fractions, improper fractions and benchmark fractions. The mathematical vocabulary was reinforced throughout the observed lesson.
After arguments had been discussed to explain which fraction did not belong, the students were asked to create representations of various fractions. During this portion of the lesson, Tracy and the two teachers circulated throughout the classroom, checking in with the groups and asking questions to elicit student thinking. Effective questioning was used to help the students solidify the mathematical concept of understanding fractions and representing a variety of fractions using various manipulatives.

Throughout the remainder of the 2016/2017 year, the triad worked on effective questioning. It resulted in the triad creating a bank of questions that they felt elicited student thinking and understanding. Tracy observed the following:

We did identify specific questions that we thought worked for all strands that really developed the math discussion. [Kathy and John] picked out those target questions and why they thought that they were good questions for asking. Moving forward they intend to make that a part of their regular practice. (Tracy, Interview, Sept. 26, 2017)

During the 2016/2017 academic year, the triad met every five to six weeks cycling through co-planning, co-teaching and debriefing sessions that included a couple of days. When reflecting on the duration spent working with Tracy, Kathy noted the following:

It is hard because when you are doing it just every few months you miss that momentum and by the time that you are debriefing and you are ready to start something new, the IC is split between so many other people and so many other schools. If I could improve one thing it would be having more time to actually work with the IC. (Kathy, Interview, Oct. 24, 2017)

Kathy added to this point by acknowledging that it was difficult for Tracy to build relationships with her students because there were gaps when Tracy could be in the classroom. This meant that Tracy was less familiar with special needs that some students had, such as behavioural needs, or students with individualized education plans. The triad incorporated differentiation into their plans, but Kathy acknowledged that it was difficult for Tracy to be familiar with all of the needs of her students.
Kathy also acknowledged that collaborating with John and Tracy influenced her assessment practices. Kathy no longer waited to do an assessment at the end of a unit to determine marks. Rather, she was assessing throughout a unit, which was shaping her mathematics programming and planning:

> Just getting [students] to work on something together and listening to them talk has already changed the way that I am assessing them. I am not just waiting for a test or a project type of assessment, but I am listening to them more, how they are working through things in the process rather than just at the end of a unit. I feel that has also helped me. I have been able to catch a lot of misconceptions in the process and we could correct them before it gets to some sort of evaluation of what they have learned by the end of the unit. (Kathy, Interview, Oct. 24, 2017)

The focus of effective questioning as a coaching goal changed in the second year. During the first meeting of 2017/2018, the team decided that the content of the instructional coaching would focus on supporting students with mathematical processes, such as reasoning:

> The aspect that we are working on specifically in the school where it is a little more focused with myself and another grade 7 teacher and our IC is getting kids to improve their reasoning and proving skills. How do you know that this is correct? How could you show this to somebody else and teach them this skill or concept? There seems to be a disconnect between an operational or a computational skill and actually understanding how it applies or what it really means. (Kathy, Interview, Oct. 24, 2018)

During the lesson observed on October 20, 2017, the students were engaged in various games involving fractions. The students had to justify which fraction was the largest and all members of the group had to agree. Kathy, Tracy and John circulated through the room of twenty-seven students to promote discussion by challenging the students to explain who was winning the fraction game and why. This prompted students to reason and justify their answers.

> When planning for the 2017/2018 academic year, Kathy and John had to split Tracy’s time with the grade eight team who were planning to do a collaborative inquiry with Tracy. While Kathy expressed enthusiasm that another grade level in the school recognized the
benefits of what she and John had accomplished with Tracy in the prior academic year, it also meant that it would be more challenging to have time to work with Tracy:

Our time allotted to planning and working with our IC is now split with another grade level team. So our time allotted is less than last year so we have to spread it out accordingly. On the other side, I am happy that other teachers in the school are interested, so I am hoping in that sense that I get to learn from what they have been doing. That might actually work out to be a positive anyway. And we get release time, although it is limited this year. (Kathy, Interview, Oct. 24, 2017)

Finding time to work together became a challenge given the demands of Tracy’s schedule.

Kathy’s professional learning occurred in a context of a collaborative inquiry model. Her administrators encouraged her to team up with her grade level colleague to focus on any challenges of practice that they wanted to address within the realm of mathematics. Kathy valued the learning that occurred with her instructional coach, as well as with John:

When it was introduced to me, it was let us try and focus on math and let us partner you up with another teacher at the school who is also teaching math in the same grade and see if we can collectively make some lessons that we could try out with different classes in the same grade. (Kathy, Interview, May 5, 2017)

Kathy and John were not always teaching the same concept at exactly the same time. This became a challenge for the teachers. While their long-range plans were designed so that specific stands in math would be taught in a specific order, when they got to teaching those stands would vary based on the nature and needs of their individual classes. To address that issue, the triad met to create lessons to introduce a specific mathematical concept, focused on questioning techniques. An introductory lesson did not rely on other concepts having been taught by the teachers to build the foundation. It meant that the triad had to be adaptable, but as Kathy commented there was a lot of “flexibility about the content, what we are doing and how we are doing it” (Interview, May 5, 2017).
Kathy experienced a pivotal moment when she, John and Tracy took over the library to illustrate the Cartesian plane. A robot was placed on the floor, and the students were asked how they would describe its place in space. This led to moving the robot around the room, in and out of quadrants. Kathy described this example with enthusiasm:

One of the successes of this activity was getting kids up and moving around and seeing math in a big space rather than just on paper and I do not think that that was our goal or our intention but I think that from that activity we took away, how could we do more of that? Every student was engaged, were trying, were interested, everybody, even the students who do not really seem to enjoy math or want to participate in math were involved….It was an interesting experience because for us, as teachers because we realized that it was more important to get the students to problem solve than just tell them what is right or wrong and to guide them...I think that was a valuable experience that came out of that. (Kathy, Interview, May 5, 2017)

Teaching through problem solving and using rich tasks was adopted by Kathy. She made some realizations about her mathematics practice resulting from the work that she was doing with Tracy. One shift that occurred was Kathy’s use of problem solving to illuminate mathematical concepts:

I have been more open this year to give students more opportunities to work through problem solving tasks or open ended tasks and then take that as an opportunity to work through the concepts without having to do just a textbook page. (Kathy, Interview, May 5, 2017).

Building the math discussion by using effective questioning was a focus in the work that Tracy did with Kathy and John. When asked how to support her student’s mathematical communication, Kathy noted that she was thinking about:

how can they work through things through with discussions with each other, with the class. How can we get them to talk about things to understand a concept way better than going through a lesson and just telling them...this is how you do this…this is the right and wrong way to go about it...but have them explore more thorough investigation and discovery and talk about why something seems to be right versus if something is not right, how do we know it is not right. A lot of it was focused on discussion and questioning. (Kathy, Interview, May 5, 2017)
4.2.6 Case Summary

Kathy reported that participating in the instructional coaching as a form of professional learning was a positive experience, and was demonstrated by the fact that she was continuing the work from one academic year to the next. Kathy also valued the learning that was occurring with her colleague. When asked what Kathy thought was the most impactful aspect of the experience, she noted that it was beneficial to have multiple people with whom she could plan.

When contextualizing instructional coaching as a form of professional learning, Kathy compared it to workshops that she had attended within the board and commented that that the active aspect of instructional coaching allows her the opportunity to do something that is practical and relevant, rather than discussing something theoretically. This is echoed by Tracy when asked about how instructional coaching was working as a means of professional learning, she commented that being in the classroom and co-teaching was having the biggest impact. Tracy’s opinion about how instructional coaching allowed for professional learning to occur within the classroom context was significant so that it was meaningful.

4.3 The Case of Linda

In the spring of 2016, Linda was hired as an instructional coach for the 2016/2017 academic year. Before becoming an instructional coach, Linda had eight years of experience teaching at two secondary schools, specifically subjects focused on the arts and special education. During her seventh year as a teacher, instructional coaching was initiated by the board, and the following year, Linda began to work with the instructional coach who was assigned to her school.
Despite the fact that the board had implemented coaches to focus on numeracy, some instructional coaches made themselves available to teachers who sought their services in other curriculum areas. Linda asked the instructional coach to work on subject matter not related to math. Linda’s experience of working with that instructional coach was a positive one:

I found it certainly gave me different ideas for lessons, but it also went above and beyond that, it gave me a chance to talk through my plans with somebody else and to have somebody as a sounding board. It caused me to question what I was doing and why I was doing it and what I was hoping to get out of it, and it resulted in what I feel were better lessons and better ideas. (Linda, Interview, March 30, 2017)

Due to the positive experience of working with her instructional coach, Linda was motivated to become a coach herself.

### 4.3.1 Preparation for the Role

During the first week of school in September 2016, Linda received various types of professional development activities at the board office to help prepare her for the role as an instructional coach. For three days, Linda participated in learning about the coaching model based on Agents of Change (West & Cameron, 2013). After the three-day workshop, Linda felt that she learned about “what coaching looked on a day-to-day basis, or how it might look on a day-to-day basis. How to basically organize or structure your day and structure meetings and how you navigate working in different subject areas” (Linda, Interview, March 30, 2017).

The latter part of the week was spent learning about Marion Small’s (2004) PRIME resource, focusing on numeracy concepts and skills along a developmental continuum. As Linda’s teaching experience did not include math, she found that this teacher development program was extremely beneficial to her.

Our board has this push for numeracy, even though I am not a math teacher, that was really good. Actually because I am not a math teacher by my own practice, it was good for me to be exposed to some of those things so I could then bring to the table as a coach. (Linda, Interview, March 30, 2017)
Professional learning extended beyond the first week of workshops. Throughout the academic year, one day per week was designated to either meet with the superintendent and other coaches, or to receive professional development.

4.3.2 Responsibilities

As an instructional coach, Linda’s responsibilities included working within a specific grouping of schools, referred to as a family of schools under the purview of one superintendent. During the 2016/17 academic year, Linda supported three elementary schools and two secondary schools. The superintendent to whom she reported had a specific view about how to schedule the time amongst the schools. Coaches were expected to work at one of their assigned schools Monday through Thursday, rotating schools on a weekly basis. Fridays were designated for professional learning or for meetings amongst the coaches.

When trying that particular model of working with schools once every five weeks, Linda observed that it interrupted momentum as the gaps of time between schools was impeding “flow”. Linda had the ability to tweak the model so that she ended up going to different schools based on specific requests. Linda recognized that her approach meant that her schedule was not predictable, therefore schools did not know which weeks she was available. She felt that this flexible approach meant that her “schedule now is different every week and every day, but I find that it responds to the immediate need a little better than if I was structuring it around that week-to-week basis” (Linda, Interview, March 30, 2017). Linda was flexible about working with teachers on any subject, but the bulk of her work was focused around mathematics education.
At the conclusion of the study, Linda was asked about ways in which she supported schools. She reported that Number Talks, or math talk, in general was a common thread that occurred at many of the schools where she was supporting:

I would say that in some shape or form number talks or mathematical talk in general. Number talks, specifically and in a larger stance, using talk moves to get students to make their thinking more visible, or to be stronger participants in class, or to be advocates for their learning. I would say that that topic came up a lot and was a ‘go to’ in terms of if a teacher said that they were having difficulty getting students to participate in math class, and it was always the same student answering over and over again, I would then talk about the talk moves that are tied to Number Talks and running Number Talks in the class. It often would circle back to that. (Linda, Interview, June 7, 2017)

4.3.3 Perceptions of the Role of an Instructional Coach

When asked to define the role of an instructional coach, Linda did refer to the model of West & Cameron (2013), emphasizing co-planning, co-teaching and debriefing. The metaphor that Linda uses to describe the role of the instructional coach is, “I view the role as a traveling teaching partner…I view my role as somebody who can come to you at your school and be a sounding board, and a co-planner and a co-teacher of ideas and lessons” (Linda, Interview, March 30, 2017). When asked how Linda thought teachers perceived of the role, she noted that many teachers confused the role with the resource teacher model. Linda explained that teachers make assumptions about the coaching role:

Our board was structured so highly around resource teachers in the past and this instructional coach position is only just three years old, so it is fairly new. Most teachers are familiar with the resource teacher model, and fewer teachers are familiar with the instructional coach model. Often I am viewed as someone who can provide resources. I am someone who can be emailed to provide ideas for lessons, but not necessarily someone who teachers would inherently reach out to plan a lesson together or to teach a lesson together. (Linda, Interview, March 30, 2017)

Another factor that complicates how the role is perceived is that instructional coaches may be seen as meeting the needs of the school administrators. Instructional coaches often meet
with principals to discuss school-wide professional learning, but teachers may perceive of coaches as being more closely tied with administration than with the teachers. The relationships that coaches have with administrators may lead teachers to believe that there is a power imbalance, and potentially an evaluative stance:

Sometimes people are not aware that I am still a teacher in a teacher’s union...definitely because a big part of my job is meeting with admin…. Because people see me coming in and spending so much time with administration, and being in their offices, planning whole school or things with them. I think that I get lumped in as an off-shoot of admin. So I am not really a teaching colleague, I am more of an administrator colleague. (Linda, Interview, March 30, 2017)

Linda also observed that principals and superintendents perceive of the role in varying ways. This becomes complicated because instructional coaches report to the superintendent, but are working in schools where the principals are the authority. Linda acknowledges that the coaching role has many grey areas in which she may be asked to do something at a school that is not really a part of the coaching model. One principal asked her to work with a teacher who was perceived as having classroom management struggles. Linda notes that her role is more effective when teachers choose to work with her, rather than to be assigned to teachers who may not have interest in working with her.

Another complicating factor about the role of the instructional coach is the fact that instructional coaches are still part of the teachers’ union, which defines parameters around issues such as preparation time or uninterrupted lunch time. Despite this, Linda found herself conducting professional learning opportunities during lunch periods, or staying late to help run staff meetings while also working throughout the day with teachers. The instructional coaching role did not adhere to many of these parameters, even though instructional coaches are still a part of the teachers’ union.
4.3.4 Teacher Participation with a Coach

In most of the schools where Linda worked, coaching was positioned as an elective opportunity for teacher development. Linda needed to find teachers who would be willing to work with her during their own time, such as preparation periods, during breaks, or after school. As Linda was new to the role, she expressed frustration about trying to find teachers to work with, and she observed that her instructional coaching colleagues who were returning to schools where they had established relationships were able to begin their work early on in the school year. Linda had taken over schools that had been coached by a different person, so she had to develop a rapport with the staff members of these schools, and generate interest to work with her:

So it felt at times like I am a used car salesman, having to give a pitch to get people to buy into working with me. Depending on the school, depending on the atmosphere, and depending on individual personalities, it has been met with different responses. Some people have been extremely open in wanting me to come in to work with them and work in their classroom and co-teach with them, and some people have shown very little interest, even explicitly resistant. (Linda, Interview, March 30, 2017)

School administrators seemed to play an important role in helping Linda recruit teachers for coaching. Schools where she partnered with principals and worked closely with the administrators provided her with increased access to teachers. The administrators set the tone for how instructional coaching was utilized in some of her schools:

The easiest way to get into a school is to develop a good relationship with admin, [then] more opportunities open up to get into a school as a coach. It is more difficult when you do not have that relationship with admin. (Linda, Interview, March 30, 2017)

Linda’s teaching experience was not always in alignment with the grades of teachers whom she was working. Linda acknowledged that this could be an obstacle but she overcame this challenge by focusing on instructional strategies, so that the curriculum concepts were less the focus:
It becomes somewhat unreasonable to think that I would be effective coming in to work with a teacher who has taught their subject for many years and I may never have taught it before. So the idea of coaching someone through their content knowledge becomes not effective, and in some cases not even possible. The way that I have sort of approached this role, and how my superintendent has approached this role is that it is about instructional coaching, so the idea of instructional strategies, so it is no longer necessarily relevant if I know the content area. What is important is that I have ideas about how to deliver content to students, and new ideas in the educational community around instructional strategies. (Linda, Interview, March 30, 2017)

4.3.5 Kirstin: Background Information

Linda worked at five schools. Two teachers with whom she worked were willing to be a part of the study. The two teachers are from different schools. The first teacher is Kirstin. She was in her fourth year of teaching when this study was conducted. Kristin has French qualifications and her first two years of teaching were focused on French education. Having little seniority, Kirstin was declared surplus at one school in September 2016 and was transferred to Crescent Public School to teach a split grade three and four class. Crescent Public School is comprised of grades from kindergarten to grade 6 with roughly 400 students in attendance. Kirstin taught a split grade three and four class of twenty students with a large population of English language learners.

When I asked Kirstin what she thought about the role of the instructional coach, she said:

I have used instructional coaches every year that I have been working. [It was] not necessarily mandated by the admin. I sought out help every year just because I am new to teaching and they are just great to help plan lessons, to plan units. They are like a guide and sort of a mentor and they can help plan rich lessons, rich tasks, give ideas that I would not necessarily come up with on my own. (Linda, Interview, April 3, 2017)

When pressed to explain more about her experience of working with an instructional coach, it became evident that Kirstin was referring to both the French resource teacher, whom she
utilized in her first couple of years of teaching, as well as the instructional coach with whom she was currently working. Kirstin did not differentiate between the two roles.

The fact that she began to interchangeably refer to both experiences indicates that the roles are often seen as the same. Noting this interchangeability at the beginning of the interview, I was cognizant about collecting data that was specific to the experience that she had working with Linda as opposed to the resource teacher model referred to earlier in the interview.

4.3.5.1 The Coaching Experience

At the time that Linda and Kirstin worked together, Kirstin did not have experience teaching either grade three or grade four. As those two grade levels were new to Kristin, and she was also new to the school, she was not ready to work with Linda until January, “I was busy setting up my class, and just wrapping my head around doing a split” (Kirstin, Interview, April 3, 2017).

Kirstin had to learn curriculum for two grades and plan effectively to ensure that the curriculum for both grade levels was addressed. To help meet that challenge, Kirstin found that Linda helped her to focus on the “big ideas” of the curriculum. Kirstin mentioned that, by the end of the academic year, she was feeling pressure to cover the mathematics curriculum objectives, and that Linda was:

really good at looking at the curriculum expectations for each grade and making sure that the activities covered them. We got through it efficiently, like doing rich tasks or doing activities that had a lot of thinking and met a lot of the curriculum goals. (Kirstin, Interview, June 8, 2017)

Although Linda did not have experience teaching that specific grade, she was still was able to support Kirstin with planning efficiently and effectively.
Linda helped Kirstin navigate the curriculum content and provided Kirstin with instructional strategies, allowing for several curriculum objectives to be covered using rich tasks. Linda supported Kirstin by differentiating the lesson plans by ensuring that the two grade levels objectives were covered. During the lesson I observed on April 7, 2017, Linda made the learning expectations transparent to the students, focusing on multiplication concepts and had different questions matching the curriculum expectations of both the grade three and grade four curriculum. It became apparent that Linda had been in the classroom several times. Linda had developed a rapport with a couple of students as she was using their names and asking questions, referencing prior conversations. The students greeted Linda enthusiastically.

While working together, Kirstin took an active role for her learning by trying out new educational instructional strategies introduced to her from Linda. Kirstin began using an instructional strategy called Number Talks, which focuses on having students use strategies when solving questions regarding specific mathematical operations. Number Talks demand that students explain their mathematical thinking and communicate what strategies they are using to solve operational problems. This type of instructional approach requires that students reason about what strategies are efficient. Number Talks also provides an opportunity for students to understand numbers in different ways by how they are composed or decomposed to find doubles, or friendly numbers when solving mental math computations. When introducing this instructional strategy to Kirstin, Linda talked about the high yields of Number Talks, discussed the protocol, and then modelled Number Talks in Kirstin’s class. Kirstin spoke about the experience:

I had mentioned to her that I had never done a Number Talk before and she gave me the nitty gritty basically. You could talk for a long time about the benefits of Number Talks but we just had one period where she explained how to do it, where we ran
through a model one and then I did it the next day in class and it was pretty easy. (Kirstin, Interview, April 3, 2017)

During the classroom observation (April 7, 2017), the math lesson did include a Number Talk portion. Linda led this part of the lesson, while Kirstin recorded the ideas that the students were generating. The students made gestures to indicate that they were ready to discuss their specific strategies. Students were able to justify how they arrived at an answer and seemed quite comfortable with the process, indicating that they were accustomed to this type of instructional strategy.

Kirstin took an active role in her professional learning by identifying a need, getting the resources to support her and then trying the specific instructional strategy with the support of her instructional coach. Kirstin said she would continue to use Number Talk in her mathematics program.

Another component that resulted from the instructional coaching experience was supporting mathematical discussion and communication through questioning. Kirstin noted that, “Posing questions to the class, and getting them involved, and this making thinking visible theme is really important, and I try to do it, knowing that I should be focusing on how did they get to the answer,” (Kirstin, Interview, April 3, 2017) which can be understood by asking probing questions.

Kirstin indicated that the work that she did with Linda had relevance for her classroom practice and her professional goals. Kirstin recorded that the work that they did together was “geared towards my needs. Like I said what I was struggling with, and what I needed support with, and she delivered and she helped me” (Interview, June 8, 2017).

Linda supplied Kirstin with many ideas about using rich mathematical tasks that satisfy multiple curriculum objectives. Kirstin acknowledged that many of the ideas that she was
incorporating from working with Linda were not necessarily new to her, but that she had forgotten about them, or that there was so many resources that it was overwhelming to navigate. Rather, Kristin could sit down with Linda, explain what she wanted help with and Linda would supply her with what she needed:

   Everything that she has sent is helpful because that is what the instructional coach tends to do is to give you what you are looking for, what comes up in conversation. I like that...there is so much literature out there, so many things like strategies, books, but they boil it down to what you actually need. (Kirstin, Interview, April 3, 2017)

The professional learning that Linda provided was embedded in Kirstin’s everyday practice.

Finding activities that were engaging to her students was another focus of Kirstin and Linda’s instructional coaching work. Linda provided Kirstin with a game entitled “I Have, Who Has”. “She gave some other suggestions to me for lessons on multiplication and division so we’re going to try one that’s more like a game.” The game was designed so that each student would have an answer to a multiplication question, and then the student would pose a question to be answered by somebody else in the class. Using the example below, the teacher would begin with one question, “Who has 6 x 8?”, and the person who has the card of that states, “I have 48” would respond and then ask another question to the class.

![Image of game cards with multiplication questions and answers.](image-url)
Linda and Kirstin began their work in January 2017. Both Linda and Kirstin were moving on to different roles for the following academic year, therefore they knew that their work would not be continuing past June 2017. When reflecting about the time that they worked together, Kirstin commented:

I would have worked with my IC instructional coach) earlier in the year. If I could have worked with her from the beginning, that would have been great - like designing the long range plans and coming up with covering two grades. Some of my students had very high needs so that would have been great. Next time I will not be shy and contact the IC and see how they can help you. (Kirstin, Interview, June 8, 2017)

Kirstin mentioned that she would use an instructional coach in the future. Because she was going back into a French teaching role, she would not be actively working with one again the following year. However, if she were to return to teaching math, she commented:

I would use the lessons again and modify them for the grade level. It is too bad that my IC is going to another role and that I am going to another role...it is a comfortable relationship so if I find an IC that I have that type of relationship with and who is open to co-planning and co-teaching then I would use them in a similar way. (Kristen, Interview, June 8, 2017)

At Crescent Public School, teachers were expected to participate in collaborative inquiry projects with other grade level teachers. Linda worked with Kirstin’s team to plan a rich task to target the curriculum objective regarding the mathematics strand of geometry and spatial sense, specifically angles, with a focus about how to make students’ thinking visible. The team also established success criteria based upon the learning goal to make assessment transparent to the students.

While some of the instructional coach’s time is to work with teams in a collective role, Kirstin discussed how the work that she did individually with Linda was more beneficial. When
asked to elaborate about the experience of planning as a collaborative inquiry group, Kirstin wanted to change topics because she had not taught the lesson that they had all planned together. She was not teaching that specific mathematical concept to her students at that point of the academic year. The co-planning, co-teaching and debriefing that Linda and Kirstin did collectively was more meaningful for Kirstin than the work that she did with her team.

4.3.6 Michelle: Background Information

Throughout the 2016/2017 academic year, Michelle and Linda worked together on a monthly basis. At the beginning of the study, Michelle was in her fourteenth year of teaching, with most of her experience in the junior and intermediate grades. During the study, Michelle was teaching a grade five class at Hadacres Public School, a kindergarten to grade five school with a population of approximately 600 students.

Michelle explained that over the course of her career she had experience working with various resource teachers. She said that she was comfortable having other adults in her classroom. Since the inception of instructional coaching in her board, Michelle utilized the coaches assigned to her school. The original coach designated to her school was there for two years, with Linda replacing that coach in September of 2016.

The coaches were introduced to the staff via an email. Attached to the email was a letter from each coach, introducing him/herself with an explanation of some of the ways that teachers and instructional coaches could work together. Michelle commented that a teacher would have to take the initiative to work with a coach and that it was not something that was pushed from her school’s administrators.

Michelle’s perception of the role of the coach focused on the coach’s ability to bring in resources:
The instructional coach is directed by the board to focus more on math because that is the biggest push, but really the instructional coach can supply us with resources, in any subject area at any grade level, and could also help with ESL students, because of course, the ICs are covering K-12. So they will see a bunch of different classes and see things that are happening. It is almost like it is a great resource because it is somebody who can go into these other classrooms, pull what is really working, have all this PD and then deliver it on a one on one method that would best benefit the teacher and his or her practice. (Michelle, Interview, April 11, 2017)

This perception of coaching was echoed again when Michelle was asked to describe the role of the instructional coach, “a math resource person” (Michelle, Interview, Sept. 27, 2017).

Michelle had worked with one coach for two years prior to working with Linda, and had utilized the original coach to help plan math lessons using open questions. Michelle and the original coach did some diagnostic assessment that Michelle found was very informative:

[the Instructional Coach] actually brought in a question that she saw at a PD session that was a very open ended question. I was always focused more on closed questions, so she had encouraged me to use very open questions. We did one as a diagnostic assessment to see what the students did not know and it was very informative. (Michelle, Interview, April 2, 2017)

However, Michelle described how the coaching “just kind of petered out because of other responsibilities - like extracurriculars, and so I did not invite her in again, not because I did not want to but because things just kind of mounted” (Michelle, Interview, April 11, 2017). Finding the time to meet with the instructional coach became difficult to schedule given the other school activities that Michele was participating in.

In the fall of 2017, Michelle began to email Linda to determine how they might work together. When they met, Michelle found Linda to be extremely affable and approachable, which made it easy to work together. In fact, the relationship evolved from a collegial partnership to an actual friendship. Over the course of the academic year, Michelle and Linda met monthly in order to co-teach lessons.
4.3.6.1 The Coaching Experience

As an experienced teacher, Michelle was familiar with the curriculum. When discussing her experience of working with Linda, the focus was less about covering curriculum content, but more about instructional strategies that would be relevant and engaging for her students. Michelle expressed an enthusiasm about teaching math. “I value math so much and I have always loved math…and I also know that there is lots to learn” (Interview, April 11, 2017), which is why she sought out working with coaches when the role was first introduced. Michelle emailed Linda on a regular basis to let her know what mathematical concept she was focusing on and Michelle spoke enthusiastically about how Linda provided many engaging resources to support her mathematics program. Linda also provided Michelle with excerpts from books that were relevant:

My IC, instead of giving me whole resources, she instead gives me little chapters that are the most beneficial for me and so I am able to read a five-page chapter versus a 200 page resource that I just would not do…I would not read it in its entirety. I really like that, so I am exposed more to ideology that is not necessarily new but it is just looking at something in a new way. (Michelle, Interview, April 11, 2017)

Michelle took an active role in her professional learning by identifying an area of need that she wanted to focus on. She targeted mathematical reasoning skills as an area for which her students needed support. When beginning to work with Linda, Michelle communicated this need, and was referred to Number Talks. Michelle had heard about them, but she had not used this instructional strategy before. Linda “coached me a lot on Number Talks. Something that is so valuable and simple, but that coaching and that encouragement really did change the way my students think about mental math. It also built their confidence” (Michelle, Interview, April 11, 2017).
When interviewing Michelle in September of 2017, Linda commented that she was continuing with Number Talks. She observed the following about her students from having used Number Talks as part of her mathematics program:

Their strategies have moved along the continuum. They are a lot more rich, the strategies, starting from counting on and moving all the way over to using friendly numbers to compensate for certain numbers, to composing certain numbers into friendly numbers. It is amazing what they can accomplish now with their mental math. (Michelle, Interview, April 11, 2017)

When Michelle was interviewed in the fall of the following academic year, she mentioned that she was continuing with Number Talks, but that she adapted the approach by providing students with strategies beforehand, so that they could name how they came to a solution. When discussing Number Talks, Michelle concluded that:

They have had the greatest impact and I started right away from the first week of school with my current students and handed out the strategies so that they had them right in front of them and they are already being able to explain which strategies that they are using and they are trying different strategies during the mental math Number Talk. (Michelle, Interview, Sept. 27, 2017)

She mentioned that she was planning on incorporating this instructional strategy three times a week.

In the 2016/2017 academic year, Michelle was a member of her school’s numeracy committee. Due to the high population of English language learners in her school, combined with the most recent EQAO data, their school-wide focus was to develop mathematical vocabulary. Michelle adapted the Number Talk sessions and used the same protocol to create “Word Talks” to reinforce specific math vocabulary. “I started doing Word Talks also instead of just Number Talks” (Michelle, Interview, June 26, 2017).

The focus on math vocabulary was evident during the lesson that Michelle and Linda co-taught on May 29, 2017. The learning goal focused on transformational geometry,
specifically identifying and demonstrating rotations, reflections and translations. The students referred to definitions of those terms by what they are commonly known as turns, flips and slides, but throughout the lesson, both Michelle and Linda reinforced the math terminology of transformational geometry.

During the lesson, the teachers also provided the students with manipulatives such as Miras (transparent mirrors), dice and graph paper. Using manipulatives in Michelle’s mathematics class was another component of her practice, which was impacted by the work that occurred with Linda. During a previous lesson that the duo had co-planned together about fractions, Michelle referenced the powerful use of pattern blocks for modelling fractions:

My IC had said, “Let’s use pattern blocks for a certain lesson,” and upon discussion, one of the students said, “Look, if we have the two trapezoids, I know that they will become a hexagon” but then another student had figured out that there are different ways of putting these other pattern blocks together to make a hexagon so the hexagon became the one whole and all the other parts could be made up as fractions of that. (Michelle, Interview, June 26, 2017)

Michelle remarked that she was going to make a point of encouraging her students to use manipulatives on a more regular basis. Michelle recognized that, at times, students in older grades are reluctant to use them, but that she would model using manipulatives with the hope that “the students will think of a different way of using the manipulatives” (Michelle, Interview, June 26, 2017) to represent their mathematical thinking.

It was evident that Michelle valued the work that she did with Linda because it was always relevant to her needs at the time. Michelle referenced specific examples of how Linda responded to her needs, “If I say, ‘listen, I am teaching multiplication, do you have anything?’, she will scour resources that I really do not have time to necessarily read through and she will just pick what is best” (Michelle, Interview, April 11, 2017). In fact, Michelle commented that
Linda brought in resources that were not only geared towards Michelle’s immediate needs, but were also engaging for her students. One example of that is:

One time she brought in the game, I Have, Who Has?, which is a game that I had forgotten completely about but it is always a nice minds-on for the kids. We did multiplication game of I Have, Who Has and she came in and observed that and we just kind of talked a little bit about how it went. (Michelle, Interview, April 11, 2017)

Michelle valued and acknowledged the personal time that Linda spent finding ideas, resources and materials to support her mathematics program.

Michelle experienced many different types of professional development, ranging from having taken Additional Qualifications (AQ) courses to workshops provided by the board. Admitting that many AQ courses felt like they were “making work”, she spoke highly about the Principal Part 1 AQ that she attended because it gave her a better understanding of policy and procedures. Michelle also valued the workshops provided by the board, and she made a point of trying to attend one workshop a month.

When asked to contextualize instructional coaching as a form of professional learning, Michelle talked about how relevant it was, and that based on her experience, she would encourage other teachers to initiate working with a coach for the fact that - “I love that it is kind of my own personal workshop” (Michelle, Interview, June 26, 2017).

Michelle showed that she valued professional learning because she attends regular workshops and has taken AQ courses. Additionally, since the inception of instructional coaching, Michelle had sought out the opportunity to work with an instructional coach. Michelle had the same coach for two years. They worked more consistently in the first year before Michelle became too busy to continue the work. However, when Linda began working with her school, Michelle made time to plan with Linda during nutrition breaks. “She is in quite frequently. We try to connect at least once a month” (Michelle, Interview, April 11, 2017).
Michelle said that she valued the learning that took place while she was working with Linda. Unfortunately, Linda was not assigned to Hadacres School for the 2017-2018 academic year. In September of 2017, Michelle had met Linda’s replacement at a board workshop and was planning on connecting with the new coach, “I did meet with her briefly, I ran into her at a conference and she seems very open and very friendly so I will happily invite her in” (Michelle, Interview, Sept. 27, 2017).

A caveat mentioned by Michelle was the importance of working with an instructional coach who would be receptive to Michelle’s ideas rather than “download information”. When probed to define what was meant by “downloading information”, Michelle stated the importance of an instructional coach understanding her class’ needs so that resources provided would be applicable rather than just being told how to do something. Understanding the nuances and conditions of a classroom require time to be spent with the class and the teacher.

The work that Linda and Michelle did together had an impact for others because Michelle shared some of their experiences with the staff at her school. Some of the staff meetings at Hadacres School were set up so that teachers would sign up for sessions run by the teachers on a variety of topics. Michelle had heard that Linda was going to run a session about Number Talks, and Michelle offered to co-present with Linda at a staff meeting. Because Michelle and Linda only planned together and did not plan with the other grade level teachers of Michelle’s team, their work still became public when they shared some their work during a staff meeting.

Michelle was a part of the numeracy committee at her school. As the school initiative focused on building and deepening student’s mathematics vocabulary, Michelle shared with her staff:
The idea of doing Word Talks…and I introduced it to my staff at my staff meeting when we did a little carousel…kind of like an Ed Camp. I gave them resources that Linda had forwarded to me such as this is Number Talks which can transfer to other types of games, or Word Talks. (Michelle, Interview, June 26, 2017)

4.3.7 Case Summary

Both of Linda’s teachers reported positive experiences from the coaching experience. The teachers found Linda to be affable and approachable. Developing a collegial rapport was an aspect that both participants referenced in their interviews and Michelle talked at great length about that as being critical component required for teachers to invite a coach into the classroom. Michelle reported that a friendship had developed between herself and Linda. Kirstin commented that she was disappointed that she and Linda would not be working together in the future. A trusting relationship was deemed to be a critical component of the experience.

Linda established a collegial relationship when working with Kirstin and Michelle, and both teachers expressed enthusiasm about how the experience of working with an instructional coach supported their professional learning. Kirstin utilized Linda to help cover curriculum content for two grade levels by using rich tasks, and Michelle was focused on deepening her students’ reasoning skills.

The teachers had different agendas when working with Linda, yet both were impressed by the resources that Linda provided to support their professional practice. One commonality between the two teachers was the introduction of Number Talks as an instructional strategy. Michelle and Kirstin discussed the benefits of Number Talk sessions for supporting their students with mental math computations and also with reasoning and communication skills, stating that they would continue that practice in the future.
Kirstin and Michelle were recipients of instructional coaching, but as an instructional coach, Linda also discussed the rich learning that occurred for her. Being hired as an instructional coach provided her with vast amount of professional development opportunities.

A challenge that was recorded by both teachers was the lack of time that they had to work with Linda. Both were cognizant of Linda's busy schedule and they did not want to monopolize her time. Because both teachers were meeting with Linda during their own planning times, or personal time during nutrition breaks, or lunch breaks, was challenging given the amount of other tasks that they needed to accomplish during those breaks. Despite the fact that they both sacrificed personal time to meet with Linda, both teachers reported that they would continue to work with an instructional coach in the future. Michelle talked about the experience as having been motivating for her, and that it pushed her to find other types of resources and ways of thinking about instruction. She stated that working with an instructional coach “broadened her mathematical horizon”.

4.4 The Case of Mary

Mary has had experience teaching grade five, grade one, grade two, kindergarten planning time, a one-two split class, and grade three classes over the last 16 years. When interviewed on May 19, 2017, Mary had found out that she had been hired on as an instructional coach on a permanent capacity. Initially, Mary had begun her role as an “acting” instructional coach for a contract that was supposed to end in December, 2016 and then got extended until March, 2017, and then again until the remainder of the year. This meant that she was in the role in a temporary basis because the instructional coach whom she was replacing
was in an “acting” role as a vice-principal. However, Mary’s contract got extended. When describing the experience, Mary notes:

I was ‘acting’ until March, and a week before I was to go back to class, I found out that I was continuing until the end of the year and that it would become permanent in September. When I was working at schools, everyone was asking if it was going to be my last time and I did not know what to say. (Mary, Interview, June 5, 2017)

Mary was ensured that she would return to the role of instructional coach after the role shifted from an “acting” role to a permanent placement.

Mary acknowledged that it was a difficult decision for her to make to become an instructional coach because she was really attached to the staff and students at the school where she was teaching. Mary had worked with an instructional coach when she was a classroom teacher. Mary felt that she could offer math expertise as an instructional coach because she had completed her Masters degree with a focus on numeracy. During the completion of her post-graduate degree, Mary was encouraged by her supervising professor to apply to teach additional qualification (AQ) courses in mathematics. Mary has taught mathematics AQ courses for York University, the Ontario Institute of Education, University of Toronto, and for the Elementary Teachers Federation of Ontario.

4.4.1 Preparation for the Role

To address the component of understanding the role of an instructional coach, Mary participated in a three-day workshop based on West’s (2013) book, *Agents of Change*. The professional learning prepared her by “learning how to co-plan and co-teach, and learning how to debrief” (Mary, Interview, June 5, 2017). Due to the multifaceted professional experiences that Mary had in mathematics, she felt that she was well prepared for the instructional coaching role as it pertained to supporting teachers with their mathematics programs. Mary had been trained by Marion Small in 2005 to use the PRIME resource, and she also had experience
working with Alex Lawson and she understood the continuum of numeracy that is a part of Lawson’s (2015) book, *What to Look For*.

Like the instructional coaching roles in other families of schools, Fridays were to be designated for continuous professional learning for the coaches, and for coaches to have time together to work on their own collaborative inquiry projects that were designed around topics, rather than coaches working within the same family of schools. This made it challenging for the coaches to meet regularly. Mary also noted that this was difficult to sustain because there was not enough time for the instructional coaching cycle to be enacted without having a fifth day to do additional planning. Another factor that made it more challenging to meet on Fridays was because the instructional coaches were being booked for other purposes:

> Fridays used to be the day to get together and debrief and do collaborative inquiry, and we had set up every Friday for us to share research passions with each other, but we have not had time to do that because we have had to be at [Central Board Office] or at the Numeracy Committee meetings. (Mary, Interview, Nov. 9, 2017)

### 4.4.2 Responsibilities

During the 2016/2017 academic year, Mary worked for a superintendent who designated instructional coaches to support schools that matched their teaching qualifications. As a result, Mary supported schools that ranged from kindergarten to grade eight. She was not responsible for working with any secondary schools.

In the 2016/2017 academic year, Mary worked with four schools, with the intention of working with one school for a week every month. She did acknowledge that this was not a rigid schedule:

> If I am working at a school and we have gotten some momentum going, and they want me to come in and do not want to wait three weeks, I can schedule them in if I do not have something else going on at another school that I have allocated time for. There is some flexibility. (Mary, Interview, May 19, 2017)
As Mary was not hired at the inception of the role, she asked other coaches who had more coaching experience for ideas about how to start working within the various schools where she was assigned. It was suggested to Mary that she initiate meetings with principals.

When interviewing Mary on November 9, 2017, she reported that there had been a lot of changes to her schedule because the superintendent whom she had been working with the year prior was no longer in the role and that, since the school year began, she had worked for an interim superintendent who was there for a short while before a replacement was found. The interim superintendent set up a schedule for the instructional coaches:

Our model was to spend three days at one school and then have a day prior to those three days in the school to plan. For example, Thursday be in a school to plan a lesson, to co-plan a lesson, and then we would co-teach Monday or Tuesday so Thursdays are our planning day and Monday, Tuesday and Wednesday are our co-teaching, and debriefing day. And that would be the model. So that started out well and the principals all liked the model. (Mary, Interview, Nov. 9, 2017)

Once the new superintendent was introduced, the model changed so that one day a week was to be spent in each of the schools that the instructional coaches were supporting. This new schedule became challenging to implement because there was not enough time in the one day to do the planning, teaching and debrief. Some of the principals of the schools where Mary worked expressed their discontent with the new schedule, and with agreement from other principals, it reverted back to the schedule that had been implemented at the beginning of the year. However, this put Mary in an awkward position:

I felt pretty torn because here I am implementing what was requested of me by my superintendent in a meeting with the coaches, and the principal is telling me that it is not working for them and to go back to the original model. I said that if was okay with the superintendent, I was happy to meet their needs. (Interview, Mary, Nov. 9, 2017)

Mary also experienced a change of schools. Mary requested to be transferred from one school where the math lead was a grade eight teacher. Mary believed that an instructional coach
with secondary teaching experience would be a better support for that teacher. As a result, the new school where Mary was assigned for the 2017/2018 academic year was a school for students with special needs. This better aligned with Mary’s experience as she had her special education certificate, and she is also extremely interested in special education. She expressed a passion for working with children who have special needs.

4.4.3 Perceptions of the Role

Mary defines the instructional coach as a “peer who is trained in content. ICs [instructional coaches] should have strong content knowledge and strong pedagogical knowledge” (Mary, Interview, May 19, 2017). Mary met with the various administrators and discovered that there was variance regarding her role amongst the schools. Mary noted that “some principals have specific ways that they want to utilize ICs, while other let the IC determine what to do” (Mary, Interview, May 19, 2017).

Mary acknowledged that principals who participate in the school district’s numeracy committee had a better understanding of the role of the coach, as well as how coaches could be utilized to support the school. Conversely:

when I go to schools where the principal is not part of the committee than it is more like they are telling me what their vision is of my role and what they want done and it is my job to blend that in with what our superintendent’s vision is. (Mary, Interview, June 5, 2017)

4.4.4 Teacher Participation with a Coach

The superintendent whom Mary worked for during the 2016/2017 academic year had a specific agenda regarding the educators who the instructional coaches should work with. It was suggested that the instructional coaches seek out each school’s designated math leads as starting points for instructional coaching. The reason underpinning this stipulation was to build capacity within the school. Mary said, “My superintendent’s goal is that the ICs work with the math
leads and coach the leads, which will then have a ripple effect and influence the teachers in their divisions” (Mary, Interview, May 19, 2017). Mary noted that some of the math leads had attended workshops to develop the ability to mentor other teachers and also set parameters around the coaching model. Within the four schools where Mary was working, math lead teachers had varying experience. Mary commented that the role of math leads was transient, with some schools having different math leads every year.

A benefit to having the superintendent make the suggestion that instructional coaches work with the math leads was that it meant that the co-teaching cycles could start fairly quickly, as the teachers were already prepared to work with the instructional coach:

So my job is to work with the math leads. That really broke the ice, knowing that I had two to four people who I was to approach when I visited that school. It is much more difficult in the newer schools where the math leads have not been selected or math leads did not volunteer, then I feel like I am going from classroom to classroom selling my wares. (Mary, Interview, June 5, 2017)

4.4.5 Anne: Background Information

When this study was first conducted, Anne was working at Aimsure Public School, which has grades ranging from kindergarten to grade eight of approximately 1000 students. In the 2016/2017 academic year, Anne was teaching grade 3, and in the 2017/2018 year, she was teaching a grade 2/3 class.

Since the inception of the instructional coaching role, Anne had utilized the coaches assigned to her school. Aimsure School had several coaches assigned to their school because the coaches have been assigned to work as vice-principals. As described by Anne:

She [her instructional coach] got pulled a way for a VP position, and we were like ‘No, do not go’. Then we got a new IC which was great because I had taught with her, and so it was an easy entry, but she only lasted a really short time and got pulled away and she was there such a short time and just getting her feet wet. (Anne, Interview, June 5, 2017)
In beginning of the 2016/2017 academic year, Mary was the fourth instructional coach to be working at Aimsure School.

4.4.5.1 The Coaching Experience

The first instructional coach with whom Anne worked helped to set up a component of Anne’s literacy program. Despite the fact that the instructional coaches’ agenda was to incorporate mathematics, Anne really wanted assistance with implementing a balanced literacy program. Anne said, “It was amazing. She really helped me and now I am flying with the Daily Five. Without her, I would be like trying to swim because my strong suit is in math” (Anne, Interview, June 5, 2017). The Daily Five is a model used by many teachers to integrate reading, writing and word skills into a cohesive language program.

While the content of Anne’s first coaching experience initially applied to literacy, the focus shifted to mathematics when working with Mary. At Aimsure School, there were four designated math leads, including Anne. The math leads were paired with another teacher in the school, forming triads, which included the instructional coach, the math lead, and another colleague, referred to as the protégé. In the 2016/2017 academic year, the triad that was made up of Mary, Anne, and one of her grade level teachers was focused on an instructional strategy commonly referred to as Talk Moves. These include the following:

- the wait time, the interviews, the direct questions, the specific questions that you ask. Also encouraging the kids to also ask those same questions of each other when they are sharing their work with the class. Agreeing and disagreeing with work that they have shown and doing gallery walks and writing a little sticky note on students’ work and saying, ‘I really understand your strategy’ or, ‘Could you explain yourself more clearly’, or, ‘I do not understand what you are saying’. (Anne, Interview, June 5, 2017)

Anne and her colleague focused on having students reflect and share their work with others, as well as respond in thoughtful ways to other strategies or solutions that may have resulted from solving problems. When students make their thinking transparent, teachers’ can
make better understand how to support their students, as well as gather data for assessment purposes. Mary said that the teachers were using various talk moves to gather evidence of where the students were at, and how to move the students along the numeracy continuum. Mary commented that Anne and her colleague had “clear goals about what we are going to do about this triangulation of data. When we have these conferences with these students, we are going to try to use this continuum and ask this kind of question and wait for the answer” (Mary, Interview, June 5, 2017).

Using triangulation of evidence in order to understand students’ conceptual understanding of numbers was evident during the lesson that I observed in Nov. 20, 2017. During the lesson, which was focused on area and perimeter, both Anne and Mary were intentional about conferencing with students as they completed the challenge. Both teachers had a graphic organizer, entitled the Landscape of Learning (Fosnot, 2007), which includes big ideas (overall expectations), models (how the big ideas are taught) and landmark strategies (what the students are doing) as related to specific mathematical concepts.

While the students were working on the challenge, Anne and Mary circulated throughout the classroom, making anecdotal notes while having conversations with the students. This data would be shared and discussed during the debriefing session, to determine next steps and to identify any problems of practice. Anne indicated that having the Mary present during the lesson, and also getting Mary’s feedback after the lesson was of great benefit:

She gets to know the students and their mathematical thinking and she is able to have that discussion with me and then I can bring forward other background information of what they have done in previous tasks, or in previous interviews that they have had with me. (Anne, Interview, Oct., 25, 2017)
Assessment was a component that Mary discussed, noting that it was integral to the co-planning component of the instructional coaching cycle, “We have worked with establishing learning goals, success criteria, and bringing that into various continuums” (Mary, Interview, May 19, 2017). She elaborated that understanding where students fit on the various continuums informs future planning and programming.

Aimsure School had multiple instructional coaches supporting the school since the inception of the role, and Anne took an active role in her professional learning by seeking out opportunities to work with the variety of coaches. Anne remarked that she had known some of the assigned instructional coaches from her past professional experience. However, the instructional coaches who she did not have a prior relationship, Anne commented, “You had to be explicit and introduce yourself and tell them that you want them to come to your class. You have to be the one who wants them” (Anne, Interview, Oct. 25, 2017). Anne took the initiative to invite instructional coaches to work with her, regardless of whether she was familiar with them.

The work that Mary, Anne and her colleague were doing was embedded within the classroom context, which made the professional learning relevant. Anne had experience with working with a variety of instructional coaches over the three-year duration, and she commented that different instructional coaches had different offerings:

Every IC comes with their own package of knowledge and resources. It is really about getting the ICs into the classrooms. A common thread which I have heard all the time from the different ICs who I have worked with is people are scared to invite them into the classroom because they feel that they are being judged and that they are being evaluated and are being assessed and they do not want them there. Once you become an IC, you are bringing a vast amount of knowledge to be in that position so you are a resource teacher at the school level. No matter what they bring, they will always help you, they will always try to improve your teaching, and they will always make things better. (Anne, Interview, Oct. 25, 2017)
Anne valued the work that occurred with the various instructional coaches who supported her school. The fact that the instructional coaches were present in the classroom was of great benefit for Anne, as opposed to an impediment. Anne understood that the instructional coach was not there to evaluate the teacher, but rather to partner with the planning, teaching and reflection process.

When Mary and Anne began working together, it was on a monthly basis. The school had put structures in place so that the triad had time to plan, teach and debrief together. As a result, the professional learning was continuous throughout the 2016/2017 academic year. Anne remarked that Mary was able to make exclamations such as:

Wow, they have really come a long way in their explanations of their strategies or even responding to another student. [Mary] was able to identify that because she had built those relationships, and she has been in the classroom for periods of time and there is that continuity. (Anne, Interview, June 5, 2017)

The time that Anne and Mary were able to spend together in the 2017/2018 year changed for several reasons. One reason was because the math leads and the proteges were no longer working with Mary as a team. Anne continued to be a math lead at the school, however, Mary was pulled into working with other teachers and was not as available to do work with Anne. “Some schools are open arms and they want you so much that you can’t spread yourself so thin, which is what it is like here” (Anne, Interview, Oct. 23, 2017).

Because Mary was working with many other teachers at Aimsure School, the two educators were still making time to work together, but were doing so in a more spontaneous way. Instead of having specific release days, the two would work organically together, “Well she randomly pops in. Her schedule is dedicated to other grades now. She told me that if she does not pop in then she will not be able to see me” (Anne, Interview, Oct. 23, 2017). Anne did admit that, if she were to be able to work more consistently with Mary, as was the model the
previous year, she would use Mary “in the same capacity, she would come in and be a part of the learning, and it would be great if she would be a part of congress and also co-debriefing after the lesson” (Anne, Interview, Oct. 23, 2017).

Mary was also able to shed light about how and why the nature of the work changed from one academic year to the next. In order to build capacity, the math leads at Aimsure stayed the same, but the focus of the instructional coaches was on was the proteges from the year before. The professional learning at Aimsure School was occurring in a collective way, involving multiple teachers, some designated as math leads and others designated as proteges. This was explained by Mary, “We have a group of proteges who are building content knowledge, building pedagogical knowledge, trying things in their classroom, planning together and now those original leads are reaching out to others” (Mary, Interview, Nov. 9, 2017).

4.4.6 Case Summary

Mary and Anne had a comfortable working relationship. The fact that they had known each other beforehand was of benefit, because a relationship had already been established. While the frequency of their work changed from one academic year to the next, Anne still found that the time spent teaching together was beneficial. Anne had a positive comment about the coaching experience, “[instructional coaches] always bring out the best practices and either refresh them for me or bring something new for me. It is not always just for math, it may be cross curricular” (Anne, Interview, Oct. 23, 2017).

Anne remarks that the value of an instructional coach reaches beyond providing resources. She valued the co-teaching process. Anne referred to the importance of planning together in order to anticipate potential misconceptions. She also recognized the benefit of having the instructional coach in during the lesson, specifically as another person to observe
and conference with students which then would be discussed while debriefing the lesson. The co-teaching cycle was something that Anne valued as a means of critically reflecting upon her practice.

Because Mary was new to the instructional coaching role, the experiences that she had working with various principals and even the superintendents provided her with different ways that the role was enacted. It led Mary to conclude that the role has the most impact when specific goals have been identified by the teacher as a challenge of practice. Once that has been identified, the instructional coach can provide research and resources to assist on working through that challenge. Reflection and next steps result from working through specific coaching goals. Mary believed that getting into the classrooms to work with teachers and to reflect together was critical to the coaching role and making it meaningful for teachers.

4.5 The Case of Mark

When Mark became an instructional coach, he had ten years of secondary teaching experience, specifically in the subject area of science. He was hired during the second year of the coaching initiative in an “acting” capacity. Mark expressed enthusiasm for coaching in the realm of mathematics:

I had already a good disposition or attitude towards math. Part of my degree was in math. I had taught math and science so that did not scare me, the idea of dealing with mathematics. In fact, that excited me. My own attitude and predisposition to the subject and understanding of the content, but not necessarily the strategies, but I understood the skills that kids could use to add and subtract, the strategies were new to me. (Mark, Interview, June 12, 2017)
An important consideration that Mark stressed was the notion that instructional coaching should focus on student work, and that by keeping that as the focus, teachers are equipped to consider their practice. His approach to coaching is to begin the conversation with an understanding of what students are doing:

Let us look at the math that the kids have done. Let us use that as the third point. Boy, is that ever powerful because it shifts the focus away from the teacher to say, this is what little Johnny produced, let’s talk about math here. How is the four-step problem solving working for Johnny? What could we do differently? Then the discourse changes cause it shifts from the teacher to the student, and it is the student who we are ultimately here for. Again, the purpose of coaching is to improve student performance, their learning through our practice, both instruction and assessment together. (Mark, Interview, June 12, 2017)

4.5.1 Preparation for the Role

When Mark was hired to be an instructional coach, the coaching program was already in its second year. As a result, Mark did not receive the same professional development as the first year instructional coaches, including workshops with Lucy West. Instead, Mark’s cohort of instructional coaches who were hired at the same time watched videos about the coaching process and discussed the role of coaching, and the coaching cycle including co-planning, co-teaching and debriefing. Mark commented that, despite the workshops that he attended, most of the learning happened while in the role. In February of 2016, six months into his acting as an instructional coach, Mark received professional development that focused on mathematics:

In the beginning of the year [February 2016], we had a three day coaching, specifically content coaching in mathematics. Lucy West and her team came from Metamorphosis and we had a full day of primary, a full day of junior, and a full day of intermediate content. We dug deep into algebraic reasoning. How do we develop algebraic reasoning? How do we move from patterning to algebraic reasoning? (Mark, Interview, June 12, 2017)

During that same year, Mark also received specific professional development specific to the PRIME resource.
When Mark began his second year as an instructional coach, he attended what he referred to as a coaching institute with Lucy West. Mark commented that attending the coaching institute in his second year as an instructional coach was of great benefit because it consolidated the learning that had occurred for him the year before. In the 2017/2018 academic year, when Mark was beginning his third year as an instructional coach, he helped to facilitate the professional development of the coaching institute and delivered it to the instructional coaches who were just hired.

4.5.2 Responsibilities

Mark supported five schools. Of the five schools, four were elementary, and one secondary school, which was the same from one year to the next. As a secondary teacher supporting teachers in the elementary schools, Mark initially was concerned about working with primary teachers:

Our superintendent really believes in the K-12 model. Initially when I was told that you are supporting four elementary schools last year around this time, there was a little bit of, how am I going to do this? How am I going to go into a math classroom and work with math teachers when I have never taught grade one? One of my biggest challenges, the feeling that comes along when you know that you are going to face a challenge, was working in the primary years. How am I going to teach the concept of time or fractions, strategies for addition and subtraction, any of the operations when I have never had that exposure? Never thought about one particular addition strategy aside from your standard algorithm. So for me that was a huge undertaking, but also one of the best experiences. (Mark, Interview, June 12, 2017)

When reflecting about his role as a coach, Mark differentiated between co-teaching and providing professional learning in more traditional stand-and-deliver type activities. The bulk of his work was participating in co-teaching and 20% was spent providing school-wide professional learning, either by facilitating at staff meetings or offering lunch and learn sessions on a variety of resources. When providing professional development sessions to the whole
school, Mark tried to co-present with teachers so that he would not be presenting alone. He did this intentionally, understanding that he did not want to appear as the expert.

When asked to present at staff meetings, Mark would often approach teachers asking for their assistance. This was done so that he would not appear as the “sage on the stage” (Mark, Interview, June 12, 2017), and be perceived as a co-learner rather than as an expert. If he is positioned as a co-learner, Mark believed that he would have more opportunity to get into classrooms, as teachers would be more open to the process of co-learning together:

What I find is when I position myself as a learner, when I say, ‘Look, I have not done this before but I will be willing to come to your classroom and I will do it, I will try and I have no problem with making mistakes’. (Mark, Interview, June 12, 2017)

Mark communicates to others that he is a part of the learning journey with them. He will provide resources, ideas and feedback, but he is adamant about the co-learning perspective.

4.5.3 Perceptions of the Role

When Mark was initially interviewed for the study, he was in his second year as an instructional coach and had switched from one family of schools to another, therefore he had experience working with different superintendents. He acknowledged that there were inconsistencies about how the role was implemented amongst different areas of the school district, but he felt that “in our superintendency, we have very clear message to the principals about what our model is: co-planning, co-teaching, debriefing and we want to work in these coaching cycles.” (Mark, Interview, June 12, 2017). Mark was also intentional about conveying the role of the instructional coach to the teachers with whom he worked:

So my particular approach is to make sure that the teacher understands the coaching initiative and the coaching relationship that we are about to embark on. There is an initial commitment to this and the teacher is open to this process, so it is not someone unwilling to be coached. We begin by reviewing what that purpose [of coaching] is which is to improve student performance by improving teacher practice. (Mark, Interview, June 12, 2017)
Mark felt that he had more impact with teachers if the learning went deep, meaning that he wanted to focus on one aspect of a teacher’s practice and explore it. He believed that trying a lot of different instructional approaches meant that the learning might not be as meaningful:

We really need to examine what is working, what is not working and it is not about the coach’s agenda, it is about having an open and honest conversation with the teacher who is interested in being in this co-learning journey to say, ‘This is what I have identified as my problem of practice and here are a couple of areas that I would like to explore.’ We can determine together what might be the best intentional instructional strategy that we can focus on. It is always best, in my opinion to focus on something deep, that is specific rather than just focusing on a bunch of things. (Mark, Interview, June 12, 2017)

4.5.4 Teacher Participation with a Coach

Mark initially began working with designated math leads at schools, however, there were some teachers who approached him who were not the math leads at their schools. Mark discussed this matter with his superintendent who was open to having Mark work with other teachers seeking his support. Mark found that the work that he did with one particular teacher who initiated the work with him was impactful because she had intentionally chosen to embark on the instructional coaching cycle because she was not a math lead at her school.

This contrasts another experience that Mark had when a principal told him that he was to work with two teachers with whom the administrators wanted him to help. Mark said that the teachers had not expressly chosen to work with Mark, but were strongly encouraged to:

When a principal presents it as, ‘We want you to work with the IC’, there is the message that you might need that as opposed to you coming to your own realization that you want to work with somebody because you are genuinely interested. Choice is hugely important. (Mark, Interview, June 12, 2017)

Mark found that the work resulting from these instances were less impactful with one teacher frequently cancelling the sessions. The other teacher was more receptive to the process
and Mark believed that some impact had resulted, but it still was little compared to other teachers who had sought out his support.

When interviewing Mark in October 2017, he continued to support five schools, four elementary and one secondary school. Mark commented that he was extremely busy working with various teams. He commented:

Word gets around. This is my second year so I have established relationships. So going into second year in schools where I have already been means that word has gotten around and they know me, and as a result the work that I did last year with certain people has spread so more want to work with me. I have to manage that so that I do not spread myself too thin. (Mark, Interview, Oct. 4, 2017)

4.5.5 Carrie: Background Information

When interviewed in November 15, 2017, Carrie was in her fifteenth year as a teacher. The bulk of her teaching experience was in the primary grades, ranging from grades one to three. During the 2016/2017 academic year, when Carrie began to work with Mark, she was teaching grade four of the first time in her career. Carrie was teaching a grade three and four split class. Carrie works at Sliver School, a kindergarten to grade five with approximately 250 students in attendance.

Even though Carrie was not a designated math lead at her school, she worked with Mark during the 2016/2017 academic year, and they continued their work for the 2017/2018 academic year. Initially Carrie approached Mark to work with her for the purpose of planning her math program using what is referred to as a spiraling approach:

I had heard a lot about spiraling and it has never made sense to me that we teach a month of addition and subtraction and then we move on and never go back. We expect kids to understand area and perimeter the following year but they have not seen it in nine months. I was trying to wrap my head around the split grade class and how do I meaningfully spiral the curriculum. (Carrie, Interview, Nov. 15, 2017)
When Carrie began discussions with Mark, she originally wanted to plan together to implement spiraling into her program. Mark was insistent that they co-teach together, and Carrie agreed due to his persistence. Carrie had not always found working with an instructional coach to be of benefit to her:

It is kind of walk in the door, do a lesson, and say that was great and walk out and then you do not see them again. So I did not find that it helped or had any value for me as a teacher. So I went to talk to the IC [Mark] about spiraling the curriculum and he said that we should teach together. I said, “No, no, no. I just want to talk about spiraling the curriculum.” And he said, “No, no. We will co-teach together.” Finally, I said, “OK. Fine.” (Carrie, Interview, Nov. 15, 2017)

Thus began the work of the two meeting frequently to co-plan, co-teach and debrief.

### 4.5.5.1 The Coaching Experience

While Carrie’s initial plan was to incorporate spiraling into planning her mathematics program, her focus switched from long-term planning to create a template to support her students when engaged in problem solving type activities. This shift in focus resulted from Carrie noticing that her students were frequently only solving parts of a problem, and that the students were not always finding solutions that reflected what the problem was asking. She concluded that it resulted from a lack of fully understanding the problems that were being presented to the students. In order to slow her students down to fully consider what the problem was asking,

Carrie and Mark created a problem-solving template that forced the students to restate what the problem was asking the students to figure out, choose a strategy that the students would attempt, then a portion of the template was designated for the students to do the work, and the fourth part was left for the students to look back to make sure that the solution was reasonable and to write a concluding sentence. Carrie and Mark worked on various versions of the template throughout the 2016/2017 academic year:
We kind of started developing a template that morphed as we went through the year of trying to get kids to understand the problem solving process better. My chief complaint with the kids is that they do not seem to understand the questions. They do not read the problems effectively so we took it from there and started developing this template. We had a first draft of it, and then when we realized that maybe it needs to have this to make the kids understand this better, this template kept morphing until it got to something that I found was really great for the way that I teach. (Carrie, Interview, Nov. 15, 2017)

During the 2016/2017 academic year, Mark and Carrie were focused on this aspect of the mathematics program. When assessing Carrie’s needs for the 2017/2018 year, the focus shifted at the beginning of the school year. This was partially because Carrie was teaching a split grade three and four class that had a mix of students who were newcomers to Canada with minimal English, other students who had some English, but who were still also receiving English Language Learning support, combined with students identified with special needs.

Carrie had been trained using the PRIME resource so she and Mark decided that it would be beneficial to administer a diagnostic assessment to determine the needs within the classroom. I was present during this assessment, and observed how both Mark and Carrie circulated throughout the classroom to support various students. Carrie and Mark then took the diagnostic assessments to determine next steps for Carrie’s class:

We went through that diagnostic and looked at who was where and where some of the deficits were so we would know what to focus on when we got to that and after giving that diagnostic tool, we discovered that my kids are all over the place. (Carrie, Interview, Nov. 15, 2017)

When back in to observe on Nov. 27, 2017, the focus was on problem solving involving the operation of multiplication. The template that both Carrie and Mark had created the year prior was being used, with the learning goal and the success criteria included at the top of the problem solving template. The importance of making the learning goal and success criteria transparent to students was an aspect of Mark’s instructional coaching that he was emphasizing:
exploring assessment, good components of formative assessment, creating success criteria and descriptive feedback and the importance of learning goals and success criteria so that we can go back and actually give feedback that is meaningful. (Mark, Interview, June 12, 2017)

Although Carrie had reservations about working with an instructional coach based on her prior experiences, she did take an active role by initiating a conversation with Mark to help her with programming her mathematic curriculum to incorporate the notion of spiraling. Although the focus switched from planning to problem solving, she was fully engaged in the process as her commitment meant that she was willing to spend her lunch time and planning times to work with Mark. When asked when she had time to work with Mark, Carrie’s response was:

We do that on lunch. And all of my planning is done on my own time. Last year I was lucky enough that I could book him after lunch so we could plan then. But this year, that is not so, so we plan during lunch. (Carrie, Interview, Nov. 15, 2017)

In the 2016/2017 year, Carrie concluded that her students were not fully implementing the problem solving process to be able to find solutions to rich word problems. As a result, Carrie and Mark created a template and sentence starters to help her students to think about what the problem was about and to think of strategies that could be used to help find a reasonable solution. While the problem solving template was used again in 2017/2018, Carrie initially wanted Mark to help her run a diagnostic assessment so that she could be more proactive with her planning. Mark was a part of the process of planning, teaching, assessing and consolidating:

He would come in and we would co-teach the lesson and then we would debrief and go over the kids work together to kind of see who got it, who did not, why they did not, what were some of the misconceptions, how can we rework the template, or is there a need to rework the template that we had developed. We would then plan the next lesson. (Carrie, Interview, Nov. 15, 2017)
During the 2016/2017 year, Mark and Carrie would meet about once every three or four weeks. As stated by Mark:

In our superintendency, we really emphasize the importance of co-planning, co-teaching and debriefing over an extended period of time. It cannot be a one-off. We do not get impact if I work with you just that one time. (Mark, Interview, June 12, 2017)

Mark also recognized that learning occurs over time, so he was also enthusiastic about continuing the work that he was doing with Carrie from one year to another.

The work that Carrie and Mark did together had implications for others because they shared their problem solving template at a math conference hosted by the school district. Carrie and Mark co-presented the problem solving template that they had co-created. This template was also shared with the other teachers at Carrie’s school:

It has been discussed at staff meetings and copies were handed out. Me and my IC did a workshop at the board’s math conference in the spring. We did a workshop at the conference based on problem solving and using the template. (Carrie, Interview, Nov. 15, 2017)

4.5.6 Case Summary

Carrie had not always found value when working with an instructional coach. However, she was willing to initiate a conversation with Mark to learn more about planning her math program. Carrie’s curiosity and inquisitiveness set a course to begin working with Mark. Mark believed in the model of instructional coaching as co-planning, co-teaching and debriefing is an effective means for making change. Therefore, Mark was successful in getting Carrie to participate in the coaching cycle of co-planning, co-teaching and debriefing with him. The instructional coaching dynamic that the two established was responsive and adaptable, which meant that Carrie’s original agenda shifted as she considered the needs of her students.

The learning that resulted from focusing on problem solving had impact given that it went through several revisions to get it to the point that Carrie now uses it with her current
grade. Carrie noted that it benefited her students so that they could clearly understand what the problem was asking and then be more successful in using effective strategies to find solutions.

The fact that Carrie was using Mark again in the following academic year demonstrates her commitment to learning. Mark also had an opinion that instructional coaching be something that continues from one year to the next as he recognized that it helps for the learning to go deeper.

4.6 Chapter Summary

This chapter describes instructional coaching as a form of professional learning in the realm of mathematics from the perspective of the participants. Each case was examined using the core components of effective professional learning as described by Desimone (2009). The content or focus of the instructional coaching experience is described in each case. The nature of whether the learning was active, meaning that the teachers played a part in determining the coaching agenda was also considered. Another element analyzed was the relevance of the coaching sessions, and whether the teachers believed that there was coherence between theory and practice. The duration of time spent in coaching cycles, as well as the collective nature of learning were also summarized in each case.

It became apparent that the participating teachers took an active role in their learning by the very nature that they made time to meet with the instructional coach and invite the coach into their classrooms to co-plan, co-teach and debrief. The fact that the teachers took an active role in their professional learning meant that they created the agenda for what they wanted to accomplish with their respective instructional coach. By being able to determine their own challenge of practice, the learning that resulted was coherent and relevant for the teachers, embedded in their own practice. While some of the teachers worked with the instructional
coaches on their own, or as part of a collaborative inquiry, the learning that occurred was collective, and in some cases was shared within the school, and even within the school district. The time spent engaged in this form of professional learning was sustained over an academic year, and in some of the cases, continued into the next academic year.

Each case presented in this chapter is unique, given the context of the schools, the grades being taught, the experience of the teachers, and the relationships that developed with the coaches. Despite the differences, when using the lens of Desimone (2009), it is apparent that all of the examples incorporated the core components of effective professional development programs.

It appears that the teachers’ practice in mathematics was influenced by the work that they were doing with their respective instructional coaches. Evidence of new instructional strategies being utilized, such as Number Talks, math games, or rich problem solving tasks are evident in the case studies. Working with the instructional coaches also informed assessment of mathematics by means of debriefing. A more detailed account of the mathematical learning that occurred is included in Chapter Five, as the cases are analyzed to answer the original research questions posed in Chapter One.
CHAPTER FIVE – CROSS CASE ANALYSIS, INTERPRETATION AND DISCUSSION

5.1 Introduction

The previous chapter presented each case as a singular unit, examining the participants’ perceptions and experiences about instructional coaching as a form of professional learning. The research questions posed in Chapter One are used as a framework to organize the content:

1. What are the perceptions of instructional coaches engaged in mathematics instructional coaching?
2. What are the perceptions of teachers engaged in mathematics instructional coaching?
3. How has instructional coaching influenced or shaped teachers’ mathematical teaching and learning?

This chapter includes a cross case analysis to consider how instructional coaching, as a form of professional learning, has shaped professional practice in mathematics education from the participants’ perspectives. Major findings are included, as well as a discussion about the implications of the findings. Further research will also be recommended. Embedded in this chapter are suggestions about how to implement the role of instructional coaching.

5.2 What are the experiences of instructional coaches engaged in mathematics instructional coaching?

The instructional coaching model utilized in the Ontario school district where the study was conducted is founded upon West and Cameron’s (2013) model, positioning the instructional coach as a co-learner, partnering with a teacher or a group of teachers to co-plan, co-teach, and debrief lessons, with an emphasis on mathematics. While this is the consistent framework on which the instructional coaching role is based, it became evident that the experiences of the instructional coaches varied in the different regions within the school district.
5.2.1 The Role of the Superintendent in Shaping the Experiences of Instructional Coaches

The superintendent impacts the experiences of instructional coaches who are supporting a particular family of schools. Linda was the only instructional coach who had experienced working with just one superintendent, whereas Tracy, Mark, and Mary had worked with different superintendents since being hired as instructional coaches. The participants said that some superintendents have instructional coaches support either secondary, intermediate or elementary schools, based on the instructional coaches’ teaching qualifications. Other superintendents use instructional coaches to serve all of the educational divisions, regardless of the instructional coaches’ teaching experience.

The instructional coaches understood the rationale for having instructional coaches support primary, junior, intermediate and secondary divisions for building continuity amongst the divisions, however, Linda and Mark did mention that there was a significant learning curve required in order to adapt to working in schools where they did not have the same teaching experience. One of the superintendents with whom Mary worked gave her some flexibility about changing one of her schools because she thought that an instructional coach with secondary teaching experience would better serve the grade eight math lead.

The superintendents have authority to determine the set of schools each instructional coach are assigned to, and they also impact the scheduling of the instructional coaches’ time. Mary spoke about how her schedule was influenced by the various superintendents who had been assigned her family of schools, and how she had to navigate the varying schedules resulting from the change in superintendents. Mary alluded to how this created tension because
she had to negotiate two levels of authority: the superintendent’s vision and the principal’s agenda.

Instructional coaches report directly to superintendents yet they work within settings where the principal holds authority. If the superintendent and the principal have differing agendas or models about how the instructional coaching role be enacted, the experience of the coach can be one of working within this tension. For instance, a principal may want to schedule the instructional coach’s time in a different way from how the superintendent scheduled instructional coaches’ time. As observed by Mary, a flexible approach is required. Linda did work within a certain amount of flexibility because she was able to shift the schedule of her schools based on the needs of the teachers whom she was supporting, even though this differed from the original model that the superintendent had arranged. West and Cameron (2013) recommend that the role of the instructional coach be centralized, so that it is enacted at the district level. The rationale for that is so the role is understood with:

agreed upon framework, formats, goals, purpose, roles, etc. should underpin the work across the district. Co-creating a design that everyone in the district can commit to is easier to accomplish when you have the authority to get all the main players in the same room and allow them to help shape the work. (West & Cameron, 2013, p. 21)

The superintendents are the centralized administrator who works with the principals and instructional coaches for their particular family of schools. This means that the role varies within the school district, but is somewhat consistent amongst the superintendent’s family of schools. This allows for some flexibility in the role, to adapt to the end of particular schools regions, but also means that there is variance within the school district.
5.2.2 The Role of the Principal in Shaping the Experiences of Instructional Coaches

Another common theme identified by the instructional coaches was the role that the principal played in shaping their work. In the schools where the principals partnered with the instructional coaches to plan professional activity days, or to work on various theory of action statements for school improvement plans, it was easier for the instructional coaches to recruit teachers to work with them. The principals have the authority to put supports in place to allow for extra time to plan together and debrief, as was the experience of Tracy and Kathy. Linda also discussed how there were some schools where she felt that she had more impact than at others because of the way in which the administrators included her in supporting the staff’s professional learning.

While the coaching model is based on co-teaching cycles, many instructional coaches who worked closely with principals would also offer lunch and learn professional development sessions to introduce a new math manipulative, or a to discuss a specific resource. Instructional coaches also discussed how they would contribute during staff meetings. Although the instructional coaches commented that lecture format workshops are not the most effective form of professional learning, Mark made a point of trying to get some of the teachers involved in delivering professional learning by assisting him with leading the sessions. He consciously wanted to position himself as a co-learner with the staff members, and he navigated stand-and-deliver types of professional activity by acting as a facilitator and not as an expert.

The role of the principal could be a source of support in the form of providing release time, and coordinating planning times, but the principal could also be a source of tension. This tension occurred when the principal selected the teachers for the instructional coach to work with. Mark commented on having to work with a couple of teachers who were told to work with
him by the administrators of the school. Mark perceived that his impact was limited because the teachers had not initiated working with him.

Linda experienced a similar situation, being asked to work with a teacher for the reasons of supporting that teacher with a perceived challenge of practice. Linda noted that it placed her in an uncomfortable position to have the principal’s agenda overlaying the work that she was doing with that teacher. Linda thought it would be beneficial to establish a framework for coaches and administrators to work together given the impact that she perceived that they had in regards to making an instructional coach’s work effective.

The principal is a crucial factor, significantly influencing the success or limitations of instructional coaching (West & Cameron, 2013). Knight (2011) argues that principals need to be the first learners in their schools. Principals who model co-learning by engaging in learning alongside the staff help to create a climate for learning in their schools, which then make the role of the instructional coach one that is more readily received by staff. As noted, “If we want students to be learners, then teachers need to be learners. If we want teachers to be learners, then principals need to be learners” (Knight, 2011, p. 76). The principal sets the tone for the school’s learning culture (Knight, 2011; Mangin & Dunsmore, 2014; Waters, Marzano & McNulty, 2003), but also has the authority to support the coaching initiative by providing resources, time and structural supports so that teachers are able best utilize this form of professional learning (West & Cameron, 2013).

5.2.3 Math Leads and Instructional Coaching

One of the initiatives of the Ministry of Education’s Renewed Math Strategy for Ontario (2016) was to have schools designate two math leads or specialists. This role is described as “a current educator in a school whose responsibility is to deepen their math knowledge through
professional learning, to apply this learning in the classroom and to share strategies with other teachers” (Ministry of Education, 2016). While the ministry offers a description of what a math specialist or math lead in a school might be, the description is vague. Mary and Tracy commented that schools where math leads had been assigned provided a productive way for the instructional coaches to begin working within a school. They noted that they were doing work in schools with the specific math leads, which was endorsed by the principal and the superintendent.

In some families of schools, the superintendent had stipulated that instructional coaches work with the appointed math leads, but this was not consistent across the school district. Mark noted that some schools had not identified math leads, so in many schools, instructional coaches were working with teachers not identified as such. Mark also noted that there was not a definition of the role of the math lead. The ambiguity of the role could have been a contributing factor as to why there were inconsistencies about teachers being appointed to the role. Another reason for the lack of math lead teachers is due to lack of teachers feeling competent to assume the role, creating a “gap between the need for math lead teachers and the available pool of individuals equipped to assume the role” (Colgan, 2016, p. 18). Incorporating math leads into the instructional coaching framework could be a productive means for initiating relationships between the schools’ staff and with the instructional coach, however, math leads require professional learning to prepare them for that leadership role (Colgan, 2016).

5.2.4 The Transient Nature of Instructional Coaching

My study began during the third year of the instructional coaching initiative. I originally wanted to recruit participants who had been in the role since its induction to the school district. As I began to search for participants, it became apparent that many instructional coaches were
either just hired or were “acting” in the role, meaning that the instructional coaches were only temporarily hired. The fact that there were acting instructional coaches led to ambiguity about whether the contracts would be extended for the following academic year, or in the case of Mary, even for the remainder of the 2016/2017 academic year. Acting instructional coaches were often filling in for instructional coaches who had been promoted to acting vice-principal positions.

Tracy was hired at the beginning of the instructional coaching initiative. Linda, Mark and Mary were hired after the beginning, and in an acting capacity. Mary had been assigned to schools where there had been a lot of turnover of instructional coaches, and she commented that teachers would frequently question whether she was going to be able to continue working with them for the remainder of the academic year.

All of the teachers, except Kathy, reported having worked with various instructional coaches. Linda was working with Michelle and Kirstin, who had other instructional coaches assigned to their schools in previous years. Anne reported that Mary was her fourth instructional coach. Given the importance of building trust and a rapport with the instructional coaches (Knight, 2011), the fact that there are so many changes of personnel is important to highlight as it may have implications as to the effectiveness of the coaching model. Working in an acting capacity does impact the experiences of the instructional coach.

West and Cameron (2013) explains that the coaching initiative takes time to evolve. Specifically, coaching:

takes three to five years to take root in a system. In year one, new hires are often people with little or limited coaching experience…Year one is often a time when people are finding their way; trying to define their role, initiate and develop relationships, and establish schedules that work. (p. 22)
Year two is described as the year that confidence grows, as well as the establishment of relationships (West & Cameron, 2013). By the third year, the coaching role should have taken root in schools, with evidence of improved student learning. Year four and five allows for the message to be spread amongst the school staff to harness more attention and work with the instructional coach (West & Cameron, 2013).

The notion of time is important to consider when it comes to implementing instructional coaching as a form of professional learning for the purposes of supporting educators with their mathematics practice. Understanding that instructional coaching is a process that requires time to develop relationships (Knight, 2006), school districts may want to consider placing instructional coaches in the same schools for extended periods of time. As instructional coaching is considered a leadership position, many instructional coaches may consider the role as a stepping stone to administrative positions. While instructional coaching provides educators with the experience to see whole systems at play, and work alongside administrators to support professional learning in schools, it should be encouraged for instructional coaches to continue for a specific period of time before being advanced to administrative roles.

5.2.5 The Positive Experiences of Instructional Coaching

The instructional coaches recounted many positive experiences when partnering with teachers to improve their practice. The instructional coaches all referenced the impact that they perceived that was powerful when being in the classrooms, co-teaching, facilitating and working with various groups of students. The classroom experiences that the instructional coaches referenced ranged in variety: leading Number Talks, modelling talk moves, providing and participating in math games, leading math provocations such as Which One Doesn’t Belong to activate student thinking and reasoning, as well as working with students to problem solve.
while recording anecdotal notes to assist teachers with assessment. Some coaches commented that they wanted to be perceived as more than just a provider of resources, and getting into the classrooms provided them with opportunities to partner with teachers for the purposes of improving practice.

Another positive element of the coaching experience was the diversity of influence that the coaches reported. This range of influence can be thought of as a spectrum from working individually with teachers in their classrooms, to working with groups of teachers, including math leads, on collaborative inquiry projects. Some coaches referenced working with theory of action statements with administrations, impacting school improvement measures. This ability to flexibly work with individuals, groups of teachers, as well as with administrators and superintendents provided the coaches with many opportunities to shape professional learning. The coaches were “positioned to see and impact the daily teaching practice of classroom teachers. Yet, they are also positioned to see the much broader picture of what is happening schoolwide and at the district level” (Hull, Balka & Miles, 2009, p. ix).

5.2.6 The Challenges of Instructional Coaching

All of the instructional coaches discussed time as being a challenge to their practice, which aligns with the scholarly literature about the challenges of coaching (Knight, 2009; West, 2013). Usually four to five schools were assigned to each instructional coach. Even though the instructional coaches were given a framework for scheduling their time, as well as some flexibility about how their time was allocated, all of the instructional coaches reported that they felt that they were not capable of being able to spend the amount of time with the various teacher and classrooms that they wished they could.
The cycle of co-planning, co-teaching and debriefing is a complex process that requires time for pulling resources, identifying learning goals, highlighting success criteria, and anticipating student misconceptions. Aligning schedules to be available to co-teach the lesson can be a challenge, combined with the time required to debrief lessons, to compare student data, and to reflect on the learning that occurred. It became evident in the interviews that the instructional coaches were not always able to participate in all three dimensions of the coaching cycle with their teachers due to the challenge of supporting other teachers in other schools, and being able to align schedules.

One way to overcome some of those challenges was to do some co-planning via email or by using google docs so that the lesson plans could be done in advance, without trying to meet together in person. Following a lesson planning template is also beneficial, focusing on the big ideas that are being covered (West & Cameron, 2013). Targeting the learning goals or objectives, identifying the strategies and potential misconceptions, as well as questioning how and why it is being taught are ways to keep the planning sessions efficient.

Debriefing was another part of the coaching cycle that seemed to have less time than required, because the teacher participants said that they found debriefing to be critical in helping with assessment, and also for future planning. While the teacher participants and the coaches recognized the importance for the debriefing to occur, having the time to critically reflect on next steps was a challenge of time. West and Cameron (2013) describe the challenge of having adequate time to debrief, and recommend sending a written reflection within 24 hours, in addition to meeting with one another after teaching a lesson together.

In Tracy and Kathy’s coaching dynamic, the school administrators did provide Kathy and her teaching colleague extra time to work with Tracy so that they could fully participate in
co-planning, co-teaching and debriefing together. Putting structures in place, such as scheduling collective planning times is one way to support the coaching initiative.

When discussing the notion of time with the instructional coaches, some mentioned that they felt like they lost some momentum because they were spread amongst too many schools. Other coaches commented that there was increasing interest by other teachers who wanted to work with them so trying to balance their time amongst all of the teachers requesting to work with them was a challenge.

Because some of the instructional coaches were assigned to schools that did not reflect their teaching qualifications, this proved to be challenging for some of the coaches to learn pedagogies and content that differed from their professional experiences. It would be advantageous for the school district to consider whether the model is most effective by having instructional coaches serve all panels, or whether instructional coaches are best to work in schools that align with the instructional coaches’ teaching qualifications. I would argue that instructional coaches determine the sectors that they feel would be most effective, as in the case of Mary who was able to switch schools with another instructional coach. Given that the coaching model is based on co-teaching, it is a challenge for instructional coaches to have the required content knowledge of divisions that they have not received certification to teach. An effective coach “needs to have intertwined content and pedagogical content knowledge” (West & Cameron, 2013, p. 135), therefore coaches with elementary experience may have relevant pedagogical knowledge for a secondary school, but lack content knowledge of the mathematics curriculum.

Another obstacle mentioned by the instructional coaches was the notion of teachers wanting to keep their practice private and reluctance to work with an instructional coach.
Because the instructional coaching model is based upon co-teaching, it inevitably means that coaches be present with teachers in their classrooms during lessons.

While some of the instructional coaches mentioned that teachers were opening up their practice to other teachers and administrators, they commented that there still exists a mentality of privatization of practice. Tracy mentioned that one way of overcoming that was by the climate nurtured by the principal. Being in schools where the staff are working on collaborative inquiry projects together builds a sense of collegiality and support thereby teachers may be more willing to share their practice with others (Tam, 2015).

5.3 What are the perceptions of teachers engaged in mathematics instructional coaching?

All of the teachers who participated in this study reported positive experiences from the instructional coaching initiative. While the teacher participants expressed different reasons as to why the instructional coaching was beneficial for their practice, all of the teachers co-taught with the instructional coach, aligning with the model of the instructional coach as co-planner, co-teacher and co-debrief. During the interviews with the teachers, it became evident that they perceived the instructional coach as someone whom they could plan and teach with, as well as another person to help with assessment.

Kathy reported that having worked with Tracy shifted the way that she thought about various elements of her practice ranging from using problem solving as a means of illuminating concepts, to using purposeful manipulatives, as well as utilizing ongoing assessment practices by listening to students discuss their ideas and solutions. Kirstin noted that Linda assisted her with planning and using rich tasks to target multiple curriculum objectives for her split grade
class. Michelle appreciated the engaging ideas and provocations that Linda supplied her with, as well as sharing lessons that Linda had witnessed in other schools.

Anne commented about how Mary helped her pinpoint where students were at using various numeracy continuums by using triangulation of evidence. Carrie and Mark worked on assessment, as well as teaching through problem solving. While the teacher participants had varying experiences with their coaches, they all expressed appreciation and gratitude for the time and effort that the coaches put into supporting their practice.

A common trait shared by the teacher participants was the fact that they appreciated the resources that the coaches provided. The types of resources that the teachers remarked about ranged from having the instructional coaches supply them with problem solving activities, open-tasks, games, video clips and ways of using manipulatives to support lessons. While the teachers commented on the variety of resources that were provided by the coaches, both Mark and Tracy mentioned that they did not want teachers to only view them as resource providers, which can be an obstacle to coaching if the coach is perceived in that way (West & Cameron, 2013). All of the coaches in this study wanted teachers to view the role of instructional coaching as a partnership to co-plan, co-teach and debrief together. Given how busy teachers are, the coaches were instrumental in being able to provide resources such as book chapters, video clips, lesson ideas, that were time-consuming for teachers to source for themselves (Loucks-Hoursley, et. al, 2010). The instructional coaches were able to provide the teachers with valuable resources, which saved the teachers’ time. Providing the resources was supplementing the co-teaching cycle, and not done in isolation.
5.3.1 Capacity Building

Another theme that became apparent was the nature of capacity building amongst the teacher participants. Capacity building within a school’s organization means that teachers “employ their individual knowledge, skills, and dispositions in ways that advance the collective work of their schools” (King & Bouchard, 2011, p. 654). Michelle adapted the Number Talk sessions to create Word Talks to support her students with mathematics vocabulary. Michelle shared this during a staff meeting by offering it as a session that teachers could attend to learn about how to support mathematics communication.

Anne was a designated math lead at her school. The work that she was doing with Mary involved working with another colleague, which was referred to as a protege. The purpose for this model was that, by including the protege in the co-teaching cycle, capacity building occurs within the school. When interviewing Anne the following academic year, she commented that she was working less with Mary as the focus was shifting to the proteges who were then working with other staff members.

Carrie and Mark shared their problem solving template with staff members, and also presented it at a conference hosted by the school district. It became evident that the teachers who experienced instructional coaching were willing to share their learning with others thus building capacity within the school.

Instructional coaching is structured to build capacity. The instructional coaches commented on the vast amount of professional learning that accompanies the role. Instructional coaches are only hired for a three-year term, with the idea that they will return to schools in a teaching position. While this is the intent, it is important to note that many instructional coaches are being promoted to administration. The concept of capacity building and how that is
experienced by both the teachers and the instructional coaches is a factor that needs to be considered when implementing the role across the school district.

5.3.2 Risk Taking

The teacher participants referenced circumstances of trying new instructional approaches as a result of working with their respective instructional coach. Both Kirstin and Michelle began using Number Talks with Linda modelling the first few sessions for them. Kirstin noted how engaged her students were when participating in Number Talk mini-lessons. Michelle was incorporating Number Talks into her practice for the following academic year, with some adaptations. Both participants also discussed how they were using more open-tasks that evolved from co-teaching with their instructional coach.

Kathy tried new instructional approaches as well, mentioning how she was more inclined to have the students learn through problem solving, and not by using a textbook as the basis for her mathematics program. Carrie also took risks when working with Mark. She did initially express some reluctance to have Mark co-teach with her as mentioned in Chapter Four. Regardless of this initial hesitation, she took risks and adapted the work that they did together to meet the needs of her students.

5.4 How has instructional coaching influenced or shaped teachers’ mathematical practice?

To address this question, the mathematical practices that were utilized by the teachers and the instructional coaches are examined using the framework of the Ten Dimensions of Mathematics Education Continuum (McDougall, 2004). As described in Chapter 3, when examining the mathematical practices using the Ten Dimensions of Mathematics Education Continuum (McDougall, 2004), only eight of the ten dimensions (McDougall, 2004) are in the
discussion, and this question is organized around the dimensions, beginning with the most weighted with data, to the least mentioned dimension.

The two dimensions not included are teachers’ attitudes and comfort about mathematics and parent communication. The reason that these two are not included in the discussion is that the participants did not discuss either of these in enough detail to be able to make conclusions about whether coaching had any influence on the teachers’ attitudes or how they communicated with parents.

Figure 4: Diagram of the Ten Dimensions described in this chapter

5.4.1 Constructing Knowledge

Constructing knowledge in mathematics means that students are active in the learning process, creating conjectures, proving or disproving those conjectures, creating representations of mathematical concepts, problem solving, reasoning and working collaboratively with one
another to build conceptual understanding. Constructing knowledge happens when “students are given opportunities to ask their own questions and to extend problems into new directions, they know that mathematics is still alive, not something that has already been decided and just needs to be memorized” (Boaler, 2015, p. 27). This dimension includes instructional approaches and questioning.

5.4.1.1 Instructional Approach: Number Talks

All of the instructional coaches and three of the five teachers referenced Number Talks. Both Michelle and Kirstin were new to using Number Talks. Anne also reported a Number Talk component to her program. The instructional coaches discussed Number Talks that they were doing with the teacher participants of this study, as well as work that they were doing in general with other schools and with other teachers.

Because multiple solutions are encouraged in Number Talks, students learn from each other about how to decompose numbers in order to create friendly numbers, or ways to include doubles, or to find groups of ten within a string of questions. Michelle observed that her students were utilizing more sophisticated strategies that progressed from a basic strategy of counting on to being able to flexibly compose or decompose numbers into friendly numbers. She expressed enthusiasm for the development that her students demonstrated in regards to their mental math strategies.

Anne noted that using a Number Talk component in her program also developed the students’ ability to communicate their mathematical thinking. Anne provided her students with sentence stems so that they could respond in meaningful ways to each other’s’ strategies or problem solving techniques.
Number Talks was an instructional strategy that the teachers valued from having used it in their classrooms with their instructional coaches. Kirstin, Michelle, and Anne commented about the importance of Number Talks as a means to develop students’ numeracy skills as they noticed that their students became more flexible and efficient when applying strategies to solve mental math problems. The teacher learned about the benefits of using targeted questions from Number Talks in order to support their students’ numeracy development.

5.4.1.2 Instructional Approach: Talk Moves

Another instructional approach that was dominant in the data, and was observed in the classroom settings was the use of Talk Moves. Talk Moves are intentional techniques that teachers utilize to give students the opportunity to think through a problem. Students are given wait time before asked to respond. Talk Moves also shift the discourse to be student-centered rather than teacher directed, so students are encouraged to talk with one another and paraphrase what their peers are thinking about a specific mathematical concept. The teacher facilitates the conversation by asking questions to move the discourse along. Another component of Talk Moves is the underpinning notion that students are held accountable and attentive, so they may be asked to repeat what someone has said.

Talk Moves were mentioned in the bulk of the interviews and they were also noted during the classroom observations. During the November 20, 2017 classroom observation that Mary and Anne co-taught, both the instructional coach and the teacher utilized talk moves. Mary and Anne posed questions and provided “wait time” so that students had time to think before asking for responses. The benefit, and challenge for a teacher of providing that “think time” was described by Anne, who recognized the difficulty of not wanting to jump in to help or rescue a student. She noted that it had taken her years to get comfortable with letting her
students struggle with a concept, realizing that the students eventually figure it out themselves which is much more powerful than being provided with the solution.

Throughout the lesson, the students were also encouraged to talk to one another about their thinking, which is commonly referred to as “pair and share”. This gives students the ability to discuss their ideas before having a whole class discussion. Students were also expected to be able to explain their partner’s perspective, which required the students to be accountable and listen to what their classmate was saying so that they could accurately report their peer’s ideas.

Talk moves occurred in the lesson observed with Linda and Kirstin on April 7, 2017 as the number talk portion of the lesson was being delivered. Students were asked to paraphrase their peers’ thinking when discussing the various strategies used to solve the questions posed in the number talk. Another component of talk moves was evident during this lesson because there was a lot of “thinking time” provided. Linda used the phrase “thinking time” so that students were not responding to the question immediately by raising their hands, but sat quietly contemplating the question before providing an answer.

The instructional coaches described talk moves as an instructional strategy that was a “go to” with teachers. It became apparent during the classroom observations that the coaches and the teachers incorporated talk moves into their classroom discussions. The teachers mentioned in their interviews that they valued the importance of having students meaningfully engage with one another by sharing their ideas with one another, giving students’ time to process mathematical concepts, and allowing students to struggle with a problem before providing a solution.
5.4.1.3 Questioning

Effective questioning as a means of constructing knowledge was evident in the work that instructional coaches and teachers did together. It occurred throughout the coaching cycle of co-planning, by the act of anticipating misconceptions and constructing questions to help students to understand why certain misconceptions occur. It was observed during all of the classroom observations, as the teacher participants and the instructional coaches were observed circulating through groupings of students to ask probing questions. Effective questioning also occurred in the debriefing portion of the instructional coaching cycle, as teachers and coaches reflected on the learning that took place, and the questions to ask to progress the learning along the continuum of conceptual understanding.

Teachers who use probing questions can be effective in getting students to think about concepts in a way that builds understanding (reference). Effective questioning was the focus of Tracy and Kathy’s collaborative inquiry which shaped their co-teaching cycles during the 2016/2017 academic year. Tracy provided Kathy and John with a resource entitled, 100 Questions that Promote Mathematical Discourse. Kathy and John used this resource to identify key questions that were applicable to all of the strands and that promoted math discussion which they had both discussed as implementing into their practice.

Tracy also commented that questioning during the consolidation portion of a math lesson is of extreme importance to get students to explore and expand their thinking about specific concepts. When working at other schools, and with other instructional coaches, Tracy was involved in the process of consolidating math lessons, and helping teachers to think about questions to elicit student thinking. Tracy noted that she and her instructional coaching
colleagues were witnessing teachers make the realization of how asking the right questions could illuminate mathematical concepts of student understanding.

Kirstin was also influenced to think more about questioning in regards to understanding how her students were thinking about specific mathematical concepts. Kirstin reflected that posing questions to the class allowed for their mathematical thinking to become more apparent. She made the shift from looking at whether or not her students got the right answer into how they arrived at the solution. This was a shift that she recognized as being important to her practice and was something that she had worked on with Linda.

Mark had experiences working with various teachers regarding questioning. He observed that asking the right question could shift the thinking in the classroom. Mark was challenged with how the questions the teacher was asking were not going deep enough, and that it was not sparking a fuller class discussion about a specific mathematical concept that was being taught. Fortunately, a student began to ask questions which provided an opportunity for Mark to act as a critical friend and talk with the teacher about how to create more thought provoking questions, which the teacher was receptive to.

5.4.2 Student Tasks

The student tasks dimension incorporates practices such as assigning rich tasks, providing engaging opportunities for students to practice skills or procedures, as well as giving students the ability to represent their mathematical thinking beyond just symbolic means (McDougall, 2004). Every participant in this study mentioned problem solving as a means of teaching mathematics. Using problem solving or rich tasks was a recurrent theme that emerged from the analysis of the transcripts and was also evident in the classroom observations that took place during the data collection period. The approach of teaching math through providing
problems incorporates a paradigm shift in that the teaching occurs in the consolidation part of the lesson, rather than at the beginning of the lesson.

Another component to teaching math through problem solving is carefully choosing a problem to target a specific concept, and a focus of instructional coaching was around assisting teachers in sourcing or creating open-ended problems. The instructional coaches and the teachers referenced using Marion Small’s resources, which include *Making Math Meaningful* (Small, 2008) and her books entitled *Open Questions* (Small, 2016) as they relate to using open-ended problems.

Using open questions allows for multiple entry points for students of different abilities to solve the problem. Open questions have wording that can be interpreted in various ways so that several approaches and solutions can be accessed. It is important to note that open questions could reflect a differentiated approach to instruction so that students of differing abilities can solve the problem in a variety of ways. The benefits of using open-ended tasks was noted by Kathy, who realized that students could understand concepts via problem solving open tasks rather than working through a text book.

Another component that makes up the dimension of student tasks is the use of engaging methods to reinforce specific skills or procedures (McDougall, 2004). The teachers in this study sought out ways to teach mathematics in an interesting and fun way to their students. This was largely referenced as using games for that purpose, and there were several examples in the data of games being introduced by the instructional coach. One example was using a game titled “I Have, Who Has?’. Kirstin said that Linda had provided her with the game cards to practice multiplication. This game was used in Michelle’s class with Linda. Mark also talked about
using games to reinforce concepts as part of a balanced math program, and was working with a teacher to use games to better understand mathematical concepts.

Another element embedded in student tasks is representation and modelling. Throughout the interviews, and during the classroom observations, the importance of using concrete representations to build conceptual understanding was evident. As described earlier, there is overlap amongst the Ten Dimensions (McDougall, 2004). This was particularly so when analyzing the data that incorporated modelling and representing, because it was also coded in the manipulatives and technology dimension. Kathy noted that the use of manipulatives became a core element to her mathematics class, so that students had access to manipulatives and could use them whenever needed.

Instructional coaches and teachers were talking about the use of manipulatives during the interviews and manipulatives played a role in the mathematics lessons. The use of manipulatives was evident in the lesson that I observed with Kathy, Tracy and John. The first lesson, observed on May 10, 2017, challenged the students to represent fractions in different ways using a variety of manipulatives, or thinking tools as they are commonly called. The second lesson, observed on October 24, 2017, incorporated the use of a deck of cards and a game to reinforce fractions and how to compare one set of fractions with another. Michelle and Linda used Miras (transparent mirrors) and dice to teach transformational geometry.

5.4.3 Assessment

Assessment was described by all of the participants as a critical component of the interactions that occurred with their instructional coach. Assessment practices included administering diagnostic tools for the purpose of informing programming and planning, and
making assessment more transparent to the students. This was achieved by communicating explicit learning goals and associated success criteria.

Mark and Carrie worked together to administer a diagnostic assessment from the PRIME kit (Small, 2002) and had the students in Carrie’s class complete it. The purpose of this practice was to meet the needs of Carrie, who had indicated that there was a range of ability in her classroom and she wanted to ascertain where any gaps of conceptual understanding might be so that she could program effectively for her students. After the diagnostic was completed, Mark and Carrie analyzed the results to track where the various students were at on the numeracy continuum, and this became a tool for Carrie to plan her mathematics program. Michelle also commented that she had benefited from working with her coach to plan a diagnostic tool that she noted was extremely beneficial to her practice.

Another component of the assessment dimension is making assessment transparent to the students and providing feedback (McDougall, 2004). All four of the instructional coaches discussed the importance of creating success criteria and providing descriptive feedback. The instructional coaches referenced this as both work that they were doing with the other teacher participants of this study, as well as what was happening in other schools. Tracy was collaborating with other teachers to collectively assess assignments by describing the success criteria so that teachers knew how to identify and be more capable of levelling student work. When reflecting upon the 2016/2017 academic year, Linda commented that assessment was something that she was involved in at every school that she was supporting:

When asked about the type of coaching activities that Mary had been involved in at various schools, she also talked about what she was doing in regards to assessment and using that information to look at where students were at using a variety of continuums. Mary also
referred to using triangulation of evidence when assessing, such as documenting observations, conversations, and student work to understand where students fit in the numeracy continuum. On November 20, 2017, both Anne and Mary were using Fosnot’s landscape of learning to highlight specific skills or concepts that they were observing in their students.

**5.4.4 Students’ Mathematical Communication**

Each instructional coach was asked whether there was one specific resource or instructional approach that teachers were requesting in the course of the work that they were doing at various schools and with different teachers. All of the coaches commented that developing students’ mathematical communication, specifically oral communication, was a consistent focus. Linda mentioned Number Talks, talk moves and making thinking visible as teaching strategies that she was involved in with all of her teachers. Tracy also felt that building mathematical discussion was a focus that she was working on with teachers in all of the classrooms where she was working.

When Mary reflected on the work that she was doing with teachers, she discussed helping teachers to build a balanced math program, and that one of the components of doing that was supporting teachers with creating a math community that incorporated talk moves and Number Talks. Mark also expressed student mathematical communication as a focus by using and that a resource that he often used was Number Talks.

The teacher participants of the study mentioned the importance of reinforcing specific math vocabulary. Michelle adapted Number Talks and created Word Talks to support her students in building their mathematical vocabulary. Both Linda and Michelle reinforced the math terminology of translations, transformations and reflections when they conducted the lesson about transformational geometry.
During the lesson that took place on May 10, 2017, Kathy and Tracy emphasized students’ mathematical oral skills as they were teaching the grade seven class about fractions. They reinforced terms such as denominator, numerator, mixed numbers, and they encouraged the students to use the accurate phrases when they were discussing how they were representing specific fractions.

5.4.5 Program Scope and Planning

Another dimension that the instructional coaches and the teachers worked on together was to plan effectively for the mathematics program. Planning was the initial impetus for Carrie to seek out working with Mark as she was interested in spiraling her curriculum. While the focus of Carrie and Mark’s work shifted as they began to examine how the problem solving process could be used to teach mathematical concepts, Mark did reference working with another teacher to spiral the curriculum. Mary was also involved in working with teachers to do long-range planning.

From a teacher’s perspective, Kirsten referenced the challenge of teaching all of the curriculum expectations to her split grade three and grade four class. Planning with Linda helped her to be more efficient so that she could hit various curriculum objectives in the act of using rich task. Kirstin referenced Linda as being helpful with her planning to get through the curriculum objectives.

Part of the co-teaching cycle is the co-planning, which takes place between the instructional coach and the teachers that they are working with. One of the aspects that I was looking for in classroom observations was evidence that planning had taken place. It was evident on April 7, 2017 when I met with Linda and Kirstin to observe the lesson that they were co-teaching as they mentioned the session in which they planned and prepared for the lesson. I
sat in with Linda and Michelle during a planning session, and they prepared all of the components of a three-part lesson by critically examining the minds-on portion, the manipulatives that they would be using during the lesson to support the learning, as well as how to create the success criteria to be used during the consolidation.

Another component to program planning is anticipating student misconceptions. Mark referenced *Making Math Meaningful* (Small, 2013) as a beneficial part of the co-planning process. Mary also mentioned the importance of planning together so that teachers could plan for how they think the students would answer the problems and to also plan for the consolidation.

5.4.6 Meeting Individual Needs

Teachers are working in classrooms with diverse needs. The reality is that there are “increasingly diverse student populations internationally, teachers are being challenged to increase engagement and achievement among culturally, linguistically, economically and learning diverse students (Teeman, Leland & Berghoff, 2014, p. 145). In mathematics, the idea of tailoring a mathematics program for individual needs is relatively new (Small, 2009). This dimension recognizes that “students in the same grade level clearly do differ mathematically in significant ways” (Small, 2009, p. 1). Teachers need to meet individual needs which can be done by differentiating instruction as well as providing a variety of lessons.

5.4.6.1 Differentiated Instruction

Differentiated instruction is designed to meet the needs of every student in a classroom setting. Given the range of abilities that may exist, students could be at different points on the numeracy continuum. Differentiated instruction was observed with Mark and Carrie during the lesson of November 27, 2017. The students were given a multiplication problem to solve. The
question posed was the following: “There are number of animals at a farm. Some animals have 4 legs, and others have 2 legs. Ms. Flip saw 22 legs in total. How many 4-legged and 2-legged animals did she see?” This question was given to students, but differentiation occurred because some of the questions had a different amount of legs, for instance some were given the question and the total amount of legs was 58.

Another group of students received the question, but with 38 of the total amount of legs to see how many different 4 and 2 legged animals could be calculated. As some of the students were early English language learners, they were given more skill-based questions to work on which eliminated the language posed in the problem. This is an example of how the coach and the teacher worked together to differentiate the task to meet the needs in the classroom.

Differentiation was also a focus in Tracy and Kathy’s lesson that was observed on October 24, 2017. The focus of the math lesson was about comparing fractions. The students were organized into groups that were predetermined, and the math games varied based on the needs of the students. The students were using decks of cards to create fractions with the goal of the game being that the winner would represent the biggest fraction. The game was differentiated because some games were played with denominators that were the same.

Other groups of students were playing with different denominators, so that they needed to convert the fractions into like denominators to effectively compare the fractions, and another group were adding fractions together to create the biggest fraction possible, which then led into mixed numbers. The games were selected for specific groupings of students to build upon the students’ conceptual understanding. Differentiation of the games were incorporated into the lesson based on the needs of the students.
5.4.6.2 Variety of lessons

Understanding that students learn in different ways, educators often create lessons and tasks that incorporate a variety of approaches. The instructional coaches and the teachers said that it was important to have a balanced math program.

Mary talked about how many of teachers with whom she was working were incorporating so many facets into their mathematics program, without even realizing how rich and diverse their practice was. Lessons observed often began with visual provocations, such as a Which One Doesn’t Belong (Danielson, 2016), or a Number Talk (Parrish, 2014) as an introduction to a specific mathematical concept, followed by a task to solve in which manipulatives or games might be provided. It is then followed up with a consolidation that could include a math congress or a gallery walk.

5.4.7 Manipulatives and Technology

The instructional coaches said using manipulatives as a means of representing mathematical concepts, as well as “thinking tools” for students to use when solving problems was an aspect of the ten dimensions used frequently. Manipulatives were also evident in the classroom observations that took place with Kathy and Tracy on May 10, 2017. The students were to model or represent fractions in various ways. The types of manipulative that were made available were connecting cubes, place value blocks, and graph paper. Tracy ensured that all of the groupings of students had a variety of manipulatives to choose from. The students did utilize the variety of thinking tools that were made available.

Another example of manipulatives being used occurred in the lesson that was observed on May 29, 2017, when Linda and Michelle were conducting their lesson regarding transformational geometry. They provided Miras (transparent mirrors), dice, and graph paper to
the students so that the students could problem solve how to rotate, translate and reflect the images on the dice. When Michelle was asked what aspects that she experienced with her instructional coach that would apply to her mathematics program for the following year, she mentioned that she would be more inclined to use manipulatives or thinking tools with her students.

Surprisingly, only Tracy and Kathy used technology. One of the lessons that they co-taught involved using a robot to move along a grid in order to illustrate the Cartesian plane. The lesson involved using a robot and getting the students to figure out how to represent it on a grid. This was a pivotal lesson for Kathy as she explained that she and the teachers kept moving the robot around the grid to create quadrants and integers. She noted that all of her students were engaged and that using the technology to illustrate a mathematical concept allowed her students to see math as something to think about in a big space rather than as just a problem to solve on paper.

5.4.8 Learning Environment

Although the learning environment was mentioned infrequently by the participants, the learning environment dimension is an important consideration in the dynamic that occurs when instructional coaches are working with teachers in their classrooms. The instructional coach’s presence alters the learning environment as students get accustomed to another adult working with them. The challenge that some of the teachers said was that the instructional coaches were in the classrooms too infrequently so that it was difficult for the coaches to know which students were on IEPs, or might have behavioural challenges or need modifications. Anne reported that the work that she was doing with her protege and Mary indicated that it took
students some time to get comfortable with the dynamic of having another adult posing questions in the classroom.

5.5 Major Findings

There are five major findings from the study.

1. Perceptions about the instructional coaching role vary amongst all stakeholders: superintendents, principals, and teachers. In the school district where the study was situated, the instructional coaching model was based upon the framework of co-planning, co-teaching, and debriefing (West & Cameron, 2013). The enactment of the instructional coaching model varies within the school district. The fact that there are varying perspectives about the role may influence its effectiveness. The role “should be understood by all parties. The responsibilities of the coach need to be identified and commonly agreed on (Hull, Balka & Miles, 2009, p. 3). All stakeholders should understand the role of the coach, principal, and teachers within the coaching dynamic, and establish clear objectives and expectations.

2. Instructional coaching is an effective means of professional development in that it incorporates the components that are deemed to be important for effective professional learning environments of taking place over time, embedded in the teachers’ practice, self-directed, and relevant (Desimone, 2009; Desimone & Pak, 2017). The teachers’ took an active role in their learning by choosing and determining the focus of the coaching sessions. The instructional coaches also commented about the work having impact, emphasizing the importance of choice and working with teachers who had elected to participate in the instructional coaching initiative. Some coaches worked with groups of teachers. The coaching experience took place over a period of time, meeting several times over the academic year, and in some cases into the following academic year.
3. It is evident that the teachers perceived that their mathematics program was positively impacted by the work that took place with their instructional coach. This study used the lens of the Ten Dimensions of Mathematics Education Continuum (McDougall, 2004) as a means to consider how instructional coaching influenced or shaped teachers’ mathematical practice. Instructional coaching influenced eight of the ten dimensions with the teachers; constructing knowledge, student tasks, assessment practices, students’ mathematical communication, program scope and planning, meeting individual needs, as well as the use of manipulatives and technology. Not enough data was gathered to determine how coaching impacted the participating teachers’ attitudes and dispositions about math. Neither the coaches nor the teachers in the study mentioned parent communication as something that resulted from the coaching sessions. From the instructional coaches’ perspectives, they collectively expressed that the work that was occurring in their schools were influencing some of the mathematical practices of the teachers with whom they worked.

4. Instructional coaching has a transient nature to it. There were many changes in personnel, which meant that some schools were working with various instructional coaches since the program was first introduced. The high turnover of personnel challenges the ability of coaches and teachers to partner together for sustainable professional learning.

5. Instructional coaching has the ability to make school-wide change, through the work done with collaborative inquiry groups, as well as individual teacher change. Teachers in the study discussed how they shared the work that they were doing with their coach through staff meetings or conferences, or in discussions with colleagues. An element of capacity building within the schools results from working with the instructional coach.
5.6 Implications

Investing in instructional coaching as a means of professional learning is an expensive venture, reported as being six to twelve times more costly than other types of professional development programs (Jacobs, Boardman, Potvin & Wang, 2017; Knight, 2012). Theoretically, instructional coaching fits within the core components of effective professional learning (Desimone & Pak, 2017) if implemented in an effective way. As reported in the findings, the transient nature of the coaches could have ramifications regarding the effectiveness of this program, especially considering that “coaches may be less effective in years one and two than in later years” (West & Cameron, 2013, p. 21). Hiring practices should include contracts that stipulate a minimum of a three year commitment to make the coaching initiative more sustainable. This is based on understanding that “coaching initiatives generally take three to five years to gain sustainable momentum and show measurable results” (West & Cameron, 2013, p. 19). Stability and consistency are important factors that should be considered.

A factor to consider during the hiring process is the mathematics background of the coach. To make the role more effective, the coaches should have a combination of content knowledge, pedagogical knowledge and specialized content-knowledge. It would also be worthwhile to consider the coaches previous teaching experience, and how it aligns with the school where the coaches are supporting. Is a coach with elementary mathematics teaching experience prepared to coach a secondary school’s math department when the content knowledge and pedagogical knowledge vary dramatically? Do the instructional coaches have the required expertise in mathematics to support the schools where they are assigned? West and Cameron (2013) recommend that coaches “have expertise in at least two areas: the content they
are helping others teach and how children learn that content” (p. 11). It is critical that instructional coaches who are hired have specialized content knowledge (Ball, 2003) to support the teachers with whom they work.

Another implication of the study suggests that the role of the instructional coach be clearly communicated to all stakeholders in order to help maximize its benefits. As documented by Luebeck and Burroughs (2017), “A shared understanding of the coach’s roles and responsibilities contributes to a productive working relationship, which in turn influences the levels of trust, support, and independence a coach can expect from his or her administrator. Future research efforts should target how to educate administrators about effective practices in classroom coaching and empower them to effectively support coaches” (p. 157). As described, the role of the principal is paramount to empowering the role of the coach to make impact within a school setting (Knight, 2007).

5.7 Further Research

Further research should take into account how students’ perceive of the role of the instructional coach. Using data from students, such as interviews and samples of student work that has been done with the instructional coach, would be illuminating for educators to consider how and in what ways instructional coaching impacts student experiences of mathematics education.

I was only able to follow the participants for a limited period of time. Future research could incorporate more of a longitudinal focus to investigate how the experiences of instructional coaching shape teaching and learning in mathematics.

The instructional coaches mentioned the technique of video coaching. Future studies could look at how instructional coaches can use video coaching as a means to reflect upon their
own practice, as well as ways for teachers to consider their practice. Tracy, Mary and Mark said that video coaching can be a powerful means for self-reflection and learning to occur. It would be worthwhile to consider how instructional coaching could incorporate this type of coaching into its practice.

The experiences of the teachers who participated in this study all referenced changes or shifts in their instructional practices, as well as their assessment methods, but not enough data was collected to deem whether the work that occurred with the instructional coach developed their content knowledge. One might argue that co-planning includes developing learning goals, success criteria, as well as anticipating students’ misconceptions, which would contribute to developing specialized content knowledge (Ball, 2003). Further research is needed to ascertain how content knowledge is developed in the work that instructional coaches and teachers do together.
References


Appendix A: Information Letter and Consent Forms

My name is Julie Middleton. I am a XXXX District elementary teacher. I am also a graduate student at the Ontario Institute for Studies in Education, University of Toronto under the supervision of Professor Doug McDougall. As part of the requirements for my PhD program I am conducting case study research investigating how instructional coaching shapes professional learning in mathematics education. By exploring the experiences of teachers and coaches who have participated in instructional coaching, the successes and limitations of the coaching model will be illuminated, thereby adding another layer of understanding about professional learning specific to this mode (instructional coaching), targeted to a specific domain (mathematics).

From April, 2017 until December, 2017, I will be following the professional learning of participating teachers, and the instructional coach using a variety of data sources specific to elementary mathematics. I will ask for you to take part in two audiotaped interviews, one at the beginning and end of the data collection period. The purpose of the interviews will be to get your opinions regarding how instructional coaching has shaped or influenced your mathematical learning and teaching. I will also be reviewing lesson plans, meeting notes and reflections related to mathematics instruction specific to the work that is being done with the coach.

The study has been approved by the University of Toronto and the XXXX District School Board. Participation in the study is voluntary and you can withdraw at any time. Audio tapes will only be used as a check against observational notes and will not be used or distributed in any public form. They will be erased immediately after being transcribed.
All identifiable electronic information will be accessed securely and encrypted, consistent with the University of Toronto’s security and encryption standards. The rights of privacy, confidentiality, and anonymity will be respected for all participants. Only my supervisor and myself, the researcher, will know the actual names of participants, and we pledge not to reveal this information. There is no conflict of interest for myself to be involved in this study, and I will be happy to provide you with copies of publications resulting from this study.

If you consent to participation in this research, please sign and return one copy of the attached consent form, and keep a copy of this letter and the consent form for your records. You may contact the University of Toronto’s Office of Research Ethics at ethics.review@utoronto.ca or by telephone at 416 978 2798.

Sincerely,

Julie Middleton
I agree to participate in Julie Middleton’s doctoral research study. The letter that accompanies this consent form provides information on the researcher including contact information and the purpose and potential use of the research. The letter also makes clear that my participation in the study is voluntary and can be withdrawn upon request.

I understand that the study will be conducted from March 2017 until December 2017. I also understand that information about my professional learning in mathematics will be reviewed as follows:

Semi-structured interviews
Lesson plans
Lesson reflections
Resources

I understand that all audiotapes collected will be kept confidential and erased after being transcribed. Transcriptions will be destroyed after five years.

I have read the information letter and consent form and sign freely and voluntarily.

Date:

Name of Teacher/Instructional Coach (please print):

____________________________________________________________

Signature:
Appendix B: Semi-Structured Interview Questions for Coaches

First Round:

1) Please describe your previous professional experience.

2) What lead you to become an instructional coach?

3) How would you describe the role?

4) How were you prepared for the role?

5) What are your responsibilities? How many schools do you serve?

6) Please describe the work that you do with the staff of the schools where you are assigned.

7) Are you involved with any school-wide initiatives, professional development?

8) How do you think that your work has shaped mathematics programs, or teacher learning?

9) Please describe any changes that you have witnessed in the teachers’ professional practice or any learnings that you believe have transpired based on the work that you have done.

Second Round:

1) Please give a brief update as to the wok that you did with the teachers at the end of the school year.

2) How do you think that the work that you did with educators influenced or shaped their professional practice?

3) When reflecting upon the past academic year, what specific resources, strategies, or concepts did you feel were most used?

4) Please describe your roles and responsibilities for this academic year. Are you working with the same schools or new ones? Are you working with the same teachers?
5) Do you see any connections with what you did with educators last year influencing this academic year in regards to planning/programming, curriculum mapping, assessment, etc.? Please elaborate.

6) Please describe any school-wide initiatives that you may be working on this year (theories of actions, professional development).

7) If you could make any changes to the coaching role what might those be and why?

8) Is there any other information that you would like to share regarding your experience of coaching?
Appendix C: Semi-Structured Interview Questions for Teachers

First Round:

1) Please give some information regarding your professional experience. How many years working? Grades taught...years at the school, etc.

2) What do you think the role of an instructional coach is?

3) Please describe your experiences of working with a coach.

4) How would describe how working with an instructional coach has shaped your professional knowledge/practice regarding mathematics.

5) Can you describe any other professional development that you have been involved with that has been beneficial to your mathematics program?

6) Please describe any school-wide professional learning that your coach has been involved in. If so, what did you learn from the experience?

Second Round:

1) Please give a brief update as to what grade you are teaching now and any changes from your position last year.

2) Reflecting on last year, and thinking about the work that you did with your coach, what do you think had the biggest impact? Why?

3) Can you describe any connections between the work that you did last year with your coach shaping or influencing what you have done so far this academic year? Can you provide any examples?

4) What are specific plans that you might have for working with your designated coach this year? What areas do you want to focus on?
5) If you were to make any changes to the role to better support you and your peers, what might those be? Why?
Appendix D: Classroom Observation Protocol

Date:

Location:

Coach:

Teacher:

Physical Setting: Anchor charts/arrangements of desks/describe how the classroom is set up.

Participants: Number of students. Groupings of students. Number of educators.

Activities: Describe the lesson, length of components of the lesson. Activities that students are participating in.
Conversations: How were the educators participating? How were students participating? What kinds of questions were being used? How engaged were students?

Subtle Factors: What body language of the participants is noticed? Why? How did the students react to educators (including myself). What stood out as noteworthy?

General impressions?

What documents were provided that accompanied this lesson? Lesson plans, resources used, websites, etc.