

Capturing Ephemeral Assessment Opportunities: An Inquiry into Secondary Mathematics
Teachers' Lived Experiences with Observation of, and Conversations with, Students

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ABSTRACT

This study is influenced by phenomenological approaches, and is an inquiry into secondary mathematics teachers' lived experiences with ephemeral assessment opportunities such as observations of, and conversations with, students. This phenomenon is explored through the use of reflective journals, semi-structured interviews, and focus group interviews. Two layers of analysis were used to better understand the phenomenon. The first layer focuses on emergent themes of what and how teachers think and do in the moment. The emergent themes were interrelated and categorized into eliciting, interpreting, and acting. The second layer focuses on the emergent factors that contribute to what and how teachers think and do during the ephemeral assessment process. The emergent factors were interrelated and categorized into teacher, student, relationships, and contexts. Through the two layers, the complexity of the ephemeral assessment process has been developed.

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Chapter 1 : Introduction

1.1 Orienting to the Phenomenon Through Living Experience

How did that go? I think that is a question I continuously ask myself, as a secondary math teacher – as a human being. Even if I don't ask it out loud, it rings in my mind all the time.

“– so we have these pictures of prices –” I could make out the words that Alf was saying as I stepped closer. Beth pointed and interjected: “why don't we just start by sorting all of the same ones to the same...” She didn't finish her sentence because Caitlin has already started to move the pictures while agreeing, “Yeah that's a good idea.”

“Wait, do we really need to, though? We can just –” Alf said, putting his left hand on Caitlin's shoulder to stop her from moving the rest of the pictures. His right hand grabbed a blue marker as he started to write the prices and numbers of Lego pieces on the whiteboard.

“Oh yeah, that's a good idea! Grab that marker for me, please,” Beth said. Alf and Beth started recording the numbers haphazardly on two sides of the whiteboard. Caitlin started recording the numbers as well, except she ordered them from lowest to highest price.

“Oh yeah, order,” Alf said once he noticed what Caitlin was doing. “That's a good idea.”

I walked toward them. Slowly. I could hear from a distance that this group of students was talking about ways of comparing values between Lego Star Wars and Lego Friends. While other groups were still loudly suggesting questions that they'd like to pursue, this group seemed to have chosen one. A comparison of prices as it related to the number of pieces was a good direction for an investigation. I wanted to know how they were doing.

No. It was more than that.

I wanted to see if I could influence the class by stepping into the world of this particular group. But not yet. I continued to walk slowly because I wanted to see how their ideas would develop.

“But how can we tell which one is which if we just stick all the numbers together? Aren’t we trying to figure out the difference between these ones,” Beth pointed to one of the Lego friends, “and these ones?” she pointed to one of the Lego Star Wars pictures. “How about we put them in two different tables then?”

Alf and Caitlin nodded. Alf and Beth began to sort what they wrote. At this time, Caitlin noticed that I was listening to them. “So we decided to do a table of values for each one of these” Caitlin said to me while pointing to the board.

She was a bit louder. It was as if she had permission to speak up now that she noticed I was listening. Or perhaps this change in volume was an alert for the others to realize that I was coming. The image of a groundhog sentry flashed quickly in my mind and disappeared. *So I guess that means I am the predator here?* I thought to myself as I listened.

“What do you mean by each one of these?” I asked, although I knew what she meant. I wanted some clarification to see if she understood what she was comparing, by getting her to explain what she was saying. I was genuinely interested. I shifted my gaze toward the whiteboard.

Alf and Beth had realized that I was now here. They didn’t stop what they were doing, and didn’t seem startled, anxious, or annoyed. They didn’t even pause. Instead, they seemed to be comfortable with my arrival. They were used to it. *I guess I’m not an intruder, then,* I thought to myself.

“For these ones here” Caitlin said, pointing towards the Lego Friends pictures on the whiteboard, “we will have one table. And for these –” she then pointed to the Lego Star Wars pictures, and then to the table of values that Alf and Beth were now almost finished adding numbers to. “right here.”

“So how does this –” I started to ask. Alf cut in, as if already anticipating the rest of my sentence “This helps because now our information is all organized.”

“And how does being organized help?” I asked.

They paused.

Alf crossed his arms as he rested his chin on his right fist, staring at his now-completed table. Beth sat down on the chair and moved her gaze to the pictures. Caitlin looked at me. Actually, I think she looked past me. I could tell she was thinking, but this gave me an opportunity to look around the room to the other whiteboards as well. In my mind, I thought that this might help ease the pressure of having to answer right away. I wanted to give them time, and so I said nothing. I wanted to give them space, and so I looked away. I also didn’t want to leave them while potentially valuable thinking was happening.

While I glanced over to the right, I noticed that a student from another group was looking over at this group’s table of values. It sounded like this other group was previously discussing whether the price has to do with variety of colours and the appeal of one type of Lego sets in comparison to another. After one member of that group saw the table of values, she nudged another student to look in this direction. She pointed and someone else said, “That’s a good idea” as they began to sort the numbers in a similar way.

“Okay maybe it doesn’t help us yet,” Caitlin signalled for my attention as she thought out loud, “but we can make a graph with these –” She started to point to the empty space on their whiteboard, as if to say that they planned to put the graph there all along.

“And compare the slope! Yeah the slope!” Alf had unclenched his right fist and started to shake his index finger. He was excited. I was unsure if he was excited because he came up with a solution, or excited because Caitlin also came up with a similar idea.

“Ooh... yeah! Or we can just add this to our table too.” Beth moved towards the table of values on the whiteboard and quickly drew little arrows from one output to another, and one input to another. “And then just average it,” she said, continuing to draw one horizontal line next to the table and indicated that a fraction can be made for the slope.

I slowly backed away. My part was done. I felt that I would be more useful elsewhere in the classroom. Perhaps a few steps away to a group that had been engaging in interesting conversations about prevalent sexism in the commercialization and advertisement of Lego.

This group was moving forward and didn’t need me anymore. They didn’t even notice that I was stepping away.

Didn’t need me?

If I stayed, I probably would have seen other valuable thinking as well. Perhaps I would have witnessed more indications that they thought about the problems more deeply. Why did I leave? Did I think that I gave enough of a push? Or perhaps I left because I saw that this group had already moved farther than others? Did I somehow recognize, in that brief moment, that other groups needed me more? I did prompt some groups, but other groups also progressed well after this. Maybe I was, at that moment, happy with the way that the group was approaching the problem. Not necessarily with the progress that they’ve made, but more the fact that they

progressed pretty much without much prompting from me. Or maybe I felt an obligation to also go support other groups as well.

How did it go? Or maybe a better question is, *what* went? The moment I shared with Alf, Beth, and Caitlin was one of many moments in the classroom that day. In this moment, I only asked three questions. One of them was even an incomplete sentence, cut short by a student's answers. *What* exactly was that moment? One thing I am sure about, is that it was bursting at the seams with useful information for me as a teacher. For example, I learned a bit about this group's willingness to participate in solving the problem, their approaches toward the problem, and their understanding of mathematical representations. Beyond this, I also saw how part of their learning spread to at least one other group across the room in this moment. This moment was more about what I heard; it was also about what I saw. This moment was more about their mathematical work, it was also about how they worked.

But time moved on and moments fade. Even if I travelled back in time, that moment would no longer be the same.

1.2 Orienting to the Phenomenon of Ephemeral Assessments

To do a phenomenological study of any topic, therefore, it is not enough to simply recall experiences I or others may have had with respect to a particular phenomenon. Instead, I must recall the experience in such a way that the essential aspects, the meaning structures of this experience as lived through, are brought back, as it were, and in such a way that we recognize this description *as a possible experience*, which means *as a possible interpretation* of that experience. This then is the task of the phenomenological research and writing: *to construct a possible interpretation of the nature of a certain human experience*. In order to make a beginning, the phenomenologist must ask: What human experience do I feel called upon to make topical for my investigation? (van Manen, 1990, p.41, italics in original)

This research is a qualitative study that is influenced by phenomenological approaches (Creswell, 2012; van Manen, 1990, 2014) to seek a better understanding of teacher experiences of observations and conversations as evidence of student learning in secondary mathematics education. In other words, how do teachers elicit, interpret, and act on their observations of what students say and do? The excerpt in the previous section is one possible interpretation of my experience in my grade 9 mathematics class in the spring of 2015. It was one of many moments. It was *ephemeral*: fleeting and short-lived.

Rooting from my own experiences.

Like most moments, the excerpt in the beginning of this chapter was neither the beginning nor the end of my journey. So where did my interest begin? What drove me to dig deep into academic literature, conversations, and experiences, and thus research? As van Manen (1990) points out, “lived experience is the starting point and end point of phenomenological research” (p.36). While I am unable to nail down a definitive beginning to my journey, it is helpful to describe my experiences with mathematics and my experiences with educational assessment.

I begin with my experiences with mathematics in Taiwan. Mathematics was a boring stranger. Numbers, operations – mathematics was simply symbols that did not belong to me. I memorized words, relations, and sentence structures, and was encouraged for doing so. When I was 12, we moved to Canada and I lived alone with my younger brother. Mathematics was friendly. While still a stranger, these symbols were more familiar to me than the English language. Even as my ability to speak and write English improved, mathematics remained an older friend that I did not appreciate or understand. It was still boring. During my third year at university, a problem solving course helped me see mathematics differently. Mathematics was

interesting. I saw what mathematics could be, and this inspired me to pursue a career in teaching mathematics in order to share these positive experiences with students. As I continued to teach and learn more about mathematics education, I grew to enjoy teaching and learning about mathematics.

Suddenly mathematics was everywhere – as vital and beautiful as the air we breathe.

Due to my own experiences with mathematics, student engagement has always been an important consideration for me, and I have found inquiry-based methods of teaching useful for getting students excited about mathematics. Research echoes the importance of student engagement to support student achievement in secondary school mathematics (e.g. Attard, 2012; Brown, 2008; Tuan, Chin, Tsai, & Cheng, 2005). I see mathematics as a collaborative conversation and a helpful structure for solving problems, and I became comfortable with helping students see this.

My experiences with educational assessment followed a similar transformation. In the beginning, assessment was pain. Judgments, which had more to do with compliance to complete work, rained on me through wooden sticks. I complied and I avoided pain. I did not mind mathematics, but I dreaded assessment. Arrival to a different school system in Canada, meant that assessment was no longer painful at school. This also became the case at home when I began to live with my younger brother on our own. Assessment was numbers. These two, and sometimes three, digit numbers seemed to define who I was. These numbers also stood in the way of obtaining even more numbers. While my relationship with mathematics grew, my experience with assessment did not grow as quickly. Even as I completed university requirements and began teaching, assessment was still pain and judgement. Assessment was still numbers and unhelpful definitions of people. I began to reject assessment, or what I assumed to

be assessment. I saw it as disparate from learning. I began to care less and less about chasing down numbers for the sake of societal approval.

Through the early years of my teaching career, there were hints that assessment was more than what I had experienced it to be. For example, The Ontario Ministry of Education [OME] (2010) indicates that teachers' assessment strategies should include observation, conversations, and student products in order to better support student learning. I involved myself with school board initiatives and programs in order to better understand these writings from the ministry. I quickly found that while I was better understanding how we may elicit, interpret, and act¹ on student products, I knew less about how to incorporate observations and conversations in my assessment practices. As a result, I often struggled with corresponding assessment practices that honour what I value in the mathematics classroom. My previous rebellion against numbers worked well for me because I succeeded in playing the game of grades. This was not the case for all of my students. Thus, I continued my journey, meandering through research and literature. My work on this thesis, including the interactions I had with people, thoughts, and words, became a transformational experience that redefined my understanding of assessment as more than just numbers.

What is assessment? An introduction.

It seemed to me that my experiences with assessment were not unique. Conversations with colleagues also indicated to me that they believed assessment to be an unhelpful judgement of student learning. It is important, then, to explore the definitions of assessment, and how I have come to define assessment. In this chapter, I begin with some broad concepts of

¹ These phases of assessment processes are explored in later chapters.

assessment. I will elaborate on my conceptualization of assessment in subsequent chapters (in particular, Chapter 2).

Wiliam (2013) argued that assessment is the “central process in effective instruction... [and] the bridge between teaching and learning” (p.15). In other words, assessment is a powerful process with which the teacher may facilitate learning. As noted by Wiggins (1993), assessment derives from the Latin word *assidere*, meaning “to sit beside or with.” Its origins (Klein, 1966) suggest that assessment needs to be a process done *with* students, not simply *to* students. The National Council of Teachers of Mathematics [NCTM] (2000) defines *assessment* to be the ongoing “process of gathering evidence about a student’s knowledge of, ability to use, and disposition toward, mathematics and of making inferences from that evidence for a variety of purposes” (p.3). In addition, this process can be facilitated by anyone who is involved in the learning process: teacher, student, or peer.

Variety in types, forms, and purposes of assessment.

With respect to evidence, Shepard (2000) suggests that it is essential to expand “the armamentarium for data gathering to include observations, clinical interviews, reflective journals, projects, demonstrations, collections of student work, and students’ self-evaluations... [as well as] engage in systematic analysis of the available evidence” (p.8). Other authors have also agreed with this notion of variety in data gathering. For example, Mandinach and Jackson (2012) also believe that educators must “have access to and examine multiple measures of assessment data” (p.160). Reflecting on these works, I find it useful to define *evidence* as any manifested forms of student learning. In other words, any information that an individual takes in with their senses concerning a student’s learning can be considered evidence. Variety in the types and forms of assessment is supported by developments in how we understand learning in

general (e.g. de Corte, 2010), and more specifically in mathematics education (e.g. Simon, 1995; Sfard, 2007), as well as developments in how we understand educational assessment (e.g. Baird, Hopfenbeck, Newton, Stobart, & Steen-Utheim, 2014; Graue, 1993; Sadler, 1989).

Bridge between teaching and learning. Sitting with students. Inferences. Variety of types, forms, and purposes. These are powerful notions associated with assessment.

Assessments are not just numbers.

Assessment brings out the very human aspects of the classroom. Instead of simply a means of sorting students, assessment is how teachers make sense of, and meaningfully support, student learning. Observations and conversations, in particular, take place all the time in the classroom. Moss (2003) concurs and believes that anytime she interacts with her students, it is an opportunity for her to “learn about what they are learning and about the quality and effects of [her] own teaching” (p.16). These opportunities suggested by Moss (2003) may be, by their nature, in-the-moment and fleeting. These ephemeral forms of information are valued in teacher practices as part of the teachers’ variety of assessment strategies (e.g. Bourke & Mentis, 2014; Chen, Crockett, Namikawa, Zilimu, & Lee, 2012). These quick exchanges of information are “consequential – what [teachers] see and don’t see shapes what [teachers] do and don’t do” (Schoenfeld, 2011, p.228) in day-to-day activities.

These moments of the classroom are not only important for the teacher, but are also important for everyone involved. As Lewis (2008) pointed out, “each moment is experienced differently by the actors involved and their perceptions of those experiences change with time and reflection” (p.5). As such, I have chosen to focus on unpacking the moments – exchanges in the classroom - as assessment processes (defined in more detail in a later chapter) from the perspective of the teacher.

Guiding questions for my journey.

Teachers' lived experience of ephemeral assessment opportunities through observation and conversation, then, is the central phenomenon of this study. In other words, what does it mean to be a teacher as she engages in assessment processes that are in-the-moment? This report is an attempt to summarize and clarify my current understanding of this phenomenon. In the beginning of my research journey, my explorations of this phenomenon were fueled by my wonderings about assessment moments of the classroom that involve observations and conversations:

- How do secondary mathematics teachers set up opportunities for observations and conversations?
- How do they interpret information obtained from these moments?
- What do they do with the information that they have obtained?

As I continued my journey, explorations and descriptions of 'what's' and 'how's' felt incomplete. I was compelled to also explore reasons that contribute to what teachers do and what teachers think about. For example, as I oriented toward the phenomenon and reflected on my own practice as a secondary mathematics teacher, I found that I often asked myself why I was doing the things I was doing. As I conversed with my participants, I found that they often offered explanations for why they did what they did. In other words, I felt a need to explore the 'why's,' and so I added the following research question during the study:

- Why do teachers do what they do and think about what they think about during ephemeral assessment processes?

My need to explore 'why' caused difficulties for me to adhere only to phenomenological approaches (e.g. van Manen, 1990, 2014) as my methodology. Phenomenological approaches do

not aim to explore the ‘why’ and ‘causes’ of phenomena, but rather are “attempts to gain insightful descriptions of the way we experience the world prereflectively (van Manen, 2014). I discuss these methodological dilemmas in greater detail in Chapter 4.

1.3 Thesis Overview

This Chapter provides a brief description of how I have oriented toward the phenomenon. This included my motivation rooted out of my own experience as well as the reasoning for pursuing the research question.

In Chapter 2, I develop theoretical perspectives that have been helpful for me to better understand and situate the phenomenon. In particular, I explore perspectives of learning, functions of assessment, as well as my conception of the assessment process.

In Chapter 3, I focus on studies that I believe relate to ephemeral assessment processes. For the sake of clarity, I separated these into sections that related to the assessment phases established in Chapter 2.

In Chapter 4, I describe my methodology. In particular, I elaborate on the various decisions I have made for this study. These include: the influence of phenomenology in my study, my role in this study, how I have intertwined participant experiences, and how I sought to understand the collected data.

In Chapter 5, I explore the lived experiences of my participants. I begin by introducing the reader to each of my participants. I then include narrative anecdotes, which were done through an unconventional writing style that aims to be more poetic and indirect. This is to help the readers interact with the text in a way that might help them experience the phenomenon.

In Chapters 6 and 7, I seek meaning through the analysis of data. As I worked on the analysis of my data, I decided that it was helpful to explore the ideas in two layers. I subsequently decided to separate my analysis into two chapters, each representing one of the layers of analysis, as they focused on different aspects of the assessment process. In Chapter 6, I focus on what and how teachers think and do within the ephemeral assessment processes. Discussions of emergent themes subsequently address my three guiding questions. In Chapter 7, I focus on possible emergent factors that influence the phases of the assessment process described in Chapter 6. These emergent factors addressed my need to seek explanations for teacher actions and thoughts during the ephemeral assessment process.

Finally, in Chapter 8, I discuss possible implications of the ideas presented in this study, as well as limitations and future directions.

Chapter 2 : Theoretical Perspectives

This chapter provides an overview of theoretical perspectives that relate to learning and assessment. I believe the complex topic of ephemerality is at the intersection of several concepts in teaching and learning. A historical development of learning theories is helpful for arriving at my definition of the learning of mathematics and teacher actions that support this learning. I then elaborate on connections between learning theories and assessment practices which explain how the concept of assessment can be misunderstood. A discussion of the functions of assessment then leads me to elaborate on how I have conceptualized the assessment process.

2.1 Perspectives of Learning and Implications

In this section, I expand on the rationale that I briefly provided in the introduction, for my focus on ephemeral assessment opportunities. I begin with a historical perspective on learning theories that have helped me arrive at my definition for the learning of mathematics. I continue with a discussion of teacher actions within classrooms that are helpful for the learning of mathematics. I then draw attention to the connections and tensions between theories of learning and assessment practices.

Historical development of learning theories.

A historical perspective on learning theories has been useful for my understanding of why current learning theories (e.g. de Corte, 2010; Sfard, 1998) and policies (NCTM, 2000; OME, 2010) encourage the use of variety in the types and forms of assessment (e.g. Shepard, 2000), and why teachers have been doing so (e.g. Bourke and Mentis, 2014; Suurtamm, Koch & Arden, 2010). Many researchers agree that current conceptions of learning are rooted in forms of constructivist or socio-cultural theories (e.g. Bliss, 1993; James, 2012; Noddings, 1990).

Throughout the 20th century, there have been important developments in how we understand learning. During the early 1900s, behaviourist theories in education emerged in the United States, and learning was perceived as conditioned response to stimuli. According to this model of learning, knowledge of mathematics would be envisioned as an accumulation of individual knowledge and skills that are transferred directly from teachers (James, 2006; Shepard, 2000). This is because the teacher would reinforce ‘correct responses’ to desired learning outcomes with rewards such as praises (de Corte, 2010).

Meanwhile in Europe, Gestalt psychology and the Würzburg School of Denkpsychologie strongly disagreed with the tenets of behaviourism. Gestalt psychology focused on the concept of *Gestalt*, a German word that means an organized whole as opposed to a collection of parts. Proponents of Gestalt psychology perceive learning as a process which “consists of gaining insight, discovering a structure, and hence of acquiring understanding” (de Corte, 2010, p.38). The Würzburg School of Denkpsychologie, on the other hand, focused on problem-solving and thinking processes. They believed that thinking processes are always oriented toward a goal and controlled by the task (de Corte, Greer, & Verschaffel, 1996). In other words, good thinking depends on appropriate strategies, and there are specific strategies for solving particular problems (de Corte, 2010).

During the late 1950s in the United States, the “cognitive revolution” resulted in a shift from behaviourism to cognitive psychology (Gardner, 1985). According to Simon (1979), the ideas from Würzburg, Gestalt Psychology, as well as the concept of logic and cybernetics, strongly influenced the development of cognitive theories of learning. Human cognition, under this view, considers knowledge not as behaviours to be reinforced through exercise and repetition, but instead “the organisation of knowledge as the central characteristic of cognition”

(de Corte, 2010, p.39). This perspective views learning as the acquisition of knowledge characterized by the process of “absorb[ing] information, perform[ing] cognitive operations... and stor[ing] it in memory” (de Corte, 2010, p.39).

Constructivism, which arose out of research during the 1970s and 1980s, agreed with the holistic nature of learning from cognitive theories; however, it disagreed that learners are passive recipients of information (de Corte, 2010). While there are different schools of thought within constructivism in mathematics education (e.g. Lerman, 1989; Thompson, 2013; von Glasersfeld, 1990), constructivists agree that all knowledge, including mathematical knowledge, is constructed by the learner, through cognitive structures that are under continual development (e.g. Kilpatrick, 1987; Noddings 1990; Resnick, 1983; Thompson, 2013).

Constructivist perspectives have been influential in mathematics education (e.g. Confrey & Kazak, 2006; Davis, Maher, & Noddings, 1990; Thompson, 2013). Since constructivist perspectives offered opportunities to examine how students think and reason (e.g. Confrey & Kazak, 2006), they can be powerful in helping to “study mathematical learning, to develop appropriate teaching strategies, and to reflect on the everyday problem of schoolteaching” (Noddings, 1990, p.18).

Along with constructivism, socio-cultural perspectives have also been influential in mathematics education (e.g. Confrey & Kazak, 2006). Socio-cultural perspectives recognize the context in which students construct mathematical knowledge (e.g. Billett, 1996; Leganger-Krogstad, 2014; McInerney, Walker, & Liem, 2011). In these perspectives, learning is a social process “in which people develop their thinking together” (James, 2006, p.57). In what Packer

and Goicoechea (2000) called nondualist² ontology, they summarized the themes of socio-cultural perspectives³:

The person is constructed... in a social context ...formed through practical activity...and formed in relationships of desire and recognition... that can split a person...motivating the search for identity (p.231-234).

Constructivism and socio-cultural perspectives are considered by many scholars (e.g. Confrey & Kazak, 2006; Packer & Goicoechea, 2000; Sfard, 1998) to be important and related considerations when thinking about learning. Confrey and Kazak (2006) believed that:

Both biological-physical-environmental forces and social-cultural-political forces affect [the process of learning].... Neither influence is viewed as primary, nor can either instance be in fact separated due to our membership as observers and participants in all these enterprises, at all times.... A revised grand theory that draws upon constructivism and socio-cultural perspectives fully enough to satisfy the proponents of each is likely to emerge....[This theory] will need to address in a broader way than constructivism how to engage students in the reasons for the pursuit of mathematical or scientific proficiency, and pay careful attention to the larger social and cultural issues surrounding such decisions. In addition, it will recognize the acculturation involved in engaging in the practice of mathematizing, while ensuring careful attention to the development of independent thought and precise patterns of reasoning. To do this, multiple units of analysis will be precisely and carefully linked (p.334).

Both constructivism and socio-cultural perspectives have been influential in my current understanding of learning, and subsequently my definition of the learning of mathematics.

Arriving at my definition of the learning of mathematics.

Assessment and learning are closely intertwined. Several theories maintain that assessment involves teacher interpretations and actions which support student learning. As a result, how I define the 'learning of mathematics' has an influence on my explorations of

² Packer and Goicoechea (2000) referred to dualist ontology as an ontology that separates the individual from an independent world. They believed that this dualism posed "problems for a coherent theory of human knowledge, learning, and action (Packer & Goicoechea, 2000, p.228).

³ Each phrase separated by ellipses was part of six themes which Packer and Goicoechea (2000) identified to be important to socio-cultural perspectives.

‘assessment.’ My definition for the learning of mathematics has been primarily influenced by constructivist and socio-cultural theories of learning.

In this study, I define the *learning of mathematics* to be: a process that is constructive, self-regulated, situated, collaborative, cumulative, and individually different (e.g. de Corte, 2010); it involves individual cognitive constructions of mathematical meaning (e.g. Kilpatrick, 1987) through interaction with a social environment that may include group work, discourse (e.g. James, 2000; McCaslin, Vega, Anderson, Calderon, & Labistre, 2011), and multiple representations of concepts and ideas; it may also be influenced by prior knowledge, cultural context, students’ conceptions of mathematics and learning of mathematics, students’ self-efficacy beliefs, motivation, interests, and emotions (e.g. Billett, 1996; Vadeboncoeur, Vellos, & Goessling, 2011).

Teacher actions that support the learning of mathematics.

One of the implications of constructivist or socio-cultural perspectives of learning is that teachers are no longer viewed as the distributor of knowledge and the arbiter of mathematical truth. Instead, a teacher’s role is to promote and encourage students’ mathematical sense-making through posing, constructing, exploring, solving, justifying mathematical problems and concepts as well as reflecting and evaluating the quality of student constructions (Confrey, 1990). In this section, I share some examples of the many interrelated teacher actions that may support students’ learning of mathematics⁴.

⁴ These interrelated teacher actions are all aspects of what I later describe to be the assessment process. I note that there are a wide variety of ways that teachers support students’ learning of mathematics. Here I merely provide some examples for what those actions include. I have drawn widely on literature and have included examples that align with my experiences and beliefs as a secondary mathematics teacher, as well as descriptions of learning from policy documents (e.g. NCTM, 2014; OME, 2005, 2007, 2010).

In order to better support a student's construction of mathematics, a teacher is actively learning about how a student understands a particular topic (e.g. Hohensee, 2016; Small & Lin, 2010), and what circumstances would motivate and engage a student (e.g. Powell & Kusuma-Powell, 2011; Stiggins, 2007). As a teacher learns about her students' needs and interests, the teacher may create tasks and activities, or adapt⁵ ones she finds online (e.g. MARS, n.d.; NCTM, n.d.; Youcubed, 2016) and in print (e.g. Small & Lin, 2010), in order to facilitate mathematical discussions through problem solving (e.g. Kazemi & Hintz, 2014; Smith and Stein, 2011; Smith, Hughes, Engle, and Stein, 2009; Humphreys & Parker, 2015; Stein et al., 2008). Teachers may encourage students to think and talk together by having students stand next to each other and work on common spaces such as vertical non-permanent surfaces (e.g. whiteboards, blackboards, or windows) (Liljedahl, 2016). A teacher may randomize student groupings every day so that students see various perspectives and improve their abilities of working with any group member (Liljedahl, 2014).

While students are investigating mathematical ideas with each other, a teacher is also actively participating in student conversations. In addition to attending to, and interpreting, what students say and do, she may also respond to student thinking (e.g. Sherin, Jacobs, & Philipp, 2011). For example, the teacher may use questions and prompts to lead students to linking mathematical ideas and representations, clarifying their thinking, or relating to familiar and new contexts (Boaler & Brodie, 2004). A teacher may also be intentional in who she responds to, or whose mathematical ideas she highlights, in order to “advance the mathematical understanding

⁵ A teacher may change aspects of a task in order to better suit the needs of her students. At the same time, they may also alter time allotted during an activity while considering student needs (e.g. Bossé, Lynch-Davis, Adu-Gyamfi, & Chandler, 2016).

of the group” (Smith & Stein, 2011, p.43) or to “make positive contributions to students’ sense of mathematical competence” (Horn, 2008, p.230).

As a teacher interacts with students during their mathematical investigations, she may also model what it is like to do mathematics. For example, by following through and reflecting on unfruitful strategies, she may demonstrate that it is important to take risks and that it is okay to make mistakes (e.g. Zager, 2017). Another example might be to demonstrate what it is like to listen to another person’s mathematical ideas and to respectfully add to the conversation (e.g. Zager, 2017). She may also explicitly discuss positive norms in the mathematics classroom, which may include the value of mistakes and questions, in order to create safe environments for students to exchange mathematical ideas (e.g. Boaler, 2016, Horn, 2012). Through modelling, and talking about, ways of doing mathematics, a teacher also aims to foster positive attitudes toward mathematics (e.g. Boaler, 2016).

Throughout all of the teacher actions mentioned previously, a teacher may reflect on how she acted and what happened (e.g. Mason, 2002). These reflections may subsequently contribute to future actions and future interpretations of actions. Due to the variety of teacher actions, a teacher is also continuing to improve her understanding of what her students understand. This therefore allows her to make better, or better founded, decisions in the classroom (e.g. Wiliam, 2010).

Connecting learning and assessment.

Learning theories and assessment theories are connected (Baird, Hopfenbeck, Newton, Stobart, & Steen-Utheim, 2014; Elwood, 2006; James, 2006; Shepard, 2000). Shepard (2000) described the ‘20th century dominant paradigm’ as rooted out of behaviourist perspectives of learning, and involved uniformly administered tests with questions that emphasized rote recall.

Shepard (2000) explained that a dissolution of the ‘20th century dominant paradigm’ resulted from an incoherence between assessment strategies, which consisted only of tests, and developments in cognitive, constructivist, and socio-cultural theories of learning. Shepard (2000) continued to describe an ‘emergent paradigm’ where “teachers’ close assessment of students’ understandings, feedback from peers, and student self-assessment...[are] central part[s] of the social processes that mediate the development of intellectual abilities, construction of knowledge, and formation of students’ identities” (p.4). Shepard (2000) acknowledged that this paradigm is emergent because it is not yet fully developed theoretically. James (2006) similarly believed that assessment strategies that correspond with constructivist or sociocultural perspectives are weakly conceptualized. Baird and colleagues (2014) agree and attribute this issue to a “time lag between developments in learning theory and its impact upon assessment practice, as application of theory is challenging and it can take decades for the implications of theoretical advances to be worked through to practice” (p.5).

In my experience, it is on this backdrop of incoherence between constructivist or sociocultural theories of learning and assessment practice, that many teachers have found themselves. As indicated in the introduction, the conceptual dilemma (Suurtamm & Koch, 2014) involved in reconciling my beliefs about learning with my assessment practices was the primary motivator for my research journey.

In the anecdote below, I describe my exchange with another teacher about assessment.

I walked into the staffroom with my lunch. Nothing special. Just some leftovers from the previous day. I found a spot at the long table to sit down after waiting for the microwave.

New school; friendly school.

New faces; friendly faces.

I began chatting with a teacher who had been teaching at this school for about 10 years. I described the different schools I'd worked at in the past.

She was surprised at how young I looked; we made some jokes about age.

Friendly banter.

In passing I mentioned that I was working toward a thesis at the university.

"Oh what are you working on?" She asked, seemingly interested.

"Math education." I grabbed another bite of food as I responded. I watched as her interest waned just a bit. I was okay with this. Mathematics always seems to be contentious. She isn't a math teacher and I could imagine that perhaps she did not have good experiences with math.

"Oh, I was never good at math." Sure enough, she responded with something I've heard many times. I quickly thought about ways of elaborating on the topic. I wanted to mention my own negative experiences with math. I wanted to share how my own experiences had been transformed. I wanted to say many things but she quickly followed up her comment with a question, "so what specifically with math education?"

"My work has to do with assessment." I regretted how I worded it as soon as I said it.

"*Oh.*" Her loaded exclamation made it seem like I pulled out something disgusting to show her. I wanted to elaborate. I felt like I needed to elaborate. It seemed like she understood assessment in a very specific way and I wanted to hear more about how she envisioned it. Perhaps then I could also share the ways that I understand assessment. How it is much more than a grade.

But she quickly changed the topic to something else.

Students; other staff; casual conversations.

I didn't press on, and I never had another chance to. She left on a maternity leave a few weeks later.

The anecdote above was not an isolated event. There were many other instances where my short descriptions of my work hinged on others' interpretations of the word *assessment*. And 'others' included teachers, students, parents, and even other researchers in the field of education. Eventually I would preface my description of my work as the interactions in the classroom. I would describe my research interest as 'how teachers attend and respond to students' thinking,' and then end with the statement 'and I see all of this as assessment.'

As explained more fully later in this thesis, my research journey has convinced me that ephemeral assessment strategies are key to connecting my beliefs about the learning of mathematics with my assessment practice.

2.2. Functions of Assessment

The concept of assessment can be understood through the functions served. An assessment serves *summative* functions when there are judgements concerning student knowledge. In other words, it attempts to *sum* up the evidence of student understandings, often represented as a test score, or a grade. Harlen (2005) provided a definition for summative assessment that describes it as a process:

The process by which teachers gather evidence in a planned and systematic way in order to draw inferences about their students' learning, based on their professional judgement, and to report at a particular time on their students' achievements (p.213).

With respect to the *formative* function of assessment, assessment could be *formative* when it supports learning during the student construction of knowledge. In other words, the assessment helps students *form* understanding. Wiliam (2010) offered the following definition:

An assessment functions *formatively* to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of that evidence. (p.148)

Since supporting learning involves many different factors, including student backgrounds, grade level, teacher experience, classroom climate, and more, this suggests that effective formative assessment is not one-size-fits all. Instead, it is adaptable (Keeley, 2008) and sensitive to different contextual factors such as classroom environment, sociocultural differences, student ability and achievement, grade level, and subject area (McMillan, 2010). Many authors have pointed out the importance of creating appropriate classroom cultures that occasion effective formative assessment (e.g. McMillan, 2010, Heitink, Van der Kleij, Veldkamp, Schildkamp, & Kippers, 2016).

I note that ‘assessment for/of/as⁶ learning’ has also been used to describe functions of assessment (Daugherty & Ecclestone, 2006; Earl, 2003; Gipps, 1994; Harlen, 2007; Harlen, 2009), and that there are many intersecting and interconnected ideas between assessment for/of/as learning and formative/summative assessment. In order to be clear, I primarily utilize the wording involving formative and summative functions in subsequent elaborations and

⁶ Hayward (2015) suggested that while the three propositions (for/of/as) may be powerful for focusing attention on different assessment purposes, there is a danger that these phrases might “turn into an unreflective mantra drawing attention away from the key construct – *assessment is learning*” (p.38, italics in original). While this is an important message for researchers, policy-makers, students, and practitioners, it is helpful for this study to be more specific about the functions of assessment.

discussions. However, it is important to clarify that one may also utilize the wording of assessment for/of/as learning for similar discussions.

Interactions between formative and summative functions.

Many have supported the idea that information elicited in the classroom can serve either formative or summative functions (e.g. Harlen, 2012; Wiliam & Leahy, 2007). It is important to recognize that the descriptors summative and formative are not defining characteristics of any particular assessment process. Instead, Harlen (2005) suggests that it is possible for assessment information to be used “for both summative and formative purposes, without the use for one purpose endangering the effectiveness of use for the other” (p.215), as long as aspects of validity and reliability are carefully considered.

Assessment information obtained for the purposes of reporting learning may be used to support further learning. Black, Harrison, Hodgen, Marshall, and Serret, (2010), for example, worked with English and Mathematics teachers on portfolio assessments. These portfolios of evidence, collected over time, are used formatively to provide feedback to students as well as opportunities to improve their performance during the course. In addition, the portfolios could also serve summative purposes at the end of the course.

Evidence gathered for formative purposes may also serve summative functions. During day-to-day activities, whether deliberately or not, a teacher obtains information about students’ ongoing achievements. This process of gathering information may involve “observing, questioning, listening to informal discussions among students” (Harlen, 2012, p.95). Information obtained may subsequently impact teachers’ summative decisions which may include assigning a grade on a report card.

Harlen (2012) suggested that it may be useful to describe formative and summative functions as dimensions as opposed to a dichotomy, and proposed a possible dimension of assessment purposes and practices (Table 2-1).

Table 2-1 A possible dimension of assessment purposes and practices (Harlen, 2012)

	Informal formative	Formal formative	Informal summative	Formal summative
Major focus	What are the next steps in learning?		What has been achieved to date?	
Purpose	To inform next steps in learning	To inform next steps in teaching	To monitor progress against plans	To record achievements of individuals
How evidence collected	As normal part of class work	Introduced into normal class work	Introduced into normal class work	Separate task or test
Basis of judgement	Student- and criterion-referenced	Student- and criterion-referenced	Criterion-referenced	Criterion-referenced
Judged by	Student and teacher	Teacher	Teacher	Teacher or external marker
Action taken	Feedback to students and teacher	Feedback into teaching plans	Feedback into teaching plans	Report to student, parent, other teachers, etc.
Epithet	Assessment for learning	Matching	Dip stick	Assessment of learning

So how does one determine whether or not an assessment functions formatively or summatively? It is impossible to attribute formative or summative as an inherent characteristic of any assessment (William & Leahy, 2007). Instead, these descriptors only apply retroactively to an assessment process after it has taken place. In other words, whether or not an assessment process has functioned formatively depends on how teachers attended to a specific student's thinking and subsequently how she responded to the student's thinking.

Interactions between formative and summative functions of assessment are necessarily complex, and rely on teacher's professional judgement. Although student, peers, and teacher are all involved intricately in the assessment process, it is often the teacher who is making

summative decisions based on his or her experience as a facilitator of the assessment processes within the classroom. Harlen (2012) believed it is important to consider issues related to validity and reliability when attempting to apply both functions to an assessment process. For example, when a teacher incorporates formative assessments for summative purposes, it is possible that the evidence of learning may be “inconclusive and...contradictory [to other evidence], for what students can do is likely to be influenced by the particular context” (Harlen, 2012, p.95). In other words, it is more reliable for the teacher to gather a myriad of information when making summative judgements.

2.3 Three Phases of an Assessment Process

I begin this section with a description of my exchange with a teacher during the beginning of my prep period. This took place before the excerpt described in the introduction.

The bell went a while ago.

I had finished answering some e-mails from parents and was about to take another look at the activities I had prepared for my students during the next period. I've had successes with this task before. It involved Lego and was good for engaging the students in developing their own questions. It was important to me that tasks do this – draw on students' questions; honouring their questions.

I heard the office door open and was surprised to see a colleague walk in. Or perhaps I shouldn't be surprised because this wasn't the first time it happened.

“Hey... don't you have class?” I asked; hoping for a different answer this time.

“Oh they’re doing great. They’re working on the group task that we saw from that PD session. They’re so engaged!” She said as she began working on an e-mail. “They’ll be fine. It’ll take them another 10 minutes to finish up.”

I didn’t doubt her. I didn’t engage. I didn’t ask about the missed opportunities. I didn’t ask about ways that she could be part of those conversations in the classroom.

In the scenario above, I described one of my experiences⁷ with colleagues who believe strongly that they are doing the right thing in providing space for solving problems without teacher interactions. Following the scenario, my colleague remained in the office while students were investigating, and then she returned to the room⁸ to provide them with the ‘correct conclusions.’ I was concerned that she would be missing out on potentially important contributions in the ephemeral moments of the classroom: every class is rich with assessment opportunities because assessment is embedded in learning.

I believe assessment opportunities embedded in instruction can be described in the three phases of eliciting, interpreting, and acting. These three terms are adapted and developed from Wiliam and Black’s (1996) description of elicitation, interpretation, and action. Eliciting is the instance where information about student learning is generated and observed. Interpreting is the instance where the observer attempts to understand what the students mean, as well as understand what the students have understood in the context of their prior knowledge, the classroom dynamics, as well as curricular expectations. Acting is what the observer does after

⁷ In conversations with some other teachers, I found this to be a common description of how some teachers carry out investigations. Some teachers set up and implement many inquiry tasks that they have taken away from professional development opportunities and conferences. They seem to interpret the mantra of ‘don’t be too helpful’ they hear from conferences as ‘not being a necessary part of the classroom.’ They pose the problem for students, ask them to solve them in groups, and then leave the classroom. Sometimes these teachers in my experience may not physically leave the classroom, but nonetheless they would move to the computer to work on administrative tasks.

⁸ I found out about how she debriefed the investigation during a separate conversation on the same day.

interpreting the elicited information about a students' learning. I elaborate on these phases in a later section.

A teacher's role in the classroom is now more complex than telling and explaining (Suurtamm, 2013). As described earlier, teacher actions involve capturing and responding to student thinking – paying attention to ephemeral moments.

Black and Wiliam (2009) referred to the importance of 'moments of contingency.' In establishing a theory for formative assessment, Black and Wiliam (2009) stated that "formative assessment is concerned with the creation of, and capitalization upon, 'moments of contingency' in instruction for the purpose of regulation of learning processes" (Black & Wiliam, 2009, p.10). In a brief elaboration, Black and Wiliam (2009) explained that moments of contingency can be "synchronous or asynchronous" (p.10). Synchronous moments may include immediate adjustments during teaching, and asynchronous moments may include modifying instruction at a different time in the future (Black & Wiliam, 2009; Wiliam, 2014).

Unfortunately, moments of contingency were not explored in detail by Black and Wiliam (2009) or in subsequent discussions (e.g. Wiliam 2014). For me, there were many questions left unanswered and areas unexplored for the phrase to be useful in my study. For example, could moments of contingency be simultaneously synchronous *and* asynchronous; when, what and who determines whether moments are contingent; and how do teachers or students experience these moments of contingency? While Wiliam (2014) believes "the way in which teachers, peers, and the learner themselves, create and capitalize on these moments of contingency involves consideration of instructional design, curriculum, pedagogy, psychology, and epistemology" (p.6), there were no further explorations on how these considerations are involved. After deliberation, I decided against framing my work based on Black and Wiliam's (2009)

exploration of moments of contingency. The main reason for this decision is that ‘moments of contingency’ seemed to be framed as an aspect of formative assessment. Since my explorations involve moments that are not only contingent formatively, but also summatively and more, I felt that this warranted me to fall back on just 'moments' and not 'moments of contingency' as Black and Wiliam (2009) have described.

In attempting to develop my own conceptualizations of the assessment process, I found the general description of *elicitation*, *interpretation*, and *action* from Wiliam and Black (1996) to be useful when considering the assessment process. While Black and Wiliam continued their research on the theory of formative assessment (e.g. Black, Harrison, Lee, Marshall, & Wiliam, 2003; Black & Wiliam, 2009; Wiliam, 2010; Wiliam, 2011), I find the words, of elicitation, interpretation, and action, in their earlier work to be useful for my conceptualization of the assessment process to be more useful than moments of contingency. Upon reflection, I also decided to use –ing instead of –tion because the suffix emphasize, for me, that ‘eliciting, interpreting, and acting’ are actions in the moment.

I am also drawing on various work from the field of noticing. Noticing has been conceptualized in different ways but most authors have two main processes within noticing: attending to particular events, and making sense of those events (Sherin et al., 2011). Some researchers choose to define noticing only as what and how teachers attend to events (e.g. Star, Lynch, & Perova, 2011; Star & Strickland, 2008), while other researchers also explore how teachers make sense of the situation (e.g. Colestock & Sherin, 2009; Goldsmith & Seago, 2011; van Es, 2011). There are also studies that expand the idea of sense-making to also include deciding how to respond (e.g. Kazemi, Elliott, Mumme, Carroll, Lesseig, & Kelley-Petersen, 2011; Jacobs, Lamb, & Philipp, 2010; Jacobs, Lamb, Philipp, & Schappelle, 2011). The

differences between these conceptions of noticing seem to be functional, and depend on the scope of the study. Mason's work (1998, 2002, 2011, 2015) approached noticing in a philosophically different way as he focuses on building awareness. He believes that as we pay attention in the classroom, moments are produced that can be re-entered, and reflections subsequently allow opportunities for breaking out of habitual responses.

The literature involving noticing has been influential in my thinking about assessment because these authors explore aspects that are similar to how I have defined eliciting and interpreting. In particular, I see parallels in the assessment process and some authors' definitions of noticing (e.g. Kazemi, Elliott, Mumme, Carroll, Lesseig, & Kelley-Petersen, 2011; Jacobs et al., 2010; Jacobs et al., 2011) that involve three interrelated skills: "attending to children's strategies, interpreting children's understandings, and deciding how to respond on the basis of children's understandings⁹" (Jacobs, Lamb & Philipp, 2010, p.172).

Drawing from various conceptions of the assessment process and noticing (e.g. Black & Wiliam, 1998; Brookhart, 2003; Brookhart, 2007; Brookhart, 2013; Butt, 2010; Harlen, 2006; Harlen, 2012; James, 2006; Jacobs et al., 2010; McMillan, 2007; Shepard, 2000; Wiliam, 2000; Wiliam & Black, 1996), I have subsequently developed a conceptual framework of an assessment cycle from the perspective of a teacher. Three instances of the assessment process are represented (Figure 2-1): eliciting, interpreting, and acting.

These three instances are closely related and are strongly influenced by each other. Through the interactions between the three instances in a cycle, the observer becomes more and more informed about the learning of her students. While observers may include the teacher,

⁹ Jacobs and colleagues indicated that the third skill of 'deciding how to respond on the basis of children's understandings' is not the actions themselves. Instead, they are referring to the intended actions in the minds of the teachers.

student peers, or the students themselves, I focus on the teacher as the primary observer for the purposes of this study. In the subsequent sections, I elaborate on my conceptual framework, which I believe can be applied to all assessment processes. At the same time, I focus on aspects of assessment processes that are ephemeral in nature and involve observations of, and conversations with, students. This conceptual framework was helpful for my thinking about assessment processes, and served as a flexible space for discussion of emergent themes and emergent factors based on the data in later sections of my thesis.

Eliciting.

Eliciting is the part of an assessment cycle where the teacher gathers information about student learning (Figure 2-1). Wiliam and Black (1996) used the terms *purposive*, *incidental*, *permanent*, and *ephemeral* to describe differences in both the way that information is elicited and the lifespan of the information. *Purposive evidence* is elicited as a result of deliberate teacher actions, and *incidental evidence* refers to information that the teacher comes across as part of her day-to-day activity (Wiliam, 2000). *Permanent* and *ephemeral* refers to the form that the information takes with respect to how long it may last. Examples of permanent evidence may be “writing, artefacts, or on audio or videotape” (Wiliam & Black, 1996, p.541), and ephemeral evidence are conversations or student actions that are either captured immediately or else it would be lost. Wiliam’s (2000) suggestion that purposive and incidental evidence exist on a continuum is indicated with cyclical arrows, and the division of the cylinders describe the fact that it may be represented in a permanent or ephemeral form.

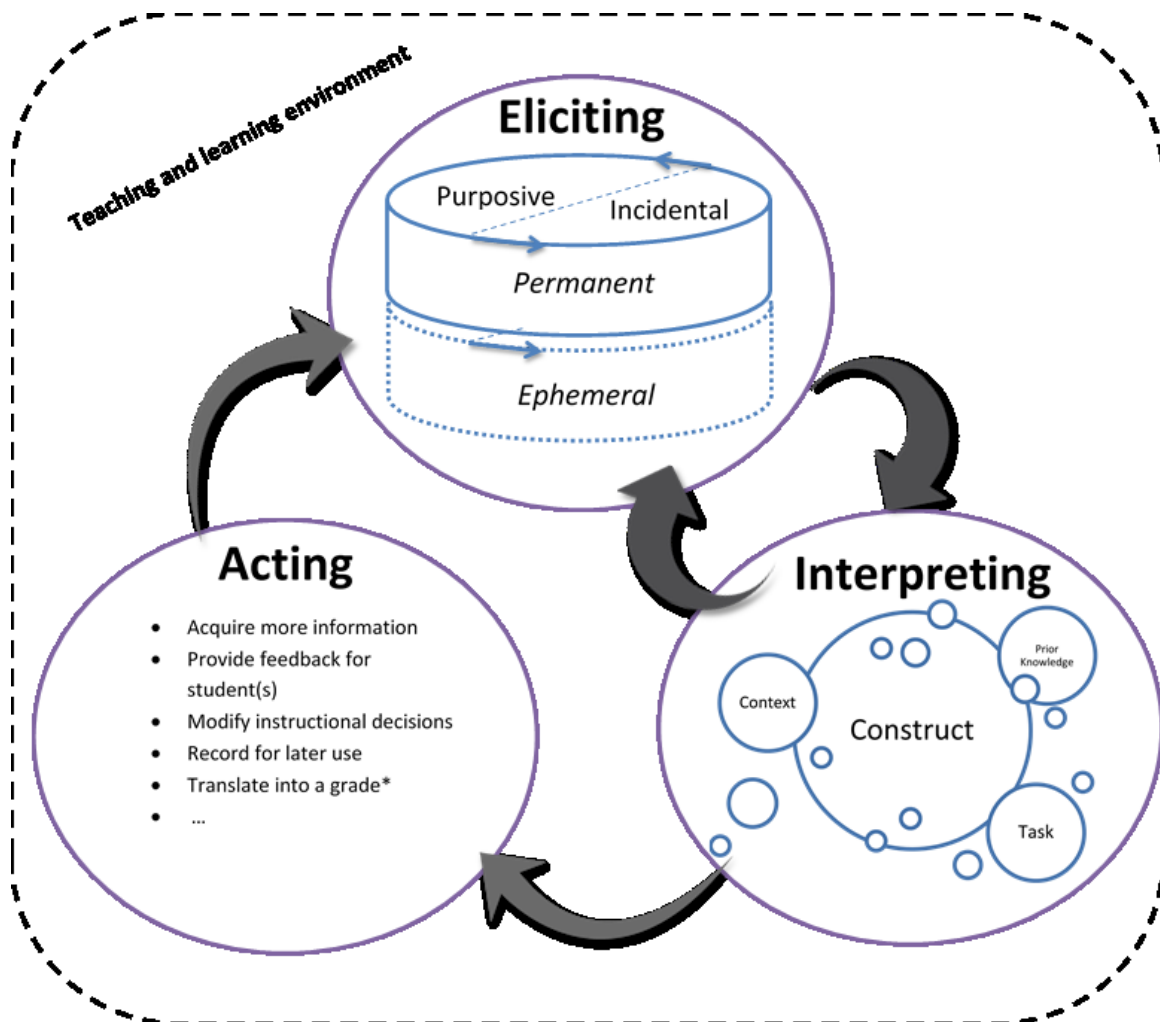


Figure 2-1 Assessment cycle. This figure illustrates the relationships amongst the different instances in an assessment cycle

I will provide a scenario – the “picture project” – where multiple types of eliciting may occur when students are asked to match the outlines of pictures with functions (example shown in Figure 2-1). This ongoing project is to be included in the students’ portfolios, and it must include functions learned¹⁰ during the semester. Students are provided class time to work on the project, and so the teacher has different ways of eliciting information about student understanding. Since the teacher designed the activity, she saw the primary task as transforming functions in order to match the pictures. Information concerning this objective may be elicited as

¹⁰ Functions included trigonometric, exponential, logarithmic, polynomial, and rational functions, as well as combinations of them.

purposive evidence. This purposive evidence may arise in permanent or ephemeral forms.

Student calculations in order to transform functions, as well as the final product are examples of permanent forms. Student conversations, as well as the process of creating functions through trial and error, may be examples of ephemeral forms. The teacher may also happen across incidental information about other aspects of student understanding besides the primary objective of function transformation. For example, if a student makes a mistake converting degrees to radians when working on trigonometric functions, this would be incidental since it is not what the teacher intended to assess. This information may be in permanent form if it is written on paper, or ephemeral if it is part of a conversation.

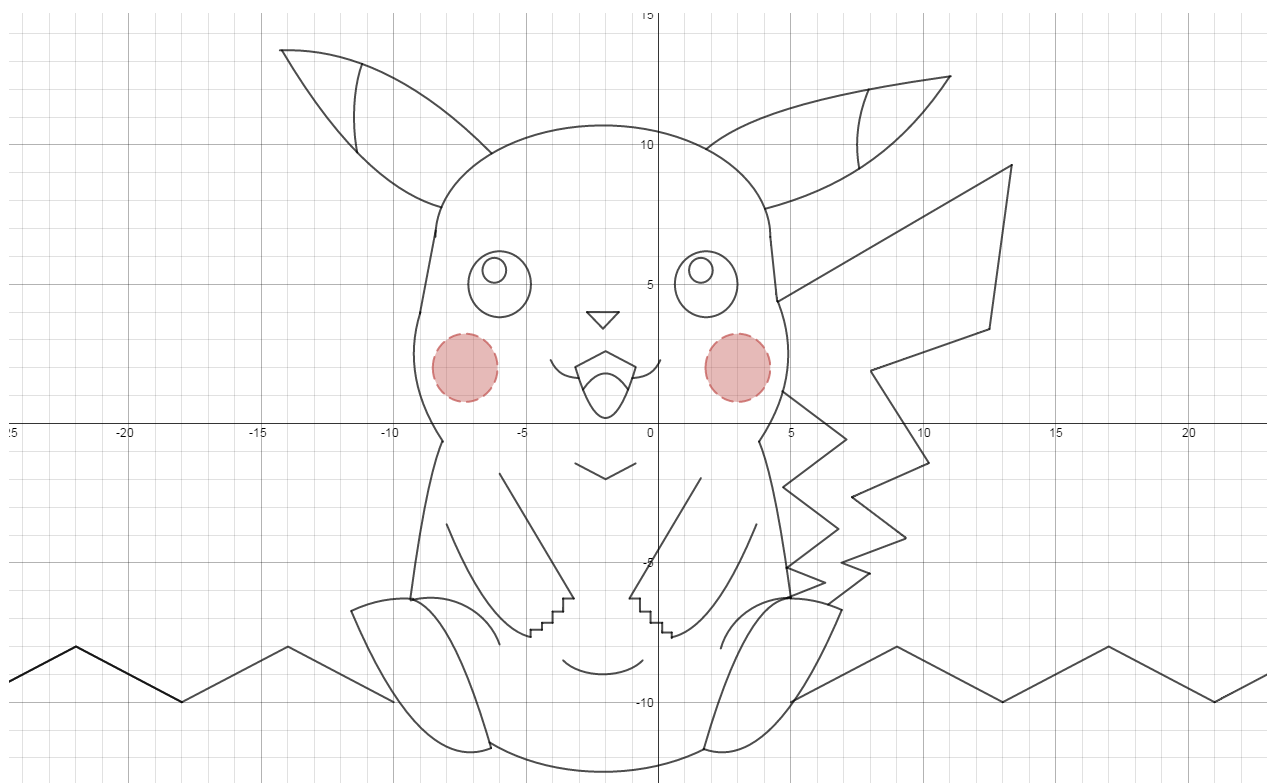


Figure 2-2 Picture Project Example. This figure is an example of student work on a free online graphing tool called Desmos. Equations for the lines and curves may be accessed at the following link:
<https://www.desmos.com/calculator/cdy10xjwfw>

This exploration of eliciting, as part of an assessment cycle, demonstrates that there are various ways to elicit information concerning student understanding. In the old paradigm, there

was a reliance on traditional timed tests (Shepard, 2000), which elicit purposively through permanent forms. While traditional testing may have been sufficiently effective under the behaviourist and cognitive perspectives of learning (James, 2006; Stobart & Hopfenbeck, 2014), it is insufficient under our current perspective of student learning. As Moss (2003) points out, “evidence supporting a consequential interpretation/decision draws from multiple, varied sources (rarely from a single ‘instrument’) about students’ learning and the context supporting it” (p.16). Assessment strategies that correspond with our current thinking would include all types of elicitation.

Within this variety, my interest lies in ephemeral forms of eliciting, regardless of whether it is purposive or incidental. These forms of information are often “mentally stored away” (Butt, 2010, p.2) by the teacher as she attempts to form an understanding of student learning. In addition, she may record what she has elicited with a checklist or short comments that describe what she encountered. However, the act of recording implies that the teacher has already interpreted the ephemeral evidence. By the time the pencil hits the paper, with the action of recording, the information has already been interpreted through the lens of the teacher from that instance of elicitation. Once interpreted and simplified into a translated form, this new product now potentially lacks the subtleties, nuance, or context that may be part of the original instance. While audio and visual recordings are not necessarily more valuable than recorded notes, these notes would have already involved interpretations.

Interpreting.

Interpreting is when the observer attempts to understand what the students mean, as well as understand what the students have understood in the context of their prior knowledge, the classroom dynamics, as well as curricular expectations (See Figure 2-1). This complex and

important instance ties together the information elicited and the actions subsequently taken. How might teachers interpret the information elicited? Wiliam (2000) suggests that interpretation needs to be criterion-referenced and in the context of learning needs. However, before criteria can be referenced and learning needs considered, a teacher would first need to understand what had been uttered or done by the student. After the utterances and actions from the student have been interpreted, a teacher may then consider the construct, which is any concept, or combination of concepts, alongside the student utterances and actions. However, more than criteria and learning needs, I believe interpretations may also involve peer dynamics, tasks (and wording of tasks), context of student experiences, and more.

I will provide three different examples that illustrate this relationship and the role of interpreting. First, if a student is unable to complete a problem on a paper-and-pencil test, then an observer would be unable to make sound interpretations on what this student understands. Second, if a teacher enters a group discussion in the middle of a students' explanation, she would be unable to make sufficient interpretations without eliciting more information. Lastly, if a student has shown a partial understanding of a mathematical concept during an ongoing portfolio assessment, the teacher may interpret and act by providing feedback. Alternatively, the teacher may choose not to act and instead wait for more evidence to be generated over time.

These examples not only demonstrate the complex relationship where interpreting is an intermediary instance between eliciting and acting (Figure 2-1), it also suggests that acting requires sufficient information. As a teacher draws more interpretations, "the ongoing logic of practice is continually updated as teaching and learning unfold" (Moss, 2003, p.18). I consider this a *compounding of interpretations* and this act may occur consciously, subconsciously, or unconsciously.

The idea of compounding interpretations is my way of thinking about *reliability* in the way that Smith (2003) has chosen to define it in the context of classroom assessment. Smith (2003) suggests that *reliability* in the classroom assessment context should consider “sufficiency of information” when we are interpreting and making decisions. In other words, the teacher would need to consider whether she has “enough information... to make a reasonable decision about [a] student with regard to [a particular] domain of information” (Smith, 2003, p.30).

Acting.

Perhaps the most defining feature of any assessment cycle is what the teacher does. The actions taken by the teacher, student, or student peers reveal whether a particular assessment cycle has functioned summatively, formatively, or both. Some examples of acting have been listed in Figure 2-1, but this is not intended to be an exhaustive list. By happening across student conversations during the previously described picture project, a teacher encounters ephemeral evidence of a student’s understanding of transformation of functions. The teacher may decide to act on this information by asking questions to elicit more information, provide immediate feedback, and/or decide to modify her instructions on a following day. These actions would then serve formative functions, as they help the student to further form his/her understanding as well as inform the teacher’s next-steps. At the same time, by combining this ephemeral evidence with other evidence, the teacher may have greater confidence in translating this information into a grade. This action would then serve summative purposes by summing up all available evidence of student learning. Incidentally, and perhaps paradoxically, inactions are also a form of action and are consequential in serving formative functions. As the teacher happens across student conversations about their picture project, she may do nothing. Not responding to the student at the time may allow the students to believe that they were correct about the substance of their

conversation. Whether this is a desirable outcome would depend on the judgement of the teacher.

How soon should a teacher act on ephemeral sources of information? Schön (1983), writing about reflective practice in teaching, coined the phrase *action-present* to describe “the zone of time in which action can still make a difference to the situation” (p.62). Under this definition, there is not a definite amount of time. Instead, the action-present varies from one situation to another. Sometimes there is sufficient time during the moment to think and interpret the situation and subsequently act. Other times the teacher may take note of what she had observed or heard, in order to better inform future interpretations and actions.

Relationships between eliciting, interpreting, and acting.

In the classroom, and in the awarenesses¹¹ of teachers, it is difficult to discern which phase would be the starting point in the teacher’s lived experience with ephemeral moments. It may be argued that one might begin with eliciting, since the teacher might begin by observing and listening to student interactions, as well as prompting and questioning in order to get more student thinking. But one might also begin with interpreting, because the process of assessment may not begin until the teacher has elicited something she interprets and therefore acts on. Or perhaps one might argue that the assessment process does not truly begin until the teacher has acted on information, that has been elicited and interpreted, in order to serve formative or summative functions.

¹¹ The three levels of awareness (Mason, 1998; Mason, 2011; Mason and Davis, 2013) includes: awareness-in-action, awareness-in-discipline, and awareness-in-counsel. Awareness-in-action is paying attention to our actions as we perform them. Awareness-in-discipline is becoming aware of heuristics and mathematical themes such as working at a problem backwards, or generalizing concepts across different systems. Awareness-in-counsel is “the self-awareness required in order to be sensitive to what others require in order to build their own awareness-in-action and awareness-in-discipline” (Mason, 2011, p.45). This may involve teachers working with colleagues in order to develop different ways that they may become aware of their actions and discipline.

It is not only difficult to discern a starting point, it is also unhelpful. The three phases of eliciting, interpreting, and acting are deeply interconnected. Therefore, it is more useful to explore the details of what each phase might embody, and the relationships between the phases¹².

Summary of the ephemeral assessment process.

While I have provided descriptions and examples of ephemeral aspects in my conceptual framework, I believe it is helpful to the reader for me to fully define an ephemeral assessment process. An ephemeral assessment process is one that involves ephemeral sources of information. These sources of information may be incidental or purposive. The teacher then interprets this information, perhaps with clusters of previously noted insight on students, tasks, peer dynamics, or herself, as she makes sense of them and considers their meanings. The teacher may consequently act in a way that serves summative, formative, or both functions.

¹² I further explore these phases through the lived experiences of my participants in the first layer of my analysis in Chapter 6.

Chapter 3 : Literature Related to Ephemeral Assessment

Ephemeral assessment is contextual and involves many considerations. In this chapter I discuss some of the considerations in literature I have identified to be related to ephemeral assessment. To clarify, I note that none of the authors in the studies use the phrase ‘ephemeral assessment.’ However, I believe there exist relationships between their investigations and how I have defined ephemeral assessment processes. For the sake of clarity, I have decided to organize this section based on the insights drawn by various authors in their studies as they relate to the eliciting, interpreting, and acting phases I have established. I conclude by summarizing the many related ideas at the end of this section.

3.1 Studies Related to Eliciting

While not explicitly termed ‘eliciting,’ several studies explored aspects that relate to this phase of assessment. As discussed in previous sections, teachers may purposively create, or incidentally encounter, opportunities that elicit information about students’ learning. These opportunities may naturally arise through classroom activities, tasks, or routines. Alternatively, teachers may also use purposeful verbal questions in class to elicit information. Since ‘teacher questioning’ is often ephemeral and a natural part of classroom interactions, it was helpful for me to better understand how teachers question.

As part of a larger longitudinal study that compared traditional and reformed curricula¹³, Boaler and Brodie (2004) created nine categories of questions based on videotaped lessons and in-depth interviews with seven teachers and their students. These categories of questions

¹³ Boaler and Brodie (2004) defined ‘traditional’ as methods that consist of demonstration and practice. They defined ‘reform’ curricula as those that involve students in open-ended applied projects, or those that involve students in exploring mathematics in groups.

included: a) gathering information, leading students through a method, b) inserting a terminology, c) exploring mathematical meanings and/or relationships, d) probing, getting students to explain their thinking, e) generating discussion, f) linking and applying, g) extending thinking, h) orienting and focusing, and i) establishing context. From their findings, Boaler and Brodie (2004) saw that a high percentage of teacher questions asked students to rehearse known facts or procedures (95% of questions for traditional teachers, and between 60 and 75% of the questions for reform teachers). Boaler and Brodie (2004) concluded by pointing out the importance of “the *different* questions teachers ask in shaping the nature and flow of classroom discussions and the cognitive opportunities offered to students” (p.781, italics in original).

While the terms ‘purposive’ and ‘incidental’ were used by Wiliam and Black (1996) to describe whether or not teachers had intended to elicit information that surfaces, they did not elaborate on what kinds of intentions teachers may have. Several researchers (e.g. Chen et al., 2012; Watson, 2000) found that teacher beliefs and intentions may affect what student responses are elicited. In an exploratory qualitative case study, Chen, Crockett, Namikawa, Zilimu, and Lee (2012) examined formative assessment practices of three grade eight teachers. Data collection involved observations and videotapes of 23 lessons, field notes, and two questionnaires about demographic data and opinions on mathematics instruction. All three teachers in this study used teacher-centered instructional styles with whole class instruction, and therefore conversations occurred with participation from the entire class. Chen and colleagues (2012) noted that all three teachers had different questioning approaches. For example, one teacher frequently used questions such as “tell me why” (Chen et al., 2012, p.571) that initiated further thinking from the students, whereas another teacher focused on questions that helped

confirm knowledge of the class. The researchers subsequently suggested that these differences may be influenced by different teacher knowledge, experience, and beliefs about learning.

Watson (2000) found assessor intentions can influence what she called ‘informal assessments,’ which serve primarily formative purposes. Working with thirty teachers from primary, middle, and secondary schools, Watson (2000) spent a day in each of the teacher’s classrooms, and subsequently interviewed teachers about their assessment practices. The researcher found that teachers in her study mainly utilized conversational opportunities to report on the mathematics that had already been done, instead of influencing and co-constructing mathematical thinking alongside students. Watson (2000) also found that teachers recognized that student knowledge based on observations and conversations was situated in the context of the moment. As a result, a change in the assessor or the time during which assessment occurred would influence what is interpreted and concluded from the interaction. Watson (2000) concluded with the recommendation that “knowledge of the role of interpretation, an understanding of the potential for inequity, and personal doubt, should be components of professional decision-making” (p.87). As Watson (2000) noted, while conversations offer opportunities for co-constructing mathematical thinking, assessor intentions affect how the information is subsequently interpreted and acted upon. This means when considering ephemeral assessment processes, it is important to account for who is assessing, who is being assessed, and when assessments occur, and why they are being conducted.

In this section, I shared some studies that examined how teachers might elicit, as well as what factors influence eliciting. Boaler and Brodie (2004) identified different types of teacher questions, and saw that traditional teachers tended to use a higher percentage of questions that involve factual responses. In addition, teacher beliefs and intentions influence the eliciting

process since teachers are the ones that decide on how they elicit information (e.g. Chen et al., 2012; Watson, 2000). These studies suggest that the eliciting process is dependent on who the teacher is and how she has decided to elicit information about student's mathematical thinking.

3.2 Studies Related to Eliciting and Interpreting

Eliciting and interpreting student thinking are closely intertwined. The following studies related to the relationship between the two phases.

Jacobs, Lamb, and Philipp (2010) found that how teachers interpret information depends on what they were able to attend to in the first place. In their study, they asked 131 primary teachers from the US to watch a video clip of students working, and then asked them to write in response to the three component skills of professional noticing (attending, interpreting, deciding how to respond). They repeated the process by showing the teachers written student work. The researchers found that the difficulty with attending to children's strategies is not only that the busy classroom is difficult to process, but also that it is important for the teacher to know what is mathematically significant "in children's messy, and often incomplete, strategy explanations" (p.194). Consequently, Jacobs and colleagues suggest that the difficulties in interpreting children's understandings are largely based on how the teachers were able to attend to children's strategies in the first place, as well as the teachers' own mathematical knowledge.

Sleep and Boerst (2012) also saw that interpreting is contingent on teacher's eliciting. The researchers worked with prospective elementary teachers during their teacher education program. They focused on seven prospective teachers' 'student thinking interview assignment' which required the teachers to "interview an elementary student about his or her mathematical thinking and then write evidence-based claims about what the students seem to understand or be able to do" (p.1040). Sleep and Boerst (2012) analyzed the interview audio and transcript, the

teachers' written statements, and any student work. One of the researchers' findings was that the prospective teachers' interpretations depended on the elicitations. For example, one teacher saw that her student solved a problem incorrectly. Instead of probing the student's understanding, the teacher asked leading questions toward a correct solution.

These studies are consequential in understanding the assessment process, because in order to interpret student thinking, teachers would need to attend to elicited information. After all, teachers cannot interpret what they did not attend to, even if the information has been elicited through activities, tasks, or questions (Jacobs et al., 2010; Sleep & Boerst, 2012).

3.3 Studies Related to Interpreting

Colestock and Sherin (2009) used the term *professional vision* in order to describe what teachers attend to, and *sense-making* to describe how teachers interpret what they have attended to. Their participants included 15 middle and high school mathematics teachers ranging in teaching experience from 1-15 years. Participants were shown four short clips between 3-8 minutes long that contained discussions of mathematical ideas between teacher and students. Participants were then interviewed and the transcripts were analyzed for what teachers noticed and how they interpreted the events. Colestock and Sherin (2009) coded five different interpretation strategies from teacher responses: comparison, generalization, perspective-taking, reflective thinking, and problem solving. Comparison is when teachers relate an event to something that had occurred elsewhere. Generalization is when teachers identify an event as one that occurs across multiple settings. Perspective-taking is when teachers speculate on the state of student minds. Reflective thinking is when teachers make responses about their personal beliefs. Problem solving is when teachers consider the events according to the task that students were engaged in.

The researchers saw two major findings. First, their participants “noticed many of the same events....[however] the teachers often developed different opinions as to what transpired in the video clips that they viewed” (p.22). These different opinions provide insights into the different ways that teachers interpret and what might influence that interpretation. Colestock and Sherin (2009) suggested that the varied opinions may be due to insufficient information provided by the video clip, as well as each teacher’s different conceptions of classroom instruction. The second finding related to the varied distribution of strategy usage. Colestock and Sherin (2009) found that participants used all five strategies, but “varied in how frequently they made use of these strategies” (p.20). The researchers also commented on how participants tended to take the perspective of the student instead of that of the teacher. They believed that this is due, at least in part, to the fact that videos were used.

Studies from Webb (2004) and Watson (2006) provide considerations for why teachers may interpret elicited information in different ways. In examining ‘discourse-based assessment processes’ Webb (2004) used a case study with one teacher who had a seventh-grade mathematics and language arts teaching assignment. Teacher interviews, classroom observations, and video recordings of the classroom were used during this study. Through his analysis, Webb (2004) suggested that, more than questions, student engagement is a necessary prerequisite for effective assessment of student understanding. If students are not engaged in the problem, their “responses may underestimate their understanding of a mathematical concept or principle” (p.184). Consequently, teachers must also be sensitive to the classroom culture and be able to “reflect on their conceptions of evidence for student learning of mathematics” (p.185) in order to support effective discourse-based assessment processes. The work from Webb (2004) suggests that when interpreting student responses, teachers should consider that incorrect or

incomplete responses may not represent the student's level of understanding, but rather her level of engagement in the task (Webb, 2004).¹⁴

Watson (2006) closely observed six students at work during eleven lessons and attempted to understand how a middle school mathematics teacher, Bob, came to know about these students' mathematical learning. Watson (2006) saw that Bob engaged one particular student, Garnet, based on "his belief about the value of developing problem-solving strategies [and] his judgement that [the student] needed his input" (p.294). The researcher further notes that Bob "consistently and coherently aimed at the development of mathematical behaviour in the nature of tasks, his interactions with students, the engagement expected of his students, and the focus of his informal judgements" (p.295). Since Bob believed that Garnet was capable of thinking mathematically, he questioned the student rather than telling her what to do. The study from Watson (2006) provides further reasons for teacher beliefs about student knowledge to be an important influence on how teachers interpret information. Beyond interpretation, teacher beliefs also seem to permeate to other aspects of the ephemeral assessment process.

These studies have indicated that teachers may have different interpretation strategies (Colestock & Sherin, 2009). At the same time, teacher interpretations depend on their sensitivity to the context of the task and classroom culture (Webb, 2004), as well as teacher beliefs about student knowledge (Watson, 2006).

¹⁴ I believe there are many other factors involved here as well. I further explore this in Chapter 7 through a discussion of results from my study.

3.4 Studies Related to Interpreting and Acting

The interpreting and acting phases are also closely related. Acting is what teachers do after interpreting information that has been elicited. As described in Chapter 2, teacher actions in an ephemeral assessment process may serve formative or summative functions.

Son and Sinclair (2010) set out to investigate how preservice teachers interpret and respond to student errors in geometry. The researchers engaged 54 preservice elementary teachers in a classroom scenario where an imaginary student, Emily, had made an incorrect reflection across a line of reflection. Son and Sinclair (2010) saw that most of the preservice teachers recognized that the students had made a conceptual error. However, the preservice teachers often responded with a reliance on procedural aspects of the problem and did not address the conceptual error. Son and Sinclair (2010) suggested that these results may be due to two reasons: “(1) preservice teachers’ insufficiently developed knowledge of pedagogical strategies and (2) the different nature of procedural knowledge in geometry” (p.40).

In another study by Son (2013), she examined how preservice teachers interpret and respond to student errors with ratios and proportions in similar rectangles. Thirty-one preservice elementary teachers and 26 preservice secondary teachers were involved in this study. As part of the study, preservice teachers were asked to interpret and respond to conceptual errors from a student, Sally, when she solved a problem involving two similar rectangles. Son (2013) saw that there was a “disconnect between student errors, teacher interpretations, and teacher interventions” (p.62). For example, the majority of preservice elementary and secondary teachers mistakenly identified the student error to be procedural, and subsequently acted to mediate Sally’s procedural understanding.

The study from Elrod and Strayer (2015) demonstrated that there are difficulties when teachers use observations to serve summative functions. The researchers conducted a self-study in one author's college algebra classroom during the spring of 2013. The researchers developed an observational rubric to "assess students' problem solving during small-group and whole-class discussions" (p.90). The scores from the rubric were then incorporated in the students' grades. This process then caused a dilemma in the class where students focused on how the discussion translated into a grade, and not on truly improving their discussion. This prompted the authors to revisit the construction of their rubric, and to introduce descriptors instead of numbers for levels of achievement. Elrod and Strayer (2015) concluded that "making the rubric a natural, integral part of the classroom culture" (p.94) required that it was done throughout the term, and not simply utilized after-the-fact.

The work from Son and Sinclair (2010) and Son (2013) demonstrated that there are several challenges relating to how teachers act based on interpretations. Teachers may respond by referring to procedures even when they have identified the error to be conceptual (Son & Sinclair, 2010). Moreover, they may even misinterpret the error to be procedural in the first place (Son, 2013).

While ephemeral sources of information may not directly result in summative decisions, interpretations of this information may contribute, along with other instances, to forming better-founded conclusions¹⁵ about student learning. The experiences shared by Elrod and Strayer (2015) provide another source of evidence that directly assigning grades to observations can be

¹⁵ I note that it is impossible to truly 'conclude' results of students' mathematics learning, since the learning is a process that continues onward even after schooling – regardless of whether or not the learner is aware she is continuing to do this. However, I use the term 'conclusions' here to refer to the fact that in most institutions, teachers are required to provide a final grade to indicate student achievement.

problematic. In addition, these ephemeral assessment processes cannot be independent events, and they need to be integrated naturally into the classroom culture.

3.5 Studies Related to Methodology

Since ephemeral moments are difficult to capture, I believed it was important for me to explore various methodologies related to capturing fleeting moments. I found the study from Sherin, Russ, and Colestock (2011) to be helpful.

Sherin and colleagues (2011) began by reviewing three main categories of approaches for studying noticing before deciding on their own methodology. The first category of approaches involved watching video clips that contained samples of others' teaching. In those cases, the researchers were concerned that a teacher's noticing in watching videos is not the same as her noticing in the classroom. Another approach in noticing studies asks teachers to recall the happenings of their own classrooms. The concern for this approach is that "because the teachers have been removed from the demands of the classroom, their recollections may not accurately reflect their in-the-moment experiences." (p.82). Sherin and colleagues (2011) indicated that a third category of approaches relied on analyzing videos of teacher classroom actions as a way of gathering insights about teacher noticing. Sherin and colleagues (2011) worried that researcher inferences made about teacher actions may not imply that the teacher engaged in noticing.

After reflecting on the difficulties experienced through the different methodologies mentioned above, Sherin, Russ, and Colestock (2011) made use of a wearable camera. Thirteen high school mathematics teachers, ranging in experience from 3 to 13 years, were asked to use a "wearable camera approximately 1-inch long that can be affixed to one's glasses or to the bill of a hat" (p.83). The teachers were instructed to press record whenever they encountered something interesting. After the lesson, the teachers were interviewed to discuss (a) their

experience with using the camera, (b) why they captured what they captured, and (c) whether the captured clip represented what they had intended to capture. While the researchers saw potential in their methodology, they noted several findings that I found interesting. First, the equipment seemed to have caused a variety of technical difficulties. For example, it was difficult to time the recordings, or teachers may have forgotten why they recorded. Second, the equipment also seemed to have changed the noticing in the moment. For some of the participants, wearing the camera altered their experiences in the moment.

I felt that these methodological implications were important for me to consider. It means that participants may need support in recalling the moments in the classroom, and requires the recognition that what they recall may not truly represent what occurred in their classroom. At the same time, it was also important that participants recorded the moments with whatever felt natural to them.

3.6 Summary of Literature Review

Ephemeral moments in the classroom may be brief, but they are also complex. My conceptualization of the three phases (eliciting, interpreting, and acting) is helpful for me to unpack and describe some of the complexity. The studies I explored provide further insight into each of the three phases.

In the eliciting phase, the work from Boaler and Brodie (2004) provide me with robust ways of categorizing teacher questions. These categories reveal a variety of ways teachers may elicit information through questioning. Work from other researchers (e.g. Chen et al., 2012; Watson, 2000) also provides insight into how teacher intentions affect the eliciting process.

In relating eliciting and interpreting, the works from Jacobs, Lamb, and Philipp (2010) as well as Sleep and Boerst (2012) were helpful for my understanding. Interpreting depended on

not only what information became available due to teacher actions, but that it is contingent upon what teachers attended to.

Various studies have provided me with some insight into the interpreting phase (Colestock & Sherin, 2009; Webb, 2004; Watson, 2006). I saw that teachers may interpret differently through different strategies (Colestock & Sherin, 2009). At the same time, how teachers interpret also depends on their sensitivity to the context of the task and classroom culture (Webb, 2004), as well as their beliefs about student knowledge (Watson, 2006).

The work from Son and Sinclair (2010) and Son (2013) helped me better understand the relationships that may exist between interpreting and acting. I saw that there can be inconsistencies between how teachers interpret and how they act (Son & Sinclair, 2010). Specifically, that teachers may attempt to help students with procedural knowledge even when they have identified conceptual errors. Furthermore, teachers may incorrectly interpret conceptual errors as procedural and subsequently act based on that interpretation (Son, 2013). With respect to the acting phase, the work from Elrod and Strayer (2015) suggests that it is problematic to assign grades to observations. Beside Harlen's (2012) concern about outcomes from observations being potentially inconclusive and influenced by the particular context, the study from Elrod and Strayer (2015) suggests that there are other dimensions to consider: student beliefs and motivations. This means that for assessments that are intended for formative purposes to function summatively, teachers need to be careful about what results are able to demonstrate (Harlen, 2012), as well as how an assessment is impacted, and is influenced, by student beliefs and motivations (Elrod & Strayer, 2015).

The work from Sherin and colleagues (2011) on methodological considerations is also helpful for my study. Since I am interested in teacher experiences of ephemeral assessment

processes, it is important that I access their descriptions of what occurred. Sherin and colleagues (2011) also indicated that a wearable camera potentially changed a teacher's attention in the moment. This is an important consideration because I wanted my participants to not be distracted by a wearable camera. As a result, in my study, I allow teachers to capture the ephemeral assessment moments in whatever ways that they would feel the most comfortable.

Unanswered wonderings.

While literature has been illuminating in responding to some aspects of my questions when I began this study, unanswered wonderings about the ephemeral assessment process remain after the literature review. In order to be clear and consistent, I have organized my wonderings in terms of eliciting, interpreting, and acting.

Information may be elicited through a variety of ways, including direct teacher questioning, or as natural parts of classroom activities. My first wondering relates to information that is elicited incidentally. What does it mean to elicit information incidentally and how does the fact that it is incidental affect the subsequent phases of the ephemeral assessment process? Second, while Boaler and Brodie (2004) provided useful considerations for the purposes of the different types of teacher questions, I wonder about the teacher's perspective about their questions. In other words, do teachers know why they ask what they ask, or say what they say, when they are eliciting information? My third wondering relates to the kind of information that is elicited and subsequently interpreted. Is it really only mathematical content? If there are other aspects that are elicited, such as student beliefs, and subsequently interpreted, how do they impact, or how are they affected by, teacher actions?

Interpreting occurs in the mind of the teacher. Although the studies have been helpful for me to think about what teachers interpret, and how they interpret, questions about this process

remain unanswered from my reading of the literature. First, since it is impossible to interpret all information that has been elicited and attended to, what contributes to in-the-moment decisions to pursue certain elicited information and not other information? Second, are there factors beyond student engagement and teacher beliefs that influence teacher interpretation, and, if so, how do these factors impact interpretations?

After reading the literature, I also continue to wonder about the acting phase of ephemeral assessment processes. First, there is often an abundance of information being elicited, that teachers may not have the opportunity to interpret meaningfully, and so how do we account for inactions or unintended actions that occur without appropriate interpretation? The teacher may act without thinking or not act at all. How do these inactions or unintended actions impact the assessment process? Second, it remains unclear to me how ephemeral assessments might serve summative functions in practice, or if they can at all. Lastly, are there factors that influence how teachers act beyond simply what they have interpreted?

While my study may not be able to answer all of my wonderings, my focus on how teachers experience ephemeral assessment processes will be helpful in arriving at answers.

Chapter 4 : Methodology

This chapter provides an overview of the research methodology for this study. I begin by unpacking my rationale for why phenomenology was influential in my qualitative study. As the principal investigator in this study, I believe it is appropriate to elaborate on my involvement in the study and then explain my recruitment strategies and the data collection and analysis process. Throughout this chapter, I also address a methodological tension between a phenomenological approach as well as a more traditional qualitative approach. I focus on this methodological dilemma before discussing validity and ethical considerations with respect to my study.

4.1 Why Not Something Else? Rationale for a Phenomenological Approach

There was a time when I believed in a more certain world. Much like a scripted word problem in school mathematics, I thought that solutions to all of life's problems could be reached simply by obtaining then structuring an appropriate amount of information. As I journeyed on with my life, I found that while certainty may be comforting, it is unhelpful. It is unhelpful because interesting and worthwhile topics are often complex and involve several layers of considerations.

Classroom assessment is one of those complex topics. Creswell (2007) recommends the use of qualitative research when “we need a complex detailed understanding of the issue” (p.40). A qualitative approach is most appropriate because I am interested in digging deep into the experiences of teachers with respect to the ephemeral moments in the classroom. I want to better understand how teachers engineer these situations, how they interpret them, and what they do with them.

The methodology for this study draws from phenomenological principles put forth by van Manen (1990, 2002, 2011a, 2011b, 2014). Phenomenological approaches aim at better

understanding our everyday experiences, and the concept of a lived experience is central to phenomenological research (van Manen, 1990). The phrase “lived experience” indicates the intent to directly explore the original and pre-reflected dimensions of human existence. At the same time, the aim of phenomenological research is to:

Transform lived experience into a textual expression of its essence – in such a way that the effect of the text is at once a reflective re-living and a reflective appropriation of something meaningful: a notion by which a reader is powerfully animated in his or her own lived experience (van Manen, 1990, p.36).

The temporal aspect of a lived experience is important – of the lived experience occurring now without reflection, of the lived experience in the past as we reflect upon it, and of the lived experience in the past as we relive the experience now upon reflection. These differences are important because our reflections change the lived experience (van Manen, 2014). If we try to capture the *now*, it is already too late, because “the moment that I stop and reflect on what I am experiencing in the present – this moment inevitably becomes objectified – it turns from the subjectivity of living presence into an object of reflective presence” (van Manen, 2014, p.34). If we think about the *now* then we change the *now*. These ambiguities around time may seem impossible, but I believe it is a powerful notion for thinking about experiences and actions deriving from experiences. Van Manen (2014) referenced Heidegger in describing the *now* as “a constant absence, a continual losing of the future to the past – in the flash of the moment of the now” (p.59). Instead of ignoring these complex ambiguities, I agree with van Manen (2014) in embracing this impossibility, and believe that it adds a richness to my explorations through this study.

I found the philosophy behind phenomenology and the methodology described by van Manen (1990, 2014) to be appropriate for this study in at least two ways. First, it allows me to describe teacher experiences with ephemeral assessments, and, in co-constructing these

descriptions, incorporate reflections. A phenomenological description attempts to elucidate our experiences and resonate with our lives. Van Manen (1990) emphasizes that “*a good phenomenological description is collected by lived experience and recollects lived experience – is validated by lived experience and it validates lived experience*” (p.27, italics in original). In other words, a phenomenological description interacts with its readers in meaningful ways. For readers who have experience with assessment strategies involving observation and conversations, a phenomenological description resonates and may help further shape personal meanings. For readers without their own experiences with the topic, a description invites them into the vivid world of lived experience so that they may better understand the complex aspects of the topic.

Second, I also believe phenomenological philosophy and methodology share many similarities with how teachers construct an understanding of student learning with an ephemeral moment in time. Van Manen (2014) believes that with the act of naming and writing experiences, “we cannot help but rob the things that we name of their existential richness,” that we writers become “annihilators – killers of life” (p.21). When experiences are translated into written form, they are no longer the same. Lived experiences are temporal – situated in flow of time and contexts. Written representations are finite, and even our choice of words alters the experience. However, this does not imply that writing is unhelpful. Instead, van Manen (2014) suggests that: “To write is to reflect; to write is to research. And in writing we may deepen and change ourselves in ways we cannot predict” (p.20). These considerations are similar to teacher experiences in the dynamic classroom. Moments in the classroom are ephemeral. Not only are they short lived, they are informed by preceding moments and inherited by subsequent moments. Similar to phenomenological thinking, as a teacher considers a snapshot of student

understanding, whether spoken or observed, my interpretations cannot help but restrict the existential richness of the moments. As I act, it takes away from other actions during these moments, regardless of what actions I might take. Even if it is to not do anything. I believe the many parallels between the thinking in phenomenology and the teacher interactions with ephemerality were helpful for this study.

Why were interviews involved?

In this study, a series of interviews with the participants were important for intertwining experiences of others with my own. Seidman (2013) believes that stories communicated through an interview is a way of knowing. As the storyteller shares a story, she or he is “selecting constitutive details of experience, reflecting on them, giving them order, and thereby making sense of them that makes telling stories a meaning-making experience” (p.7). These stories describe experiences. As I, the researcher, involved myself in this meaning-making experience, I became part of the participants’ attempts to re-create the moments of the classroom. In the conversations aided by interview prompts, we slowly added more colour and outline to the experience being described. While recognizing that it is impossible to completely recreate a moment in the past, van Manen (1990) believes that an interview helps us get at what we experienced by attempting to reconstruct the experience. As the experience is reconstructed, an interview also allows for conversations about the meaning of an experience (van Manen, 1990). For these reasons, I decided to employ in-depth phenomenological interviewing (Seidman, 2013; van Manen, 1990) in order to better access the experience of others through their reconstructions.

Why a focus group interview?

While exploring educational change in the Spanish educational system, Flores and Alonso (1995) also examined the focus group methodology. They found that the dialogue during

the focus group “activates participants’ memories and experiences, confronts points of view, allows participants to be conscious of latent opinions, obliges them to question themes ignored until that moment and involves looking for arguments to support an unreasoned perception or feeling” (Flores & Alonso, 1995, p.99). They believe focus groups have the power of exploring opinions and behaviours rooted in motivations and emotional processes. Wilson (1997) also notes that “there is literally no place for a researcher to hide within a focus group: language, values, feelings and ability to interact with respondents soon become apparent – a unique challenge both personally and professionally for the researcher” (p.222). These explorations and challenges are helpful for a phenomenological study. Bradbury-Jones, Sambrook and Irvine (2009) argued that “focus groups might enhance the quality of a phenomenological study” (p.670) by “[providing] a greater understanding of the phenomenon under study” (p.663). Through my readings which I have shared above, I saw how focus groups might enhance my study. As a result, I decided to include a focus group in order to provide opportunities to dig deeper into the experiences of my participants.

4.2 Inquiring and Writing Phenomenologically

Van Manen (2011a) believes there are “two methodological impulses in phenomenological inquiry and writing: the *reductio* (the reduction) and the *vocatio* (the vocative dimension)” (para. 1). In this section, I elaborate on the notions of *reductio* and *vocatio* as envisioned by van Manen (2011a, 2011b, 2014). I also explain my attempts to adhere to these methods of inquiring and writing phenomenologically.

Reductio.

Reductio consists of “two methodical opposing moves that complement each other” (van Manen, 2014, p.215): epoché and reduction-proper. The first move, epoché (or bracketing),

involves the suspension of attitudes, assumptions, theoretical meaning, and techniques that may interfere with access to the phenomenon. I need to begin by freeing myself from shackles that limit my openness to the phenomenon. Suspension of attitudes, or heuristic epoché-reduction (wonder), refers to the necessary freedom from present preoccupations. I need to be prepared to step back and let the topics and ideas present themselves to me on their own terms. As I engage in heuristic reduction, I am challenged to “inquire and write in such a manner that the reader of the phenomenological text is similarly struck by or stirred to the same sense of wondering attentiveness to the topic under investigation” (van Manen, 2014, p.224). Suspension of assumptions, or hermeneutic epoché-reduction, refers to freedom from my own subjective feelings, preferences, inclinations, or expectations. As I engage in hermeneutic reduction, I need to be open to possibilities in the phenomenon, make assumptions explicit, and then question these assumptions. Suspension of theoretical meaning, or experiential reduction, refers to freedom from abstractions. As I engage in experiential reduction, I am challenged to “examine how the theories or conceptualizations gloss or hide the experiential reality upon which they ultimately must be based” (van Manen, 2014, p.226). Suspension of techniques, or methodological reduction, refers to the freedom from conformity to rigid methodological structures. Van Manen (2014) suggests a flexible rationality at every turn of the inquiry process, and to be attuned to the phenomenon at hand as I approach. In other words, my inquiry ought not to be shackled to step-by-step procedures, and instead be guided by my explorations of the phenomenon.

I believe I can only be freed from shackles that I can see. Recognizing attitudes, assumptions, theoretical meanings, and techniques helped me begin suspending them. I attempted to reach epoché in several ways. By writing in my reflective journal, I made explicit,

and reflected on, my attitudes and assumptions about ephemeral moments in the classroom. By having an understanding of my own orientation toward the phenomenon, I was then better able to suspend my attitudes and assumptions during the interviews, and avoided suggestions, encouragements, or questions that may lead the conversations. During the interviews, I also made notes about what I thought, so that during transcriptions¹⁶ I would again be able to make explicit, and reflect on, my attitudes and assumptions as I interpret that data. Having read and reflected on literature that relate to assessment and noticing, as well as seeing that there are various ways of interpreting these ideas, I also became more able to identify, and therefore break free from, theoretical structures. For example, while I found the loose structure of the three phases of eliciting, interpreting, and acting to be helpful, I was open to possibilities of other ways of thinking about ephemeral assessment processes. Moreover, I also sought ways to refine my thinking based on the lived experiences of my participants. I attempted to suspend techniques by identifying available methods of interviewing participants and writing theses, and then freeing myself from rigid structures. For example, while I had prompts during the interviews, these were not uncompromising guides. Instead, I followed the conversations about, and explorations of, my participants' lived experiences. As another example, while I was aware of various ways that theses can be written phenomenologically, I understood that my writings cannot simply be replacement of words and ideas in their structures. Instead, I was free to write in a way that honours the essence of the phenomenon through lived experiences.

Freedom from attitudes, assumptions, theoretical meanings, and techniques then lead me to the second move, reduction-proper. Reduction-proper is the movement toward the essence of

¹⁶ During the transcription process, I used brackets to add in reflections. I used curly brackets to elaborate on my thoughts during the interview, and angle brackets to elaborate my reflections of the conversations that took place. I discuss these additions in more detail as part of a later section.

the phenomenon, and toward the experiences and meanings as lived. However, results are not immutable generalizations. Van Manen (2014) elaborates on this movement of reduction-proper through two important reminders:

The first important reminder is that phenomenological inquiry is only concerned with “possible” human experiences – not with experiences that are presumed to be empirically or culturally universal or shared by all humans irrespective of time, culture, gender, or other circumstance. The second important reminder is that phenomenological determination of meaning is always indeterminate, always tentative, always incomplete, always inclined to question assumptions by returning again and again to lived experience itself, the beginnings of phenomenological inquiry (p.230).

I worked toward reduction-proper by paying attention to the lived experiences of the phenomenon. I begin with my experiences as I turn to the ephemeral moments in my own classroom. I reflected on the meanings and wonderings that emerged out of my experiences. Recognition and subsequently suspension of these meanings and wonderings allowed me to explore my participants experiences with an openness of mind. I intentionally interviewed the participants in their classrooms so that I could get a better sense of the ephemeral moments which they described. As I worked through the transcriptions and added in more of my thoughts¹⁷, I returned to my own experiences of the phenomenon and continued to seek meanings.

These two moves of reductio are important considerations as I explore the phenomenon of the ephemeral moments within the classroom as teachers experience them. As van Manen (2014) explained:

The reduction is an attentive turning to the world when in an open state of mind, effectuated by the epoché. It is because of this openness that the insight may occur that remembrances are held in the things around us, and they may be

¹⁷ I used angle brackets in the transcripts as a way to relate to my own experiences. I elaborate on this in a later section.

released through sensory contact, even though these occurrences are not really predictable or under our control.

There is not a clearly defined line of when epoché ends and reduction-proper begins. As I identified and attempted to suspend my beliefs and ideas, which was difficult to accomplish and I will elaborate on this in a later section, I turned intentionally to lived experiences of my participants in order to focus on the essence of the phenomenon. In the process of making sense of the lived experiences, I made use of familiar and helpful structures such as my own experiences or frameworks that have helped me understand the ideas that my participants discussed. I then found myself needing to suspend attitudes, assumptions, theoretical meanings, and techniques once again. It was as if I stood in a murky pond attempting to get a better look at a fish at the bottom. As I attempted to wave away the dust and sand, I believed in moments of clarity where I caught a glimpse of the colour or shape of the fish, but the water always returned to its original state, cloudy with assumptions and beliefs.

Vocatio.

Where *reductio* refers to breaking through walls to reaching the meaning of our experience, *vocatio* refers to the process of phenomenological writing. In order to bring forward the phenomenon, I need to transform my understanding of the text into language, because it is through language that I share understandings. Van Manen (2002) believes:

Writing is not just externalizing internal knowledge, rather it is the very act of making contact with the things of our world. In this sense to do research is to write, and the insights achieved depend on the right words and phrases, on styles and traditions, on metaphors and figures of speech, on argument and poetic image. Even then, writing can mean both insight or illusion. And these are values that cannot be decided, fixed or settled, since the one always implies, hints at, or complicates the other (p.237).

My aim here is to engage in the reflective process of writing that allows me to let the phenomenon speak and be heard. Van Manen (2011b, 2014) recommends several vocative turns

in order to stay true to the phenomenon: the revocative turn, the evocative turn, the invocative turn, the convocative turn, and the provocative turn. The revocative turn asks that I write in a way to “bring experience vividly into presence” (van Manen, 2014, p.241), possibly through anecdotes and imagery. This helps the writer and reader to construct the experience for themselves as we interact with the writing. With the revocative turn, I invite others into the lived experience. The evocative turn asks that I move with devices such as metaphors, repetitions and alliterations, “so that layers of meaning get strongly embedded in the text” (van Manen, 2014, p.249). This helps the writer and reader get closer to the experience being constructed. With the evocative turn, I move to make the lived experience more tangible and relatable to the readers. The invocative turn asks that I be “sensitive to the ways that words and expressions may acquire a certain desirable intensity” (van Manen, 2014, p.260). This helps the writing speak to the writer and reader as it creates a feeling of understanding of the experience. With the invocative turn, I move to make the lived experience mean something to the readers. The convocative turn asks that I write in a way that the meaning of the phenomenon “speaks to, and makes a demand on, the reader” (van Manen, 2014, p.267). This helps the writer and reader connect to the lived experience on a shared communal space. With the convocative turn, I move to open the lived experience into shared meaningfulness for the readers and their own experiences. The provocative turn asks that I write in a way that inspires reflections and actions – to “provoke a transformative effect” (van Manen, 2014, p.293). This helps the writer and reader to think about and do something with lived experiences. With the provocative turn, I move to inspire personal reflection and future actions.

Phenomenological writing seems extremely demanding. I not only need to invite others to the lived experience, I also need to make the lived experience tangible and relatable. I not

only need to make the lived experience tangible and relatable, I also need to make the lived experience meaningful. I not only need to make the lived experience meaningful, I also need to establish a shared platform of meaningfulness that welcomes constructions of new personal meanings. I not only need to establish a shared platform of meaningfulness, I also need to inspire reflections and actions. Van Manen's (2014) recommendations for writing, then, requires "an aesthetic imperative, a poetizing form of writing" (p.241).

I kept these turns in mind as I attempted to write phenomenologically. In order to make the lived experiences tangible, relatable, and meaningful, I created narrative anecdotes for each participants' experience that incorporate metaphors and poetic language. Rooted in my participants' lived experiences, these narrative anecdotes were intended for creating a space for audiences to reflect on their own experiences. These narrative anecdotes were created before a full analysis of the data was completed so that I could focus on expressing, and not explaining, the lived experiences of my participants. Throughout this thesis, I also included various scenarios and stories that are based on my own experiences as a secondary mathematics teacher. Similar to the narrative anecdotes, I also used artistic approaches for the writing of these scenarios and stories. It is my hope that these writings might help illustrate lived experiences in a way that resonates with experiences of the audience.

4.3 Where Did I Exist? My Role in the Study

I was nowhere *and* everywhere.

These two seemingly contradictory indications of my presence are not separated by a conjunction "but." Instead, "and" was chosen because my presence could only be appropriately described by a combination of both. As explained in the discussion of reduction and vocation, in order to explore phenomenologically, I needed to suspend distractions brought on by my own

existence (be nowhere) in this research journey, but recognize that I was a necessary part of my exploration (am everywhere).

Both methodological impulses of *reductio* and *vocatio* ask that I suspended myself as I oriented and interpreted, and to focus on the meanings of the phenomenon for the reader as I wrote. Thus:

I was nowhere.

Reductio is an aspect of phenomenological approach that asks for a suspension of distractions brought on by the researcher. This meant I must suspend my prejudgements, bracket my assumptions, deconstruct the claims I bring into the study, and restore openness in my orientation to the phenomenon. In other words, I, the primary investigator of teacher experiences with ephemeral moments, was nowhere in this study. I was nowhere and I needed to be nowhere. Otherwise I risked examining the topic with clouded judgments – like driving in dense fog with a shattered windshield, or like jumping into a puddle that is actually an ice-fishing hole. But was this ever truly possible? Could I ever really suspend prejudgements or assumptions? Could I approach the phenomenon of which I have knowledge and experience, without bringing that into current consideration?

As I explained earlier, I employed several strategies in order to work toward *reductio*. These strategies included recognizing, reflecting on, and subsequently suspending my own beliefs and existences, as well as constantly returning to the lived experiences of the phenomenon. For example, during the interviews, I consciously avoided interjecting to share my definitions of concepts, such as my views of assessment. As my participants described how they listened and responded to their students, they did not immediately recognize their descriptions as assessment. I held myself back from expressing my belief that the process they described was

assessment and chose to focus on helping my participants elaborate on their stories and their thoughts.

Vocatio describes necessary aspects of phenomenological writing where I consider the lived experience beyond myself. This meant my primary concern in writing is the readers. I am encouraged to bring the text to life for the readers. But I needed to let the phenomenon uncover its own meanings. As van Manen (2014) draws from Heidegger, I needed to “let what shows itself be seen from itself, just as it shows itself from itself” (p.28). As I did this, I needed to allow the reader to connect to and reflect on their own lived experiences as they resonate with the text. Otherwise I risked the reader’s misunderstanding of, or failure to connect to, the phenomenon – like describing the experiences of riding in a limousine to a child living in poverty in a third world country, or like describing the taste of peanut butter as sour to one who has peanut allergies. But how was this possible? How did I remain mindful about letting the phenomenon speak for itself, when it does not possess a language?

In attempting to let the phenomenon speak for itself, I wrote the scenarios, stories, and narrative anecdotes. These writings were rooted in lived experience and written in an artistic way in order to better paint an inviting world for the audience to experience.

As I recognized my roles as an employer of strategies and a writer of lived experiences, I realized that, inevitably, throughout the study:

I was everywhere.

Similar to the ambiguities surrounding time, there were also ambiguities around my role in this study. I was nowhere, and at the same time, I was also everywhere in this study.

According to van Manen (1990), true removal of the researcher from the text is an impossibility. Even as I engaged in *reductio* and *vocatio*, I existed in my orientation to the phenomenon, as it is

motivated by, rooted in, and maintained with my own experiences. I existed as a creator of new understanding as I interacted with the literature or with participants, even as I attempted to suspend my knowledge of the phenomenon. I existed in the individual interviews as a co-creator of the lived experience, even as I attempted to restrict my influences on the conversations. I existed in the analysis of data as a sense maker of the phenomenon. I existed in the writing and naming of experiences as the decider of words, sentences, paragraphs, and chapters; thus an annihilator and killer of life. I was inescapably a creator, a co-creator, a sense maker, and a decider of words as I completed this study with the only lens that I could use: my own.

Thus, I was nowhere and I was everywhere. Like Bertrand Russell's struggle with the set of all sets that are not members of themselves (Klement, n.d.), my role in the study was a paradox. It might be a paradox, but it was not contradictory. In making explicit my own experiences through a reflective journal during the beginnings of my inquiry, I attempted to name and set aside my existence. As I recognized that a complete disappearance of my experiences is impossible, I became more attentive to instances when they arise. In making explicit my thinking during the interviews, as well as my personal reflections from the transcripts, I again made my existence and potential influences transparent. As I appeared, disappeared, and reappeared repeatedly in the process of my phenomenological inquiry, I aimed to create a backdrop textured with the lived experiences, where readers can reflect on their pasts and create their futures. This process involved active decision making on how and in what way I introduced my existence into the study.

During the interviews, while I refrained from dominating the conversations with my own experiences and biases, I shared some comments in order to provide a comfortable atmosphere

for the participants to share their experiences. Van Manen (1990) emphasizes the importance of comfort, and that it is useful to emulate “talking together like friends... [since] when the participants of the conversation try to out-argue each other, the conversation disintegrates” (p.98). Besides considerations for my role as an interviewer, van Manen’s (1990) emphasis was also an important consideration for me as the mediator of the focus group. Therefore, I was there in the interviews and focus group interviews.

During the analysis, while I had not appropriated participant experiences in order to fit an existing theory, I categorized themes according to my proposed framework of the assessment process of eliciting, interpreting, and acting. This was because I believed these three instances are primarily temporal separations that are helpful for an in-depth consideration of the ephemeral moment. In other words, I was building an elaboration of the past (eliciting), present (interpreting), and future (acting) of the lived experience. By making use of a structure that began before I interacted with my participants, I was unable to let go of my understandings. This means that I was in and out of *reductio* as I toiled over the structure with which I attempted to understand my participants’ lived experiences. In other words, I was there in the analysis.

During the writing of the thesis, I was involved in interpreting my readings and choosing the literature I incorporated. This meant I was there in the literature review. As discussed in the previous section, since my work was inspired by phenomenological methodology, I also needed to write in a way to “bring experience vividly into presence” (van Manen, 2014, p.241). As a result, the narrative anecdotes in chapter 5 were written in a way that addresses this. This means I was there in the writing of this entire text.

Thus, inevitably and necessarily, I was everywhere.

4.4 What Experiences have I Intertwined?

As recommended by van Manen (1990), I begin by orienting to the phenomenon. My starting point is rooted in my own experiences, and I began orienting to the phenomenon long before a formalization of the words that constitute my phenomenological question, or even before my master's program. During the beginning of my explorations in this master's study, I maintained a reflective journal for 23 non-consecutive days. The first 19 days of the journal were completed between January 2013 and June 2013. These chronicled my entanglement with aspects of educational assessment, as I attempt to identify "the phenomenon that seriously interests [me] and commits [me] to the world" (van Manen, 1990, p.30). As my journey progressed, and my inquiry became more focused on the ephemeral moment, I continued the reflective journal from day 20 to 23 between February and June 2015. These reflections helped me orient to the phenomenon, as well as make transparent my existence in assumptions, frustrations, beliefs, and wonderings. For example, in my reflective journal, I came to a better understanding of what was important to me in my interactions with students. I could see that I believed that it was important to listen and respond in ways that helped students continue mathematical conversations, and helped me better understand what they were saying. I was cognisant of the fact that I valued listening to student thinking and when my participants explained that they valued listening, I tried not to assume what they meant. Instead, I sought opportunities to prompt them to elaborate on their thoughts.

My exploration may begin and end with my experiences, but it must involve others. Van Manen (1990) believes:

[Phenomenological inquiry needs to] borrow other people's experiences and their reflections on their experiences in order to better be able to come to an understanding of the deeper meaning or significance of an aspect of human

experience, in the context of the whole of human experience.... *We gather other people's experiences because they allow us to become more experienced ourselves* (p.62, italics in original).

As a result, it was important that I sought other people's experiences in order to better understand the phenomenon involving the ephemeral assessment process.

Shaping future conversations: the pilot.

Before recruiting participants, I ran a pilot study which focused on testing out my interview prompts for the first interview. The participant was a teacher colleague. This colleague had taught secondary mathematics for 10 years and had experience as a department head. My reflection of this conversation helped me better prepare for subsequent interviews, as well as new aspects of the ephemeral moment I had not considered. For example, as we reconstructed the lived experience of the ephemeral moment, he elaborated on his past connections with a student, as well as indicating attentiveness to the students' emotions. Potentially construct-irrelevant variances, while they may not be appropriate when making summative judgements (Harlen, 2005), coloured his formative actions. These insights and questions that arose out of my conversations with my teacher colleague were helpful for my becoming aware of possible responses from my three participants.

Reaching for others: Recruitment strategies.

For the study, I sought three secondary teachers to share their experiences with me. Seidman (2013) recommended that the researcher consider sufficiency and saturation when it came to the number of participants involved in a study. I believed that any more than three would be counterproductive for a study that seeks to provide an in-depth description which requires a significant amount of time and reflection. Three participants also allowed for meaningful discussions during the focus group. I wanted to be able to devote the necessary time

to each participant and I felt that three participants allowed for deep meaningful interviews and reflections.

In addition to approval from the Research Ethics Board at the University of Ottawa, I also obtained permission from a school board. The director of the school board subsequently contacted a superintendent who then involved a mathematics instructional coach. An invitation, which included my recruitment letter (Appendix A), was then distributed through the instructional coach to teachers in their board.

Recruitment of participants involved reaching out to teachers “who [were] currently engaged in those experiences that [were] relevant to the study” (Seidman, 2013, p.20). The recruitment letter indicated that I sought “teachers who include opportunities for observations and conversations in their teaching” (Appendix A). The participants turned out to be the first ones to respond to the invitations from the mathematics instructional coach who distributed the recruitment letter; I did not turn anyone away. The introductory meetings with participants revealed that they thought a lot about observations and conversations as assessments within the classroom. As a result, they were appropriate participants (Seidman, 2013) for this phenomenological study.

4.5 What is Collected in the Process?

The data collection process followed the timeline shown in Table 4-1. It also involved several sources of data, shown in Table 4-2, such as audio recordings and transcripts of the interviews and focus group, artefacts used to supplement the conversation, and interview notes. The artefacts included images of student work, descriptions of the tasks, manipulatives that

helped participants recall events in the classroom, student posters, as well as iPad video recordings.

Table 4-1 Timeline of data collection.

Timeline for data collection		
Personal reflective journal (Researcher): Beginning in January 2013, this also occurred during transcriptions.	Content	Dates
	Meeting #1: Introductory individual meeting with participants. No audio recording was made.	Cadence: November 5, 2015
		Casey: November 10, 2015
		Fernanda: December 15, 2015
	Meeting #2: First semi-structured individual interviews.	Cadence: November 23, 2015
		Casey: December 1, 2015
		Fernanda: January 26, 2016
	Meeting #3: Focus group meeting with all three participants.	March 3, 2016
	Meeting #4: Second semi-structured individual interviews.	Cadence: April 5, 2016
		Fernanda: April 18, 2016
		Casey: April 22, 2016

The sources of data were drawn from the reflective journal, two interviews with each participant, the focus group interview with all three participants, and my reflections from the transcript. The reflective journal was written well before this project officially began. The interview process took place between November 2015 and April 2016. My reflections from the transcript were written within the transcripts, and this process will be described in more detail in a later section. In a way, these reflections from the transcript were a continuation of my reflective journal.

Table 4-2 Description of data sources

Action	Data source	Other
Introductory meeting	No data collected during introductory meeting	- Built rapport - Answered questions concerning research Notes encouraged Artefacts encouraged for future meetings
Individual Interviews (first & final)	Audio recording and transcript of interviews - Pictures of artefacts used to supplement conversation	Notes and artefacts were used by participants to recall events, but are not collected as data.
Focus Group	Audio recording and transcript of focus group - Pictures of artefacts used to supplement conversation	
Reflective journal	- An ongoing journal was kept by the researcher. - This included interview notes made during each interview	

Introductory meeting: creating a comfortable space for conversations.

In our introductory meetings, I met with each participant at their work after school hours. This meeting took approximately 30 minutes and I provided them with more information concerning the study as well as the consent form. I elaborated on the purpose of the study which is to provide a better understanding and deeper description of how teachers elicit, interpret, and act on observations and conversations.

As Seidman (2013) points out, it is often important to recognize “the world’s definitions, classifications, and tensions” (p.97), because our “interviewing relationships exist in a social context” (p.97). In my own experiences as a teacher and a colleague of teachers, I understand that the word *assessment* can be a contentious subject, and often only associated with reporting and grading purposes. As a result of recognizing these potential definitions, classifications, and tensions, I briefly mentioned that I am interested in a variety of actions from the ephemeral

moment. This introductory meeting also allowed me to encourage the participants to note a classroom moment involving observation and conversation, and to bring any related artefacts that may help us re-create the moment during our first interview. This introductory meeting was not recorded, but was invaluable to inform as well as to build a positive relationship for subsequent meetings. The word *assessment* was also not named by me as the interviewer early during the sessions. In the first interview, focus group, and second interview, I let the participants use the word in their own context with their own definitions.

First semi-structured interviews: constructing moments in the classroom

The first semi-structured individual interviews allowed opportunities to discuss prepared prompts (Appendix B), as well as any artefacts or emergent assessment ideas they wished to share for approximately 90 minutes. The purpose of each interview was to reconstruct the moments of interest that have occurred for each participant. Cadence brought images of two students' work which were related to conversations that occurred during class. She also brought an assessment feedback form she used for conversations with students about their progress. Casey brought student work, excerpts of student journal entries. She also brought her iPad and had recorded videos of the moments in the classroom, which she watched before our meeting. I did not ask Casey to record videos, but she thought they would help her recall moments in her classroom. Fernanda brought a description of her lesson plan, which she elaborated on during the interview.

It was important to keep the questions open (see Appendix B) so I could allow the participants to weave their experiences. The prompt began with questions that helped identify background information to better understand potential factors in the teachers' perspective. I then sought to understand how the participant teachers approach eliciting learning evidence from

students. After having a conversation about eliciting evidence, I then attempted to tease out how teachers interpret the elicited evidences, as well as how they act on what they have interpreted. For the most part, I focused on the moments of the classroom that each participant chose to describe. However, in many instances, Fernanda, Cadence, and Casey also drew on their experiences with other students in order to support their thoughts and comments. The last question addressed supports and challenges that teachers encounter during the assessment processes.

Focus group: exchanges and emphases.

The focus group was a space for all three participants to meet and discuss their experiences with assessment strategies. Guiding prompts are provided in Appendix C. I began by drawing attention to a similarity across the first interview from all three participants. This involved the notion of community building in the classroom. Participants were asked to exchange some ideas as to what building classroom culture looked like in their classroom and why that was important. Then participants were asked to discuss a particular conversation or observation that had changed the way they thought about a particular student. We then tried to tease out specifically what we think about as teachers during these moments in the classroom. We ended with a discussion about professional judgement and its role in these ephemeral moments during class. As mentioned in a previous section, the intent of the focus group was to enhance my understanding of the phenomenon by promoting thoughtful exchange of participant experiences.

Final interview: clarifying and seeking reflections

A few weeks following the focus group, I met with each participant for a final interview. Prompts are provided in Appendix D (for Cadence), Appendix E (For Casey), and Appendix F

(for Fernanda). Slightly different prompts were used in order to honour and follow up on what each participant had stated in previous sessions. Since it had been difficult to capture, an emphasis was also placed on how we as teachers interpret events in the moment. The purpose of this final interview was to clarify participant statements from previous meetings, as well as reflect together on the ideas that we had discussed.

Continuing the reflective journal through transcriptions.

Schön (1983) coined the terms *reflection-in-action* (awareness of thinking as one acts in the moment) and *reflection-on-action* (thinking back over what happened)¹⁸. As I prepared for my interviews, I saw opportunities to reflect on the interview process. In order to capture my reflection-in-action, I made short notes during the interview about thoughts that came to mind as I interacted with the participants. As I transcribed the audio recordings, these notes helped remind me of what I was thinking during the interview. I elaborated on these reflections-in-action in curly brackets { }. The additions in the curly { } brackets were added to the transcripts as I transcribed. I wanted to make sure that I was still able to recall what I was thinking of at the time. For example, I wrote about my decisions for following up on certain utterances, as well as my hesitations for whether to explore potentially sensitive topics.

I used angle brackets < > in order to reflect on the interviews (reflection-on-action). Within the angle brackets, I reflected on the content of the conversation, and added comments and questions about the experience. The additions in the angle brackets < > were added after transcriptions were completed. My comments and questions often related my own lived experiences to the conversation. For example, one conversation with a participant about building

¹⁸ Mason (2002) later added *reflection-through-action*, which he explained was “becoming aware of one’s practice through the act of engaging in that practice” (p.15). I did not have an opportunity to reflect through possible actions due to the scope of this research project.

rapport made me remember my experience of working hard every day in order to earn a particular student's trust. In the angle brackets, I described my experience with that student, and wondered about what I could have done differently.

As mentioned before, I believe there are many similarities between the phenomenological approach and the ephemeral moments in the class. These layers of descriptions and reflections in curly and angled brackets were helpful for returning to the conversations I had with each of the participants, as well as for intertwining my own experiences with others.

4.6 Analysis of Collected Data.

I have engaged in many different ways of analysing the data. Through transcription, I was able to reflect, revisit, and think more deeply about my research questions and the data. When examining the transcript, artefacts, interview notes, and personal journal, I conducted a thematic analysis. The act of seeking themes "is not a rule-bound process but a free act of 'seeing' meaning" (van Manen, 1990, p.79). While I believe that there may not exist universal themes free of subjective interpretations, since the development of themes will inevitably be through my own lens, it is still useful to uncover thematic aspects of the phenomenon. Van Manen (1990) draws a useful analogy and describes themes as "knots in the webs of our experiences, around which certain lived experiences are spun and thus lived through as meaningful wholes" (p.90). In other words, in order to better understand teachers' lived experiences with ephemeral evidence, it is useful to identify and reflect on the construction of these knots, as well as how the experiences have been woven around them.

Whole text: arriving at pseudonyms.

I began my thematic analysis through three approaches: wholistic, selective, and detailed. In this section, I explore my whole-text analysis. First, I reflected on the entire experience of all

the interviews and identified any fundamental meaning or main significances. In this first approach described as a “wholistic or sententious approach” (van Manen, 1990, p.94), I sought to express potential meanings through considering the whole. After reflecting on the moments that the participants and I had constructed together, I created meaningful pseudonyms that I believed matched each participant.

The first participant spoke about rhythm in two ways during the interview. For example, it might be the student getting to know the flow of an operational routine. She also gave another example of how teachers get into different rhythms depending on what it is they are doing during class. “and then all of a sudden... you get into behaviour... you get into other rhythms...” (line 1295 – 1296). She talked about, as a teacher, setting up different rhythms for herself in order to deal with various challenges in the classroom. As a result, I feel that the name Cadence was appropriate as it is a name derived (Harper, 2016) from the English word that means rhythm and flow.

Derived from an Irish surname, Casey carries the meaning of being watchful, vigilant, and observant (Campbell, 1996). I thought this was appropriate for the second participant since she spoke about details in her interactions with her students. She included ideas such as pauses, facial expressions, and intonation. She watched her students intently and utilized this information in order to form her interpretations.

My first interview with the third participant was at the end of the first semester. As a result, her mind was in transition from the end of one course (Grade 9 academic) to the beginning of the next (Grade 12 Calculus and Vectors). Her responses and considerations often involved her future plans for the upcoming semester. One of her main takeaways from the moment she described, was to do more activities that are not planned in detail. Her reflections

throughout the interview also often had her in the mindset of responding to parents of grade 12 students. She also spoke of the importance of taking risks as a teacher. Fernanda, derived from Ferdinand, means adventurer (Harper, 2016). It carries the meaning of being prepared for the upcoming journey. I thought this was an appropriate pseudonym for Fernanda.

A side note is made here about pseudonyms for students mentioned by Casey. While the pseudonyms for the three participants were handled with much thought and consideration, the pseudonyms for students were mostly randomly generated. Casey used a large number of student names in her interviews. I used the search engine Baby Name Voyager from the website Baby Name Wizard (Wattenberg, 2015) to retrieve pseudonyms for each student. The search engine is an interactive search engine for baby names by popularity. It identifies popular baby names in each time period in the form of a graph. I used pseudonyms that contain the same first letter of student names for easier identification. The names were chosen from the most popular names in the 1900s that did not share similarities with other original student names.

Selective and detailed: Engaging in two layers of analyses.

After using the whole-text approach to reflect on my overall sense of the participants and their experiences, as well as to arrive at appropriate pseudonyms, I engaged in two layers of analysis. The first layer addressed the first three questions that I asked in the introduction: how do teachers set up ephemeral assessment opportunities, how do they interpret information obtained, and what do they do with the information. The second layer centred on an exploration of why my participants did what they did or thought what they thought about.

For these two layers of analyses, I utilized the ‘selective’ approach and ‘detailed’ approach (van Manen, 1990) in order to examine the text more closely. The selective approach involved “the selective or highlighting approach” (van Manen, 1990, p.93) where I circled,

underlined, or highlighted statements or phrases from participants that seemed “particularly essential or revealing about the phenomenon” (van Manen, 1990, p.93) of experiencing ephemeral evidence. For certain exchanges that may hold significance, I used the “detailed or line-by-line approach” (van Manen, 1990, p.94) and examined each sentence closely. In a separate document, I then copied and pasted sentences that related to emergent themes.

For my first layer of analysis after the wholistic approach, I began by immersing myself in the moments described by Fernanda, Cadence, and Casey in the interviews. I listened to the audio recordings, as well as read and re-read the transcripts in order to get a sense of the lived experiences. Each time I focused on questions that relate to one phase that I had previously elaborated on. As I read through for eliciting, I asked myself: What thinking goes behind eliciting? What occasions eliciting? How did the participant elicit? As I read through for interpreting, I asked myself: How did teachers interpret what the students said or did? What did they consider as they listened to students or watch students? What helped this interpretation? As I read through for acting, I asked myself: What kinds of actions were taken? How were their actions influenced by how they interpreted? Does the fact that it was in-the-moment influence how they acted?

Every time I focused on a phase, I highlighted parts throughout the transcript and added margin notes about how the conversation related to, for example, eliciting. For each participant, I then copied the exchanges related to eliciting and pasted them into separate documents. In these new documents, I synthesized exchanges into statements, and clumped together related statements about eliciting, and then combined related threads across all three participants to yet a new document meant for exploring eliciting. In this ‘eliciting document,’ statements derived from interviews with Fernanda, Cadence, and Casey were considered together as I wrote a

number of thematic statements that I felt were essential to the eliciting phase. I repeated this process for the interpreting and acting phases. With the help of my supervisor and committee members, I saw that my thematic statements, such as ‘incidental eliciting require awareness,’ and subsequent descriptions were written too much like truth statements. This was not my intention. As a result, I sought instead for words and phrases that symbolized aspects of each phase, and that could stretch across the lived experiences of all my participants. I subsequently arrived at *generate & attend* for eliciting, *sense-making & impression-building* for interpreting, and *interpersonal function & coherence* for acting. I discuss these emergent themes in Chapter 6.

The second layer of my analysis related to emergent factors of influence. As I mentioned in the introduction, I felt a need to explore why teachers did what they did and why they thought about what they thought about. Some of my wonderings persisted after my literature review. As I analyzed my data and parsed out statements related to eliciting, interpreting, and acting, I noticed that there were a large number of statements that did not fall under the three phases. Instead, these statements pointed to aspects that influenced how they elicited, interpreted, or acted. I collected all of these statements in a ‘considerations document.’ I then found it useful to categorize these ‘considerations’ into four emergent factors of influence: *teacher*, *student*, *relationships*, and *contexts*. I discuss these emergent factors of influence in Chapter 7.

4.7 Methodological Dilemma, Validity, and Ethical Considerations

Is what I did truly phenomenological?

As I mentioned briefly in the introduction, I became aware of a methodological dilemma during my data analysis and subsequently in the writing of my thesis. Of the different phenomenological traditions, I found van Manen’s (1990, 2014) work spoke to me and how I wanted to approach the teacher lived experience of ephemeral moments in the classroom.

However, van Manen (1990, 2014) indicated that this phenomenological approach does not seek explanations through theoretical structures. In addition, phenomenological inquiry focus on the ‘what’ and ‘how’ of the phenomena, and not the ‘why.’

This was difficult for me. I had begun to form understandings about the assessment process through the aspects of eliciting, interpreting, and acting. As I worked with the lived experiences of the participants, I was drawn to framing assessment through the three phases in order to dig deeper into the intricacies, even while recognizing that I should be suspending such a theoretical structure. At the same time, I was also deeply interested in emergent questions that have surfaced during my journey. These questions began with the word ‘why.’ In exploring these questions, I found that I ventured into a path that seemingly ran counter to the phenomenological inquiry that van Manen (1990, 2014) had described. It would have been easy to ignore these emergent questions about why teachers did what they did, and thought what they thought. However, van Manen (1990) explained that phenomenological inquiry also requires that I “follow through with the several investigative queries which the concrete life situations makes problematic” (p.170).

So, I found myself stuck.

Is what I did truly phenomenological?

I could not whole-heartedly answer yes. I have followed the majority of van Manen’s (1990, 2014) recommendations for approaching my study phenomenologically, with respect to *reductio* and *vocatio*. At the same time, my insistence on exploring ‘why’ stuck out like a sore thumb. However, I feel strangely at ease with sitting squarely in the middle of my dilemma.

For the purposes of clarity to the reader, I described this study as *drawing* from phenomenological approaches, instead of *being* a phenomenological inquiry.

Validity.

Since in my research, there exists a qualitative pulse that is more traditional, and a pulse that is phenomenological, I elaborate on aspects of validity with respect to the two separately. There have been different perspectives on how validity is conceptualized in qualitative research (e.g. Creswell, 2007; Eisner, 1991; Guba & Lincoln, 1982; Whittemore, Chase, & Mandle, 2001). Creswell (2007) identified what he called validation strategies as a framework for thinking about validation in qualitative research, and for approaching credibility. Credibility is the process of observing, interpreting and concluding bits and pieces of evidence in order to describe a compelling whole (Eisner, 1991), and in ways that respect participants' meanings (Lincoln & Guba, 1985; Whittemore et al., 2001). Some of the validation strategies Creswell (2007) proposed include: prolonged engagement with participants in order to build trust and avoid distortions introduced by the researcher, triangulation across different sources in order to provide corroborating evidence, member checking where participants' views are solicited with respect to the findings, external checks of the research process in order to keep the researcher honest, and rich descriptions in order to enable transferability.

In keeping with the recommended validation strategies, several procedures have been undertaken. I met with each participant before the first interview in order to establish trust, and I maintained a positive rapport with them throughout the subsequent interviews. I also kept a reflective journal in order to identify preconceptions and beliefs that I held prior to the interviews. The focus group was designed for participants to exchange their experiences with ephemeral moments. The emergent themes were diversified and strengthened through this exchange. Having three participants with two individual interviews each, helped to triangulate available interpreted evidence. A rough copy of the emergent themes from the first semi-

structured interview and the focus group interview was provided for the participants during the final interview. This allowed the participants an opportunity to clarify their perspective and elaborate on their thoughts. This was my way of honouring the member checking validation strategy. I worked with my supervisor frequently in order to interpret and re-interpret data as well as writing about the data. This provided additional perspectives on the intertwinement of experiences. Along with feedback from the committee on the thesis, these served as external checks on my thinking and my writing. Finally, I attempted to provide rich descriptions of my participants' experiences through different ways in Chapter 5. These descriptions were my attempts to enable transferability.

Phenomenological approaches differ in their stance with respect to validity. Van Manen (2014) believed that even the most “evocative descriptions [from participants] will fail to capture the fullness and subtleties of our experiences as we live it” (p.54). This is because descriptions, even with words, text, and artefacts, are still not recreations of participant experiences. Even if such a recreation were possible, it would nevertheless be a new experience since it would then contain at least a new context which is the existence of the previous experience.

Phenomenological inquiries are not “well served by validation schemes that are naively applied across various incommensurable methodologies (van Manen, 2014, p.347). Instead, van Manen (2014) offers the following criteria when thinking about phenomenological studies:

- (a) Heuristic questioning: Does the text induce a sense of contemplative wonder and questioning attentiveness;
- (b) Descriptive richness: Does the text contain rich and recognizable experiential material?
- (c) Interpretive depth: Does the text offer reflective insights that go beyond the taken-for-granted understandings of everyday life?
- (d) Distinctive rigour: Does the text remain constantly guided by a self-critical question of distinct meaning of the phenomenon or event?
- (e) Strong and addressive meaning: Does the text “speak” to and address our sense of embodied being?
- (f) Experiential awakening: Does the text awaken prereflective or primal experience through vocative and presentative language?
- (g) Inceptual epiphany: Does the study offer us the possibility of deeper and

original insight, and perhaps, an intuitive or inspired grasp of the ethics and ethos of life commitments and practices? (p.355-356)

In the process of developing the narrative anecdotes, I kept van Manen's (2014) questions in mind. While van Manen (2014) intended the criteria to be embodied by the entire text, I found that his questions were most effective in guiding my creation of the narrative anecdotes, which aimed to invite wonder and questions, contain rich and recognizable experiences, as well as offer reflective insights. I elaborate on the creation of the narrative anecdotes in Chapter 5.

Ethical considerations.

It is of utmost importance that participants are assured of confidentiality and anonymity in a research context. Any information which may identify an individual, school or school board was removed and participants were referred to with pseudonyms. Within the data collected, I did not include any artefacts produced by students. It was difficult during this study to ensure complete teacher anonymity, since the instructional coach, who assisted with recruiting participants, was aware of teacher participation. However, confidentiality and anonymity were discussed with the instructional coach. In addition, teacher participants met one another during the focus group, and therefore individuals were not completely anonymous. All participants were asked to keep discussions confidential, but there is no guarantee that this will occur.

Chapter 5 : Lived Experiences

My focus throughout my journey has been to explore teachers' lived experiences of ephemeral assessment opportunities. I wanted to know how teachers establish these opportunities, what they think about, and how they decide on what to do during these moments that quickly fade away. While it is impossible to live the lived experience of my participants, it is possible to lean on their experiences and their reflections about their experiences so that I might better understand ephemeral assessment processes.

I begin this chapter by providing a background of each of the participants, as well as a brief description of their memorable exchanges. By 'memorable exchanges' I mean the moments that Fernanda, Cadence, and Casey have constructed. Fernanda, Cadence, and Casey, each in our first interviews, worked with me on recalling and better understanding the moments of their classrooms that they considered to be meaningful with respect to observation and conversations. These 'memorable exchanges' were ephemeral, and were the sources of our subsequent conversations during the focus group and the second interviews. The final section of this chapter involves narrative anecdotes that I have written based on each participant's memorable exchanges. Van Manen (2014) indicated that phenomenological writings, besides analysis, need to also "penetrate and stir up the prereflective substrates of experience as we live them... [and] to create a sense of resonance in the reader" (p.240). My narrative anecdotes are aesthetic representations that attempt to create a space for the audience to encounter their own understanding of the phenomenon. Through poetic language, I pull the readers into my participants' memorable exchanges and invite the readers to reflect based on their own lived experiences.

5.1 Getting to Know Fernanda, Cadence, and Casey

In this section, I elaborate on the participants' teaching experience, current teaching assignment, the physical classroom environment, as well as beliefs about teaching and assessment. I felt these were important to share, because they invite the reader to get a sense of Fernanda, Cadence, and Casey. First, the description of teaching experience and current teaching assignment helps provide the context of our conversations, since participants often referred to their experiences in the classroom. Second, a description of the physical classroom environment helps get a sense of the space within which each participant shared their ephemeral moments with their students. Third, descriptions of participants' teaching philosophies help the readers get a sense as to why the participants did what they did in the classroom, and how they went about doing what they did. Lastly, I also provide some background information for each of my participants' memorable exchanges.

Fernanda.

Fernanda had taught all levels of mathematics at the high school level for 24 years. In recent years, she has had two periods as resource and student success teacher, and one period of mathematics teaching every semester. She often taught senior level classes during the school year, although this year she taught a grade nine academic mathematics course during first semester. This class had twenty-six students. Our first interview took place at the end of her first semester. While she based her memorable exchange from her experience in the grade nine academic mathematics classrooms, she often drew on her experiences with senior level classes. This was especially the case when she was explaining her beliefs about mathematics teaching. Her senior level classes were typically small, with eight students being the smallest, and twenty-five students being the largest.

We met in her mathematics classroom during the two individual interviews. There were whiteboards in the front of the room, with the teacher desk next to the whiteboards. There were also some whiteboards on the side of the classroom with bookshelves on the bottom. Motivational posters decorated the walls. The tables and chairs in her mathematics classroom were neatly organized in groups of two and faced the front. She explained that the desks are in pairs so that students can work in partners but can also turn around and work in groups of four. For her grade nine students, she changed the grouping about once every month. Intentional grouping helps her get to know the dynamics between the students. She does not arrange seating for her grade twelve students, as she believes that students should know what works for them by grade twelve. However, she does encourage students to change their seating on their own so that they can experience working with different people and being in different parts of the classroom.

Fernanda seemed to relate ‘assessment’ to ‘providing a mark for student achievement.’ As a result, she rarely used the words ‘assess’ or ‘assessment’ during our initial interview when we were exploring her memorable exchange in the classroom. When I reached the 8th prompt during the first interview, I used the phrase ‘informal assessment process that involve observations and conversations.’ This resulted in a weird look from Fernanda. Realizing this was the first time we used the word ‘assessment’ during this interview, I briefly offered some elaboration as to what I meant. She subsequently began to talk about grading and how there are too many variables for observations and conversations to be used for marking purposes:

Researcher: What are some of the supports and challenges in these informal assessment process that involve observations and conversations? And, uh, by assessment processes I mean [...] knowing where [students] are at.

Fernanda: [If] you leave a student mid way [in a conversation] [...] then what is that mark, right? [...] [And] I think it takes longer for the teacher to unpack what really happened, and it makes you have to then take time to do that (Fernanda, Initial Interview, January 26, 2016).

However, during the focus group interview, group discussions about professional judgement seemed to open up the group's conceptions of assessment. As the group thought about professional judgement, participants began to realize that there is professional judgement involved with everything the teacher does. Casey and Cadence began to think out loud and stated that most of their decisions were impacted by professional judgement, including how they might facilitate conversations or choose tasks in a way that suits their students. Fernanda also saw that professional judgement impacted how she might instruct and what examples she might use. As the group continued to talk about professional judgement, they noted that it is involved with everything they did, and not simply about evaluation. As we subsequently talked about assessment, the group related to our conversation about professional judgement and began to incorporate examples beyond grading decisions. For example, Cadence spoke about feedback as part of an assessment process, and Casey added the word 'formative':

Cadence: it's the feedback. You haven't achieved this yet, so you need to do some more work. So [...] it's, again, [...] more of a conversational piece, those assessments.

Casey: well, which is why, the formative, right? (Cadence and Casey, focus group interview, March 3, 2016).

For Fernanda, this conversation about professional judgement, and subsequently assessment, had an impact on her thinking about her practice. While talking about assessment during the second individual interview, Fernanda discussed an example of formative assessment. She explained that she moved a student's thinking along a continuum of learning through her conversations:

Fernanda: [...] and not words that [...] are suggestive to an evaluation, but "this is a good start, need to finish with this" [...] like really little specifics that can move [this student] along the continuum [of learning] (Fernanda, Second Interview, April 18, 2016).

This differed from conversations about assessment during our first interview that focused primarily on how she provided marks for students, and provided the possibility that Fernanda had expanded her descriptions of assessment to include formative functions.

Fernanda often paused during the interviews to think about her responses. She seemed careful about her word choices, and about how those word choices reflected her as a teacher. Her reflective nature was also shown through how she approached teaching strategies. This can be illustrated with her discussion of the student use of vertical non-permanent surfaces to engage in problem solving. During the first interview, she explained that she heard about vertical non-permanent surfaces as a classroom setup that might help facilitate conversations between students. She wondered about the impact it might have on the comfort level of her grade twelve students, but concluded that she was willing to try the strategy in her classroom whenever her students were working in groups or doing activities. During the focus group, she explained that she was impressed with how well it worked in her class, and remained reflective about the experience. She asked several rhetorical questions as she continued to think about her success with vertical non-permanent surfaces:

Fernanda: was it because they were up? [...] Was it because they were in a small group? And they had a purpose? And they were working together? Or was it because of both? I don't know (Fernanda, Focus Group Interview, March 3, 2016).

During the second interview, she continued to reflect on why vertical non-permanent surfaces were such a hit with her students.

Fernanda firmly believed that a positive classroom culture supports teacher observations and conversations. As a result, she elaborated on different ways that she has tried to create this environment. Her two examples included knowledge of students, as well as the use of open questions and puzzles that invite multiple strategies and representations.

First, Fernanda believed that knowing her students helped support observations and conversations. She included getting to know students' strengths, weaknesses, interests, as well as struggles with mathematics. She explained that knowing students' strengths and weaknesses in their work habits or collaborative skills helps her with grouping decisions:

Fernanda: so grouping, [it] obviously helps if I know their strengths [...] and weaknesses [...] in how they work together (Fernanda, Initial Interview, January 26, 2016).

She suggested that these grouping decisions then supported the emergence of good mathematical conversations during student discussions. She also believed that knowing students' interests was helpful in her considerations for task design. By knowing what topics students were interested in, she was able to engage students in tasks where students felt that they had expertise to offer others in conversations. Fernanda also identified her knowledge of students' past struggles with mathematics as helpful for supporting observations and conversations in the classroom. This knowledge helped her seek opportunities to interact with students privately and strike a conversation with students about their past struggles and subsequently develop an idea as to how to move them forward:

Fernanda: knowing where they [...] particularly struggled, I can make sure [to] walk around and gently [invite] them for help, and try to make them more comfortable right off the start (Fernanda, Initial Interview, January 26, 2016).

Second, Fernanda also believed that the use of open questions and puzzles was helpful in building a classroom culture. She explained that open questions and puzzles open up conversations. She believed that with open questions and puzzles, since there is not usually an obvious designation of right or wrong responses, every student has ideas to offer. This helps dispel student's negative preconceptions about their abilities in mathematics, and subsequently support a positive classroom culture.

Fernanda's memorable exchange: Five linear relations.

For Fernanda's memorable exchange, she chose to talk about an activity she did with her grade nine academic students. The activity began with presenting students with five linear relations on a graph. In a whole-class discussion, students contributed questions and terminology about the five lines on a graph. Fernanda then asked the students to work in pairs to explore those questions, as well as develop more questions to explore.

She was impressed with how well the activity was able to reveal student understandings about linear relations. Originally thinking that this activity would only take five minutes, she explained that this activity ended up lasting over thirty minutes. Fernanda also chose this activity as the moment to discuss with me because she saw the activity as one that is atypical of her lessons. She explained that she typically would have many more materials prepared, that this particular activity was unplanned, and that she was happy with how it turned out.

Fernanda had a hard time recalling specific details of any particular exchanges with students. Her difficulty was partly influenced by her having been away from school for a week or so before our interview. She took a lot of time in between her explanations and she reflected broadly about her beliefs (such as time or the importance of knowing students). Eventually with additional questions, we were able to flesh out more details.

I have prepared a narrative anecdote later in this chapter that helps to portray Fernanda's memorable exchange.

Cadence.

Cadence had been teaching for 17 years. She taught at a regular high school for 6 years before transferring to her current school, an alternative regional high school for students that have not been successful in a regular high school program. At this school, students are involved

in a co-operative (co-op) education program where they alternate between attending school and participating in their co-op placements. She described some of her students as part of the ‘service retail group,’ and the others as the ‘trade and tech guys’. She believed that these co-op placements were helpful in her conversations with students. This is because she tries to incorporate realistic scenarios that students may encounter during their placements. She teaches grade 10 locally developed mathematics, grade 11 workplace mathematics, and grade 12 workplace mathematics, and often the same students go through their entire mathematics program with her as the teacher. She also teaches native studies to the grade 9 students at this school, and found teaching a different subject to be valuable for building relationships with students. She described her school and her class as small, and that the small size was also advantageous for building connections with students.

We met in her classroom for both individual interviews. The tables were arranged in a large U shape, surrounding one line of tables, as well as her teacher desk. In the front, there were large whiteboards. Student work was posted on the walls. This student work included drawings from her native studies class, and poster boards with students’ work in mathematics.

Cadence seemed to define ‘assessment’ as any events that allow for subsequent grading. She often referred to ‘my assessments’ when she meant ‘a test,’ ‘projects,’ or ‘conversations’ that allowed her to place a mark for a student with respect to a curricular expectation. For example, while she was explaining her school’s progress with their mathematics program, she indicated that they were developing appropriate assessments that would better accommodate her students. She explained that the majority of her marks are based on observations of, and conversations with students.

Cadence often gave others an ‘out’ during a conversation, so that others would not feel embarrassed or judged for their actions. For example, during the focus group interview, she shared her practice of incorporating observations and conversations in her marks. She then immediately clarified that she felt this was easier for her because she had a smaller class size and she didn’t have pressures with respect to grades at her school.

Cadence also seemed to empathize with the circumstances of others, and often elaborated on a student’s background during our conversations. For example, after describing that a student had often struggled with behaviour issues at his previous schools, she quickly followed with explanations and stories about how he simply got lost and needed to build connections with others.

Cadence valued the conversations with her students in the classroom. She emphasized that building relationships with her students was key to attempting to do anything in her classes. She admitted that when she worked at a regular high school, she did not understand this. However, her experiences at her present school helped her see the importance of building relationships with her students. She elaborated on this belief during the focus group interview. In regular academic or applied programs, she believed that it may be enough to engage students with her love for the mathematical content. In contrast, she needed more than an appreciation for the subject in order to reach students at her current alternative school setting:

Cadence: Like when I was in a regular high school, and teaching [...] the applied, the academic classes. You could really engage kids using your love of curriculum, right? [...] Whereas when I hit this group of kids, it wasn’t about the curriculum anymore (Cadence, focus group interview, March 3, 2016).

Later, during the second individual interview, she added that now that she had become better at building relationships, she would be even more impactful if she were to return to a regular school setting:

Cadence: I feel now, with the learning I have, [...] I would probably even connect with even more students, and [...] [my teaching] would probably be even more powerful (Cadence, second interview, April 5, 2016).

She spoke about different ways that she built connections with students in the class. For example, she explained that using ‘real-life’ math helped her engage students in learning mathematics as well as build relationships through the subsequent conversations. She believes that leaning on realistic scenarios allowed her to find out how students have experienced mathematics and that this helped her decide on how to move students forward in their learning:

Cadence: When [students] [...] have those personal experiences, [...] they [would] engage in that conversation, other students’ [...] experiences will help (Cadence, initial interview, November 23, 2016).

She believed that her relationships with students enabled her to strike conversations with students about their lives, which in turn helped her know even more about what interests and engages students.

During the first interview, Cadence often used the word ‘rhythm’ to describe different aspects of her classroom. For example, when she was describing how students were working, she mentioned that some of them knew a ‘rhythm’ to solving a problem. In that sense, the word ‘rhythm’ seemed to refer to a series of procedures that students undertake when problem solving. When she was describing how time flows quickly in a semester, she mentioned how teachers can get into behaviour issues and other ‘rhythms’ and forget other goals. In this case, ‘rhythm’ referred to teachers’ habitual reactions to happenings during the day. She also referred to ‘rhythm’ as ones that the teacher sets up and that the students learn to adapt to. In this case, ‘rhythm’ corresponded with routines and norms that teachers establish throughout the school year.

I asked for more clarification on what she meant by ‘rhythm’ during the second interview. While responding, she found that she meant different things by her use of rhythm. We decided that it was a good word to describe a wide variety of actions that teachers do subconsciously. While musing on the possibilities of applying the word ‘rhythm,’ other metaphors such as harmony and dissonance also surfaced to describe interactions between teacher and students.

Cadence’s memorable exchange: 158 percent.

Cadence explained that one of her objectives for the grade 10 locally developed course is for students to better understand statistics. The 16 students in her class were initially working with secondary statistics, but Cadence felt that students were not engaged with examples such as how many tires are thrown out each year. She believed that the number of tires thrown out was not connected to what students were interested in. In response to the students’ lack of engagement, she decided to have students work with a survey project where students got to choose topics that they were interested in. She believed that this survey project provided students with opportunities to relate mathematics to their interests, improving their engagement, and therefore better facilitating student understanding.

For Cadence’s memorable exchange, she chose to talk about her conversations with two girls while they worked on their survey project. She came across one student, Amy, who had trouble understanding the meaning of 100%, which had surfaced from her survey responses. Another student, Barbara, was listening to Cadence and Amy, and subsequently asked her own question about a percentage of 158 that appeared for her. Cadence used a variety of examples to illustrate ideas about percentages to Amy and Barbara, including: how many students in the

classroom wore sneakers, how many of the sneakers were of the brand Converse, and how many students were present during the assembly on a previous day.

Cadence explained that she chose this exchange for two reasons. First, she was able to discuss concepts of mathematics with a student, Barbara, who would not normally do so willingly. Second, Cadence felt that the exchange helped Barbara better understand percentages. Third, she believed examples greater than 100% are helpful for her to use in the future.

I have prepared a narrative anecdote later in this chapter that helps to portray Cadence's memorable exchange.

Getting to know Casey.

Casey had been teaching for 18 years. Every year since the beginning of her career, she had taught both mathematics and science. She explained that her major focus had typically been sciences, but that she had taught all levels of mathematics from grade 9 to grade 12, with the exception of grade 10 applied mathematics. Casey believed that it was rare for her to have a bored student in her science class, but that it was common for students to state that they hated mathematics. This was a major motivator for her to incorporate more hands-on activities during the mathematics classroom. During our first interview, she was in the middle of teaching 30 students in a grade 11 university mathematics course. While her memorable exchange was from this grade 11 class, she also drew from her experience co-teaching a grade 9 applied mathematics course with another teacher, Matt, in the previous school year. She co-taught with Matt again during second semester, and so our conversations during the second interview often related to her experiences in the grade 9 applied mathematics classroom.

For our interviews, we met in her science classroom where she also taught her grade 11 university mathematics students. The desks were neatly arranged in pairs facing the front, and

surrounded by several lab benches equipped with sinks, faucets, gas valves, and other lab equipment locked away in shelves. In the front there were whiteboards, as well as another large lab bench. In the back of the room there were a variety of puzzles, including sudoku, crossword puzzles, and more. Between the first and second interview, she had come across the use of vertical non-permanent surfaces and had started to use them whenever her students in grade 9 applied mathematics are involved in group work. She described her use of the whiteboards, however we did not meet in the room where she taught grade 9 applied mathematics.

Casey was well spoken and spoke quickly. She was expressive with her hands, and often gestured at various points during our conversations. Casey's responses were often extensive and involved many different aspects of her beliefs about teaching. For example, she believed that teachers need to create a positive atmosphere for students to feel safe in contributing their ideas. In her explanations of how this positive atmosphere can be built, she included student beliefs, freedom in the tasks, engaging activities, group work, student dialogue, and modelling risk-taking. At the same time, she also tied in an explanation of the work that she was doing with the Jo Boaler course on growth mindset (Youcubed, 2016), as well as a brief story about an interaction with students during the classroom.

When Casey reiterated the student conversations, she was often very animated and changed the tone of her voice significantly to illustrate what the students said and how they said it. It seemed to me that Casey was a good storyteller, and her stories were often nested. For example, while explaining an event, she would provide background information on the individual students in the form of another story based on her previous interactions with them. For example, while describing what a grade 11 student, Beau, did during an activity, Casey elaborated on her experiences with Beau beyond what he did during that activity. These

experiences included a story about how Beau went to see Casey about getting additional support in math, as well as another story about what Beau did during another activity in the past.

Casey seemed to define ‘assessment’ as formal events that allow her to place a mark on student achievement. However, it is possible that her conception of assessment shifted throughout our conversations. During the focus group, we were discussing professional judgement and the conversation focused on grading students. I offered something that I had heard from my supervisor Dr. Christine Suurtamm about the importance of assessing what we value:

Researcher: something that my supervisor Chris Suurtamm always says, that we have to... assess what we value. So that’s something that always stick in my head (Researcher, focus group interview, March 3, 2016).

Much later in the conversation while the group returned to discussing how they assign marks, Casey brought up the phrase of ‘assess what we value’ and indicated that it’s a fundamental shift in how she thought about assessment. She believed that if we were to really value conversations about mathematics, that there would need to be a way to incorporate these conversations in grades. During the second interview, she continued to wonder about how to formalize conversations and observations so that these might serve summative functions:

Casey: How do I build that in? [...] Is it an ephemeral moment log-in, that I’ve consistently seen a student demonstrate [some learning] (Casey, second interview, April 22, 2016).

Casey’s continued wonderings during the second interview indicated that she had continued to reflect on her assessment practices since our discussions during the focus interview.

Casey’s memorable exchange: From sine to cosine.

Casey had started the students in working on what she called a ‘spaghetti curve’ activity. This activity involved students needing to use uncooked spaghetti to transfer lengths from a unit

circle to create a sine or cosine function graph on a piece of paper. Students were free to begin with the measurements for either sine or cosine, and Casey visited groups and recorded student work and student thinking with an iPad. She explained that she has never done recorded student conversations with an iPad before, but thought it would have been helpful for the purposes of our first interview.

Unlike my interviews with Fernanda and Cadence, who described only one or two conversations with students, Casey provided stories for several groups of students, and involved a total of 16 students in her descriptions.

In order to explore the exchanges in depth, Casey and I focused on discussing conversations that involved two students, Callie and Elizabeth. However, I note that many of Casey's descriptions and examples also drew from her interactions with other students during class.

Casey chose this exchange with Callie and Elizabeth because it provided a good example for how many different things teachers consider when attempting to better understand where students are at. Also, this exchange provided information about Callie's confidence and comfort level with the task and with the concept, which was helpful for Casey in making decisions in the future.

I have prepared a narrative anecdote later in this chapter that helps to portray Casey's memorable exchange.

5.2 Narrative Anecdotes

Van Manen (1989) described a narrative anecdote as a "mini-story possessing a rhetorical quality that moves it more closely in the direction of *sayings* and *proverbs* on the one hand, and *poetic fragments* on the other hand" (p. 243, italics in original). These stories are written to

compel readers, to lead readers to reflect, to involve readers personally, to transform readers, and to measure a reader's interpretive sense (van Manen, 1990).

Why narrative anecdotes?

Narrative anecdotes provide opportunities for me to “address the phenomenological themes of a phenomenon so that the ‘invariant’ aspect(s) of the phenomenon itself comes into view” (Van Manen, 1990, p.122). In other words, I aimed to create living contexts from which to build on in subsequent chapters.

Weber (1993) argued that story-telling is an “underestimated, taken-for-granted aspect of teaching and research that merits further serious attention” (p.80). She believed that narrative anecdotes provide powerful processes to construct and assimilate knowledge in “a form that is simultaneously theoretical and practical” (Weber, 1993, p.79).

Phenomenological writing, as mentioned in the previous chapter regarding the vocative, aims to bring the phenomenon to the forefront through experiences. It is my aim through the different vocative turns to invite the readers to experience the phenomenon in a tangible and relatable way, as well as to invite the readers to create their own meanings out of their own experiences. Narrative anecdotes then, serve to construct such an environment. At the same time, it further informs my analysis as I read and re-read the transcripts, listen and re-listen to the audio recordings, and write and rewrite the narratives.

How were they created?

How do I reconstruct the moments in the classroom? These moments were not mine, and I am certainly no mind reader. I read and re-read the transcripts throughout the analysis in order to get a sense of the memorable exchanges described by the participants. This was not enough.

I completed the analysis in order to better unpack the ideas and concepts as I reflected on the participants' experiences. I also reviewed what I had added in the angled brackets, where my own past experiences with my students had been evoked by the transcript. As I think about this tangled web of experiences, I also reconsidered concepts I've learned through literature. This was also not enough.

I began to re-listen to the audio recordings as well as re-imagine the environments where the classes would have taken place. I was fortunate enough to have interviews in the space where the moments occurred for each participant. I recalled what I sensed when I was in those rooms. I reimagined the brightness of the room. Cadence did not turn on the lights and left all of her curtains open. Fernanda's classroom, on the other hand, had smaller windows and so the room was brightly lit with hanging fluorescent lights. I reimagined the scents of the room. Casey's room had a mixture of smells – collaged with the faint smells of the ring stand left on the table (it was also a science room), the old textbooks in the shelves, and markers on the whiteboard in the front of class. These were, still, not enough.

In a sense, it might never be enough. It is not possible to own these moments that are not mine to begin with. However, it is still important for me to reconstruct them, as well as for the readers to interact with them. And so, I began writing. I wrote and then reread what I wrote. I wrote and then I re-listened and re-read the audio recordings and transcripts. This helped me build coherence with what I have written and the moments that the participants have described.

In other words, the first three narrative anecdotes were *rooted* in my participants' lived experiences. As much as possible, I integrated the memorable exchanges that they have described for me. These narrative anecdotes were my interpretations and reconstructions of the moments in their memories based on their telling of them. For the sake of immersing the readers

in the text, I invoked what I understood were my participants' experiences, and wrote creatively in order to "bring experiences vividly into presence" (van Manen, 2014, p.241). I also took into consideration several theses that aimed to write phenomenologically (Francis, 2015; Knowles, 2015; Streit, 2016) and examined how they chose to write creatively.

Following the three narratives that aimed to recreate the participants' memorable exchanges, the final narrative anecdote was rooted out of my own experiences while speaking with participants. As described in the previous chapter, I reflected during conversations with participants and afterwards using the curly { } and angled < > brackets. I used this narrative anecdote, then, as an opportunity to explore some of the things that I thought about during the moments I shared with my participants. In order to construct this final narrative anecdote, I consulted my reflective journal and the transcripts. I reviewed the different instances where I noted my thoughts in the various brackets. These then helped me develop a narrative anecdote that aimed to focus on how we interpret moments.

The four narrative anecdotes were written in different styles according to what I thought best illustrated each participant's memorable exchanges. For example, the narrative anecdote that portrayed Cadence's memorable exchange was written in a poem, whereas narrative anecdotes for Fernanda and Casey were written as stories. This decision was made in order to honour the different focuses that the participants brought to the conversations and to the construction of their moments.

5.3 Wrestling with Time

The following narrative anecdote is based on Fernanda's memorable exchange.

I hesitated.

I initially had no idea what I was going to do with this. But that's why I loved this activity.

"Five lines on a page."

Or so I thought.

"Probably only 5 minutes."

Or so I thought.

No, no. Definitely more than 5 minutes. It lasted over 25 minutes, and the instructions were so simple. That's why I loved it. I need to do more of this.

The graph appeared on the smartboard, and I gave them a few instructions. The graph had 5 lines, each in a different colour.

"Tell me everything you can about these 5 lines." "Prove your statements mathematically." "Choose a coordinate point in quadrant two – what can we do with that?"

"What question could you ask a classmate about these lines?"

Verbal instructions. Kids tend to listen more when I ask them verbally, but of course, they also each had their own copy of these five lines.

Murmurs. These always began with a soft rumble before rolling into a full-blown conversation. But I was patient. I didn't mind waiting, and wait time is always important. I've worked hard with this class to get the students more comfortable with sharing ideas. With seeing mistakes as opportunities to learn. With sharing ideas and exploring them.

I've sown the seeds. I've continued to water and take care of the soil. This was where I reaped the rewards.

The students started to throw out words. They were comfortable with each other and with themselves... but there wasn't a lot of math¹⁹.

I am sure I didn't actually hear the clock – there are too many students throwing out suggestions for that. But the clock was definitely there. I could feel the time move. The clock ticks and I glanced at the amount of time that had already passed. “Wow it's already been 5 minutes,” I thought. “We haven't gotten there yet.”

Then, a single strike of lightning brightened up the sky: “We could get the equations.”

I waited for this. This is what I waited for. We got there. But wait, I wanted to remain calm. I didn't want to seem so excited that it overshadowed all the other contributions that others had put in. No, I needed to be careful. Like building a house of cards, I needed to be careful.

“Okay, find the equations of the lines then.” I nonchalantly picked up that comment and rephrased it as a next-step. The students were getting there, but that strike of lightning was helpful for lighting up the way.

The rumble died down a bit. Instead of the whole class listening for what responses I accepted or rejected, they are now working individually on identifying the equations of the lines. I wanted them to have some individual time in order to process and remember how to get the equations of lines.

¹⁹ In Fernanda's words, she did not interpret other responses as “math” responses. She wanted students to use specific mathematical vocabulary that they have been working on, which included slope, positive/negative correlations, vertical, horizontal...etc. She also wanted the students to use equations.

The students worked as I moved around – to help, to listen, to prompt, to direct. I tried to get to everyone but I am unsure if I did.

The clock ticks forward relentlessly and it had been at least 10 more minutes. “But this is good. They are doing great work. They are getting this.” I thought. “Or at least they’re getting help. This is good.” I repeated in my mind.

I continued to move around and observe. Time is of the essence and I can only access these essences if I keep moving. Some of the girls were meticulous and wrote everything down on their own copies of the graph. Some of the boys – typical boys²⁰ – they drew it first and then did it.

Some kids have gotten the equations and they were moving on to the other prompts. Some kids were still in the process of trying to come up with equations.

“What questions could you ask a classmate about these lines?” “How did she get that equation?” “Why didn’t you get that equation?”

I remember some of the questions I asked the students as I went around, but not in enough detail²¹. Some of the kids were stuck; some of the kids were done. That’s always how it was.

One of my students asked another student about creating a parallel line. I don’t remember who it was, but I thought it was a great question. Best part about it? It was one of their ideas.

So I chose to revoice this idea for the rest of the class.

²⁰ “Typical boys” was a direct quote from Fernanda when describing how the students chose to draw a diagram first.

²¹ Fernanda had difficulty remembering specifics of the moments in the class. Instead, she described a lot of general beliefs about her teaching and her classroom.

“So let’s say another classmate asked you how to get a line parallel to this one. How do you do that?” After I got their attention again, I asked them to find a parallel line. I pointed at a line. They looked at the line I pointed at. I used the word parallel. They heard the word parallel.

Suddenly the clock seemed to tick louder.

I looked up. The minute hand seemed to have moved faster than when I last checked. I had some worksheets prepared with different topics on line work. I wanted them to have time to do those too. They needed that time. They would benefit from that time.

But, first things first. They heard the words and saw what I pointed to. But not all of them understood what I said. I decided to rehash the ideas. We had chopped up and cooked these ideas together before – or at least I thought we did. But it seemed that some of them never ate the dish we prepared together.

“So let’s rehash this,” I thought.

“The line that you drew,” I gestured to a student and his graph, “is it parallel? Does it visually look parallel? Was this an acceptable line?”

They looked at the line. I looked at the line.

I gave them time even though the clock had started to spin – reminding me that I needed to keep going.

They looked at me. I looked at another student. He had another line and this was the time for us to use it.

“How about this one? Was this an acceptable line that is parallel?” I gestured to another student’s line. “But it’s a different number, different equation, is that still parallel?”

We then reiterated the idea of parallel lines. New dish, same ingredients. Hopefully it went down better this time.

I then passed out a worksheet so that each student could work on different things that they needed to work on.

5.4 Creating Connections

The following narrative anecdote is based on Cadence's memorable exchange.

Conversations are **key**.

Without those in the classroom, it would be

Impossible

Unthinkable

For these

kids – for **any** kids –

To **lean** in and be part of the classroom;

To **feel** confident in the shoes of a student;

To **step** forward toward better understanding.

Conversations are keys.

Not only to open doors to the future

But also to

Chests of treasure inside them that they perhaps have not seen before when it had

always been there

always been waiting

always been golden and waiting to be awarded or statued or held to a better standard.

Locked chests of power.

Their power.

These kids – **all** kids –

Need these.

Our school is a different school.

Alternative – **what a label** we've given them.

But all kids need to see that they have power in mathematics.

Their **own** powers.

And so, conversations are key for them

To lean in and be part of **themselves**;

To feel confident in **their own shoes**;

To step forward toward better understanding of **what they can be** and **what they can do**.

I approached a girl that had waved me over.

Confusion about percentages.

What is 16 divide by 16?

In percentages?

In this class?

In this world?

The calculator screamed 1 so definitively.

One answer.

Such **certainty**.

What did it **mean**?

We struggled together and we conversed.

We tossed around examples like pairs of Converse

From those that wore sneakers.

Or those that snuck out of class during yesterday's assembly.

Great conversations.

I could see her doors opening.

The keys have turned.

I could see her reaching for her chest of power.

“So, I got 158 percent, Miss”

Another student overheard our conversation.

Conversations are key, but

Key **for whom**? Only those who were a part of the conversation?

Clearly not.

“How does that work?”

Her **own** questions.

Her **own** wonderings based on listening into another conversation.

We were within an arm’s reach after all.

We continued with the same examples:

Converses and sneakers; sneaking out of assemblies.

They were with me.

They were part of the conversation.

Key.

5.5 More Than Words

The following narrative anecdote is based on Casey's memorable exchange.

Callie and Elizabeth had finished building the sine curve with spaghetti. I approached them as they were preparing to build their cosine curve.

I tilted the iPad toward their work as I pushed on the screen. It began to record as I stared into the screen. What did I want to capture? What was I capturing? I didn't want another footage of my foot.

I don't typically record these conversations, but I thought it would help me remember the moments of the classroom later²². It's interesting though – when I had the iPad in my hand, it changed my interactions with the students. I missed many things that I would typically pick up in the classroom. It's like I suddenly had blinders on. More than that, I was pushed toward becoming only an observer, and not interacting as much in the moment. Usually I would go from spot to spot to spot to spot to spot, but the iPad nailed my shoes to the floor a bit longer than I would normally linger.

“Okay ladies,” I said as I stepped into their world. Their world, that they had been building their understanding in. I stepped into their world as I left the other worlds that were all in motion in the classroom²³.

²² Casey wanted a reminder for our conversations during the interview. She chose to use an iPad to record in class.

²³ Casey had not used an iPad before in the classroom. She noted that she was unsure as to what happened in the rest of the classroom while she was having conversations with the smaller group. She also noted that normally she would be more aware as to the happenings of others in the classroom.

“Predict for me, cosine, before you actually start that.” I gestured toward the spaghetti in their hands. They seemed like they were ready to go. I glanced over at the sine curve that they had created. It seemed like they were on the right track.

“Well...” Callie began as I looked at some of the dots that her and Elizabeth had marked down for their cosine curve.

“Well,” Callie stumbled over the first word. It was like she tripped over something on the road. She paid no mind to it. But was it a pebble or a rock?

She continued “I think it’s going to look like this.” She drew a curve with her hand that matched the sine curve that she and Elizabeth had previously created.

I moved the iPad out a bit so I could capture what she was doing with her fingers. I was conscious of the iPad. I had to be – I had to move it.

I must’ve felt her look in my direction, but I can’t be certain. My attention was caught on attempting to move the camera. But I do remember her voice.

Uncertainty.

She did not sound confident.

I looked over at Callie as a pause lingered over us. The pause was not more than a second, but it felt longer. Long enough for me to pull my attention away from the iPad to look at Callie.

“Well, but I’m not really sure.” As if uncomfortable with the split-second delay, Callie came to her own defense. “I’m not really sure what it looks like but I think it kind of looked sort of similar.”

Was that really a defense though? Or did she give up control to Elizabeth?

Her words painted colourful borders around her uncertainty.

“Well no, cosine is supposed to start up here” Elizabeth interjected as she pointed at the y-axis above the origin. She drew a curve with her fingers and continued to explain: “and then it needs to go down.”

Certainty.

Elizabeth sounded much more confident and moved much quicker to explaining herself. She seemed to know the melody.

Elizabeth continued to draw with her fingers. Her fingers moved calmly, and her voice – steady. She touched her fingers down onto the paper, indicating the end of her explanation. Like a conductor waving the last few beats for an opening sonata, she retrieved her hand and waited for an applause.

“Okay, so what do you predict after that” I asked.

This *you* was not the same as the previous *you*. I was still having a conversation with the two girls, but the burden of prediction had landed on Elizabeth.

But she could handle it.

I could tell.

I shifted the camera. I missed a bit of the gesturing and I was determined not to miss more.

“Okay,” without skipping a beat, Elizabeth continued on with the next movement of her symphony, “it’s going to keep going down and it’s going to keep going on.” Her fingers moved across the paper like a cab circling a familiar neighbourhood.

“But it’s moved over,” She lifted her other hand in order to help her explanation – always better to direct traffic with both hands – “it’s like this curve, except moved over.” She pointed to

the sine curve that they had just finished. Using both hands, she gestured as if she could lift the glued pieces of spaghetti all at once, and moved them toward the right side of her paper.

The iPad stood in the way of me being able to focus on her facial expressions. I didn't normally have something so obnoxiously in my way of seeing students. Managing the recording split my attention in a way that I had not foreseen. But through the corner of my eyes, I could see that Elizabeth did not look confused.

No furrowed eyebrows.

No gazing into the distance.

I looked over to Callie and she seemed to be listening closely. She was looking in the direction of Elizabeth, and in the direction of what she had pointed out.

She was starting to understand the connection.

I turned off the recording and prompted Elizabeth and Callie to continue with their work. I stepped out of their world in search of another.

5.6 Constructing Realities Where Realities Meet

In this section I build on my moments with the participants during the interviews

We converse; the mind *wanders*.

It does not physically pick itself up, put on its heavy boots, open the doors, step out into the concrete, and circle around mental blocks – but it does *wonder* with past experiences and alternate possibilities.

The mind wanders, but not away from the conversation.

It wanders through the conversations to make sense of the world that is realized only by interactions that we share. It wanders through the conversation in order to identify the next foothold to hold its weight on.

-- Fernanda --

She gives me a strange look while I was in mid-sentence.

I stare at the piece of paper that had my interview prompts on it as I continued talking. I hesitated. Only for less than a second, but I hesitated.

I don't remember exactly what I just said. But I do remember saying the word "assessment." It is the first time during this interview that the word was brought up.

Why is there a strange look on her face? We had been talking for about an hour about how she established environments appropriate for conversations and observations. She then shared a particular instance in the classroom where students worked on concepts relating to linear relations. She described how she listened for student thinking, and how she responded to them. This was assessment to me.

But I understand that this may not have been what the word “assessment” immediately meant to her.

“And by assessment processes, I really do mean, like uh, your conversations with kids, knowing where they’re at, and, uh, yeah.” I stumble over the words but manage to elaborate.

Many words flash through my mind: evaluative, purposes, processes, observations, professional judgement. Words went through my mind, but they were really questions. Should I elaborate on various purposes of assessment? Should I step into exploring definitions of assessment?

I do not want to force my definition of assessment onto her, but it almost seems like I have no choice but to do so.

I can feel my body temperature rise.

In this split second I feel guilty, lost, and anxious.

-- Cadence --

To provide context, she speaks of students in her classroom who have had troubles with authority.

She describes her world where the emphasis lies in connecting with students. She needs to do this otherwise the buildings crumble before pillars of support can be engineered.

Many of my own experiences flash through my mind. These were not videos, complete images, or fully formed sentences. Rather, these were metonymous or synecdochic flavours of my past experiences.

My interactions with Kyler flash through my mind. He bounced from foster home to foster home and had difficulties participating effectively in the classroom. He had issues in the majority of his classes except mine. He felt safe in my class.

My interactions with Jocelyn flash through my mind. She missed a significant amount of school before having me as a teacher. She also lacked confidence in her own capabilities in mathematics. She enjoyed my class and felt comfortable enough to come for help.

“It’s the ‘so what did you do on the weekend,’ right?” Cadence says. “Having personal connections. That’s key.” She gestures as if to invite me to share what I did over the weekend.

It looks to me as if she had specific stories in mind. Stories, perhaps, that are similar to ones in my own experiences.

-- Casey --

We explore why she said what she said.

We speak about the responses from Callie and Elizabeth and what contributed to the feeling that Callie was uncertain and Elizabeth was confident.

Hesitations, pauses, repetitions.

It wasn’t simply the words.

It was also how they said it.

Gestures, eye contact, tilted heads.

It wasn’t simply the sounds.

It was also what she saw.

These all contributed to form her perception of student certainty.

I am reminded of my own interactions with students and with others in general. I think about the comparisons between an e-mail to a phone call to a face-to-face conversation. These images flash through my mind as I explore these ideas with Casey.

I am also suddenly aware of my awareness about awareness. My readings about noticing flash through my mind. These were not recalls of complete passages, but merely a sense of how I interpreted the work by John Mason (2002).

Chapter 6 : Emergent Themes from the Three Phases of Assessment

I acknowledge that the themes that emerged from the data were available because of who I am and because of where I am in my journey. In other words, if I had taken a different fork in the road, I may have sought different scenery in the data. Moreover, while the key ideas that surfaced from the data have not changed for me, my process of writing, rewriting, thinking, and rethinking with the help of my supervisor and committee has led me to changes in how I have structured and represented the two layers of my analysis.

As mentioned earlier, I approached my data analysis in two different ways. In this chapter, I focus on the first layer of analysis where I discuss themes that have emerged from the reported lived experiences of Fernanda, Cadence, and Casey. These emergent themes related to what my participants suggest they were doing during eliciting, what they thought about during interpreting, and what they were doing during acting. The examples from participants primarily focused on the memorable exchanges that we have discussed in great detail. However, other examples were woven in, as my participants often utilized their beliefs and other classroom interactions in order to illustrate their thoughts. In other words, this chapter is my space to discuss responses to the ‘what’ and ‘how’ questions that I had posed in the introduction, based on my data analysis.

6.1 Emergent Themes of the Eliciting Phase

An exploration of how my participants elicited student thinking revealed difficulties in identifying whether events were purposive or incidental. All of the participants had students working on a task that they had previously assigned. Fernanda engaged the students in asking questions about 5 lines, Cadence had the students work on an ongoing survey project, and Casey asked the students to build trigonometric functions using spaghetti. These tasks were deliberate

teacher actions designed to engage students with mathematics, and thus information elicited can be considered to be purposive. However, both Cadence and Fernanda elicited incidentally because neither Cadence or Fernanda had intended to initiate conversations about percentages or parallel lines. At the same time, the information may also be considered purposive because the concept of percentages and parallel lines are within the scope of mathematical thinking involved with the tasks that were assigned. Casey, on the other hand, asked Callie and Elizabeth deliberate questions, but admitted that she had several purposes in mind and was unsure which came first. At the same time, Casey elicited incidental information about Callie's level of confidence with respect to the topic of trigonometry.

As I thought more about Fernanda, Cadence, and Casey's memorable exchanges, I became more confused about what was purposive and what was incidental. While 'purposive' and 'incidental' seemed to clarify teacher intentions when I worked on my conceptual framework, it seemed less helpful when I attempted to apply them to my participants' descriptions.

I decided to let go of 'purposive' and 'incidental' as major descriptors of the eliciting phase. Instead, I found that the words 'generate' and 'attend' seemed to capture much of the eliciting phase without causing additional confusion. In the eliciting phase, my participants may generate opportunities for information about student thinking by establishing tasks or activities or by asking different types of questions and prompts. After generating opportunities, my participants may then attend to the information that becomes available.

Generate.

For all three participants, they reached their memorable exchanges through several stages of generating opportunities for better understanding student thinking. They all began by

establishing a task which generated student thinking. And they each generated more information by continuing conversations with their students about what the students worked on during the tasks. For example, Fernanda's goal with the five lines task was to engage students in discussing their understanding of linear relations. Since the task was open, it generated student thinking of a variety of mathematical concepts within the broader idea of linear relations. For example, Fernanda saw that the task allowed for opportunities for students to discuss slope, tables of values, graphs, fractions, rates of change, first differences, and parallel lines.

Fernanda noted that she had recently started to try more open questions in her instructions. She believed that open questions helped students feel more comfortable because they invite a wide variety of responses without immediately placing judgments on their mathematical abilities:

Fernanda: I'm trying more now, um, to ask more open ended questions. [...] [they] help make [students] more comfortable [...] because different strategies help them not get judged, right? (Fernanda, initial interview, January 26, 2016).

In Casey's memorable exchange, her goal in the spaghetti task was for students to better understand the relationship between the unit circle representation and graphical representation in trigonometry. This task created a context within which Casey generated more opportunities by asking specific questions depending on what she thought the students needed. For example, Casey asked Caitlin to make connections between the measurements of the unit circle and the amplitude of the sinusoidal function. Casey asked the girls, Callie and Elizabeth, to use their understanding of the sine function to predict how they might build the cosine function with Spaghetti.

Cadence's survey project, where students chose their own topics to pursue, generated opportunities for her to consequently have conversations with Amy and Barbara about

percentages. While Cadence did not foresee a conversation about 100 percent and percentages over 100, her design of the survey project provided the opportunities for students to encounter these issues while they attempted to analyze their statistics.

In the memorable exchanges of all three participants, teacher actions ‘generated’ information about student thinking. The emergent theme of ‘generate’ captures an important aspect of the eliciting process: that information about student thinking is caused by something, and therefore became available. While ‘generate’ emphasizes the role that my participants played in order to elicit information about student thinking, it also allows room for unintentional generation of opportunities that my participants subsequently attended to.

Attend.

It is not enough to simply generate opportunities for information to become available. Opportunities fade if they are not seized. As a result, I believe parsing out ‘attend’ from the eliciting phase helps to emphasize the importance of teachers paying attention to opportunities that have been generated. It also helps identify instances where opportunities had been generated unintentionally, but that they were still attended to by the participants.

Fernanda and Cadence explained that it was important to keep an open mind so that they would be able to pay attention to mathematical ideas that they did not expect to see in student thinking. For Fernanda, even though she had not yet discussed how to obtain the equation for parallel lines, she was glad that she paid attention to the student’s question about parallel lines. Paying attention and subsequently reposing the question allowed her to engage the students in exploring equations of parallel lines:

Fernanda: we hadn’t really talked about parallel lines and things like that, so I wanted them to visually see it, and then mathematically how do we prove that [the lines were parallel] (Fernanda, initial interview, January 26, 2016).

For Cadence, attending to the questions about percentages was helpful for her to further build rapport with Barbara as well as better understand Barbara's thought process. At the same time, her attention to Barbara's question also provided her with examples that she could use in the future. Cadence explained that all of these would not have been possible if she only paid attention to student thinking that she expected to see.

Casey indicated it was also important for her to attend to pauses and body language. She believed that attention to these kinds of details allowed her to better understand Callie. For example, she explained that the facial cues and pauses she noticed helped her identify Callie's level of confidence:

Casey: Callie doesn't give herself enough credit, she's very uncertain, and [...] [all this] from recognizing facial cues and her pauses (Casey, Initial interview, December 1, 2015).

It is possible for information to be generated but not attended to. Casey explained that when she was really focused on her conversations with Callie and Elizabeth, she had less awareness of other happenings in the classroom. Casey continued to explain that it is really a balancing act of whether to pay attention to a smaller group of students, or to tend to the surface happenings of the class:

Casey: So normally you're well aware of the other ones in class, [...] but that means that they get very individual attention for very short chunks of time [compared with my conversation with Callie and Elizabeth]. And do I really understand what they understand, or did I just check if they got it (Casey, initial interview, December 1, 2015).

From my conversations with Fernanda, Cadence, and Casey, I saw that what opportunities and information teachers attended to and how they attended to them was consequential. While it is important for my participants to set up opportunities for students to engage in mathematical thinking, it was equally important for them to attend to them. This is

because if they did not pay attention, then they were unable to interpret or act on these ephemeral opportunities.

6.2 Emergent Themes of the Interpreting Phase

The interpreting phase includes what teachers think about during interactions with students. This was difficult to get at during the interviews. Analysis of what the participants did were necessarily retrospective because we were unable to return to the same moment and capture what they thought about at the time. Attempts at exploring how Fernanda, Cadence, and Casey had interpreted information in the moment often resulted in an elaboration on their thinking behind how they elicited or general beliefs about mathematics education. For this reason, I decided to further explore ‘interpreting’ with all three participants during the second round of interviews (Appendix D, Appendix E, Appendix F). When asked to think about this, both Fernanda and Casey believed the difficulties related to exploring interpreting are tied to the fact that teachers are always on the move and do not have the luxury to consider what they thought about in the moment:

Fernanda: [pause] I think it’s because we [think in the moment] so quickly as teachers [...] and until somebody sits down and asks “what were you thinking about when you were helping that student” you think about it, you process it, and you move on, you ‘do!’ (Fernanda, second interview, April 18, 2016).

Casey: okay, um, wooph. [...] the one thing that is very true about teaching and you know this already, you are someone on your feet all the time. [...] you’re just caught up in go go go go go go, and we don’t actually stop and think about what we’re doing. [...] And to stop and think about what you actually think about, yeah. Wow. Uh. There’s a huge amount of thinking going on all the time (Casey, second interview, April 22, 2016).

Sense-making

Continued discussions with Fernanda, Cadence, and Casey clarified that they began by making sense of what the student said, wrote, or did, and continued to then build impressions and subsequently decide on how to respond.

All of the participants believed that it was important to understand how students think:

Fernanda: sometimes you're struggling to try to explain the way that you would do it and [the students] don't get it, and when you talk to them and then they go about it in a different way. [...] So, it kind of changes your perspectives on the importance of knowing how students think. (Fernanda, Focus Group, March 3, 2016).

Cadence: You're trying to get in their heads [...] it's [important] to understand students – how they think, how their brains work (Cadence, Initial Interview, November 23, 2015).

Casey: [teaching] is all about the students, and getting at their thought process to actually understand how they're thinking (Casey, Initial Interview, December 1, 2015).

While Fernanda, Cadence, and Casey all found it important to make sense of what students are saying and doing, they did not readily offer details about how they came to making sense. As I asked them to elaborate on how they made sense of what students were saying and doing, each participant offered a different suggestion. The participants suggested the following: teaching experience, knowledge of mathematical content and learning goals, past experiences with students, as well as interpretations of gestures, pauses, and eye contact.

When Cadence was asked how she understood the mistakes that Barbara made in the poster, she attributed it to her teaching experience:

Cadence: Um... [exhales] probably because I mean I think through my years of teaching (Cadence, Initial Interview, November 23, 2015).

Before Fernanda came across the students that discussed parallel lines during the 5 lines task, she mentioned that she briefly visited each group to make sure that they were on the right

track. When asked about how she was able to quickly discern how the students were working, Fernanda explained that it might be because she was comfortable with the curricular material, and because she had specific concepts in mind that she was looking for:

Fernanda: comfortable with the material. Comfortable with where the student [is], what the students needed to review. Like I knew what terminology I wanted them to have. How I would get [their understanding so quickly], I wasn't really sure, to be quite honest (Fernanda, Initial Interview, Jan 26, 2016).

While Casey was telling the story of Jack and Mallory, who also worked on the spaghetti activity, she explained that knowing the students helped her make sense of what the student was working on. Jack had started to draw a big unit circle. Casey saw this as problematic because she was not sure if it would leave enough space for three cycles of the spaghetti graph. Casey explained that she noticed this but did not feel the need to interfere with this particular group's work because Jack had demonstrated an understanding of the concepts from a previous encounter. As Casey expected, Jack was able to navigate through the problem and worked backwards to make the graph work.

In addition to knowing the students, Casey believed that gestures, pauses, and eye contact that she attended to also helped her quickly make sense of whether the student understood what they were doing. For example, Casey approached Aaron and Elaina for their explanation of what they were working on. Elaina had left the group to explain something to another group, and Aaron remained to explain to Casey what they had done. When reiterating Aaron's response, Casey furrowed her eyebrow, avoided eye contact, and paused throughout, as if to enact Aaron's expressions. Casey then explained that the pauses caused her to believe that Aaron did not fully understand what the group had done:

Casey: but there were pauses and he had to actually think that through for a minute a few times, and I thought "oh isn't that interesting that he had to think

about it rather than [immediately explain their work]” (Casey, Initial Interview, December 1, 2015).

Impression-building.

Participants have all identified impression-building as an important aspect of interpreting what they have attended to. In a way, we are always building impressions of everything we encounter. After making sense of the information that the teacher had attended to, the participants often described various impressions that they build as they interpret the situation. These included impressions of what the students understand over time, what their beliefs are about mathematics and about themselves, and what strategies work for a particular group of students.

For example, Casey noted that she has built an impression of what Barry and Jacqueline had understood from past interactions with them. She knew that Barry and Jacqueline were shaky about their understandings of the unit circle. These past experiences then informed her interactions with Barry and Jacqueline during the spaghetti curves activity. Casey explained that she often carries these experiences with her as she interprets new information about how a student thinks and what they understand:

Casey: So that impression of the student develops over time. Right? [...] So you bring that with you [...] [because] if you don't have that, how do you [understand] what they're [...] doing? (Casey, second interview, April 22, 2016).

Besides building an impression of what the student understands, a teacher may also be building an impression of student beliefs about themselves or about mathematics. In an earlier example, Casey mentioned that gestures and pauses led her to think about Callie's level of confidence. Cadence also often spoke about how she is often building an impression of how her students see themselves with mathematics. During the second interview, Cadence spoke about

Daniel, a student in her grade 11 math class. Throughout interactions with Daniel, Cadence had come to know that he was highly anxious about mathematics.

All three participants also explained that interactions with students also help building impressions of what strategies worked well. They all indicated that strategies that work well for one class may not work well for another because the students within them are different.

Therefore, all three participants indicated that they are always building an impression as to what strategies might best reach their students:

Fernanda: it depends on the students because [...] after I get to know them a bit more [...] I know the dynamics better in the classroom and what they're comfortable with (Fernanda, initial interview, January 26, 2016).

Cadence: For example, [...] with number talks, who should I start with and how do I get them to discuss, [...] um, it helps to know the students [because] it helps me decide (Cadence, second interview, April 5, 2016).

Casey: this particular class has an unfortunate dynamic [...] [where] there are two [students] in particular who can't stand each other's guts [...] And so I've had to change how I approach the lesson and what I did with the groupings (Casey, initial interview, December 1, 2015).

6.3 Emergent Themes of the Acting Phase

The acting phase is what the teacher does as a result of interpreting what she had elicited. Two themes emerged that related to the acting phase: interpersonal function and coherence. Both of these were important to my participants when acting on ephemeral moments in the classroom.

Interpersonal function.

Beside formative and summative functions, I found a third function to be important and helpful in my data analysis: interpersonal function. Based on my data analysis, I define an action to have functioned *interpersonally* if the action, whether intentional or not, impacts existing or future interactions between teacher-student, and/or between student-student, in a positive or

negative manner. Even when teacher actions may not serve formative or summative functions, it may still serve interpersonal functions. Conversations with Fernanda, Cadence, and Casey revealed that interpersonal functions are important aspects of teacher actions, as these can improve, or make more difficult, the possibilities for the assessment process to serve formative or summative functions. For example, students may more readily think about feedback that a teacher has offered.

One example of this was when Cadence was responding to Barbara's question about the 158 percent, she also joked with Barbara by referring to ghosts:

Cadence: "well you can't do 158 percent." And I said "well as long as you're not including ghosts... or we don't think there're spirits in this classroom and there's more than what we physically see there" (Cadence, Initial Interview, November 23, 2015)!

Barbara laughed with Cadence as they continued to talk. Cadence explained that while her comment seemed unnecessary, she felt that the joke was crucial to help build a connection with the student. Cadence believed that by acting in a way that builds a better relationship in the moment, it enables her to better support Barbara's understanding. This is because her actions helped Barbara feel more comfortable in that moment about having asked her questions about 158 percent.

Similarly, Fernanda explained that every time she had a conversation with a student, she was continuing to build a connection with them. She explains that she often used encouragements to help put students at ease about contributing to conversations during class. This subsequently impacted how well she was able to observe students working on mathematics, or have conversations with students about their thinking. This is because students felt comfortable about sharing their thoughts and ideas without worrying about being judged for their

capabilities in mathematics. Furthermore, students were more willing to take risks in front of their peers.

At the same time, Fernanda added that sometimes actions may also serve negative interpersonal functions depending on how they are understood by the student:

Fernanda: You might have said something that maybe they misinterpreted or didn't like. So, the baggage they're bringing [the next] time you have a conversation is going to impact your conversation with them (Fernanda, Second interview, April 18, 2016).

The interpersonal function of ephemeral assessment may potentially impact all ongoing and future assessment processes with a student, and therefore impact teachers' ability to support students' learning of mathematics. As a result, the consideration of interpersonal functions of teacher actions helps frame another layer of complexity to the ephemeral assessment process.

Coherence.

I found *coherence* to be an appropriate word to describe how Fernanda, Cadence, and Casey described their actions. My participants sought coherences in their actions: coherences across experiences in time, as well as across functions. Their descriptions of their actions were always connected to either an incident in the past, or their plans for the future. At the same time, there was also coherence across formative, summative, and interpersonal functions.

First, Fernanda, Cadence, and Casey seemed concerned about making sure that their actions are coherent across experiences in time. For example, Casey constantly brought up past events as reasons for her current actions. During our second interview, Casey mentioned Sabrina, who was selectively mute. Casey explained that her previous interactions with Sabrina helped her figure out how she might approach Sabrina during conversations:

Casey: So my past experience with [Sabrina] helped me figure out what won't work. [...] I always am aware when I approach Sarah it has to be a very quiet

tone. [...] So, don't invade her space. [...] and instead wait for her to explain her thinking (Casey, Second Interview, April 22, 2016).

In Casey's example, she connected her past experiences with Sabrina in order to inform how she might act when interacting with Sarah. Cadence similarly utilizes her past experiences with her students in order to inform her actions. She explained that when she's having conversations with students, she would often recall her previous interactions with the students in order to determine how to support them:

Cadence: of course [my past interactions with them would] come into play, because [...] if you're having conversations and you've helped these students before, right? You're going to know in that moment, what, how hard can I push here, right? And how delicate do I need to be? Where is the student emotionally with their math learning? Absolutely it's happening. [...] All of these help me figure out [...] how am I going to go about [helping this student] (Cadence, Second Interview, April 5, 2016).

In a different example, coherence also includes the connections between mathematical ideas over time. For example, Fernanda explained how she knew in her grade 12 class that she would soon be discussing derivatives of rational functions. As a result, she provided opportunities for students to work on reviewing concepts of polynomial and rational functions.

There is also coherence between the interpersonal, formative, and summative functions. For example, Cadence often provided feedback to students on the progress of their learning. At the same time, she also tried to record a check mark for students that achieved goals based on her professional judgement. The majority of these check marks came from her observations of and conversations with students, although she also included tests and quizzes. At the end of the semester, she then incorporated all of these check marks in order to arrive at a number that best represents a student's achievement. For Cadence, she sought to be coherent by allowing opportunities for her formative actions to also serve summative functions. In another example, Casey explained that an interaction with a student began by serving formative functions, but also

impacted Casey's summative decisions. During the first interview, Casey referenced a student, Hailee, from her grade 12 data management class in the previous school year. Through the conversation with Hailee about her statistics project, Casey found out that Hailee completely understood the process of coming up with a regression. Since Casey was also marking a test that Hailee had just written, she recalled that Hailee did not do well on regression. She had Hailee work on the question again and subsequently decided to provide Hailee with a better mark. Actions from Cadence and Casey indicated that formative and summative functions can influence each other and be coherent in, for example, identifying student understanding and supporting progress in learning.

In some instances, interpersonal functions may also indirectly improve summative decisions. During our second interview, Fernanda explained that she had created 9 versions of a Calculus test for her grade 12 students, each with a different function that students had to analyze. Fernanda explained that she came across a student, Natalie, who was writing a test and started to become anxious. Natalie began to cry and Fernanda noticed this. Fernanda approached and engaged Natalie in a conversation. Fernanda subsequently found out that the rational function that the student had was a bit trickier than the rest, and subsequently offered Natalie a separate opportunity to demonstrate her learning. In Fernanda's case, interpersonal and summative functions related to each other. These functions cohere because Fernanda began by acting interpersonally to support the student, and then discovered circumstances that impacted her summative decisions. Both actions served to better support and identify student performance during the test.

From the conversations with the participants, there seems to be two aspects of coherence related to teacher actions. First, it was important for Fernanda, Cadence, and Casey to relate the

past experiences and mathematical ideas to the present and to a possible future so that their actions were coherent. In other words, in order to better facilitate learning, all three participants found that it was helpful to consider the ongoing connections in their actions over time. Second, it was also important for the participants to have coherence across the three functions of assessment. Examples from Fernanda, Cadence, and Casey demonstrated an interconnectedness between interpersonal, formative, and summative functions.

Chapter 7 : Emergent Factors of Influence

If the emergent themes discussed in Chapter 6 focused on what and how teachers think and do, the emergent factors of influence focus on why. As I analysed the data, I began to notice many closely interrelated factors that appear to influence and are influenced by what teachers think and do. As mentioned in Chapter 1, I felt compelled to explore ‘why’ my participants did what they did and thought about what they thought about during their memorable exchanges. Despite the methodological dilemmas this direction caused, as mentioned in Chapter 4, I decided to pursue and better understand these factors. I subsequently identified tentative categories of teacher, student, relationships and contexts (Figure 7-1) in order to better explore the factors that seemed to emerge from my conversations with Fernanda, Cadence, and Casey. As a result, in this chapter, I explore emergent factors of influence, which addressed the ‘why’ question that had emerged in the middle of my research journey.

A further exploration of these emergent factors became the second layer of my analysis. These factors permeate my participants’ explanations about their teaching beliefs, as well as our explorations of their memorable exchanges. While some of these factors were briefly touched on in the previous chapters, I believe there to be inherent differences that warrant further discussion in this chapter. For example, the interpersonal function in the acting phase of the ephemeral assessment process has some similarities with factors that involve relationships. However, where the interpersonal function affects, or is affected by, teacher actions, the factor of influence impacts the entire ephemeral assessment process, including how teachers interpret in the moment. Moreover, the factors of influence seem to impact my participants’ teaching practice in general, beyond particular ephemeral moments.

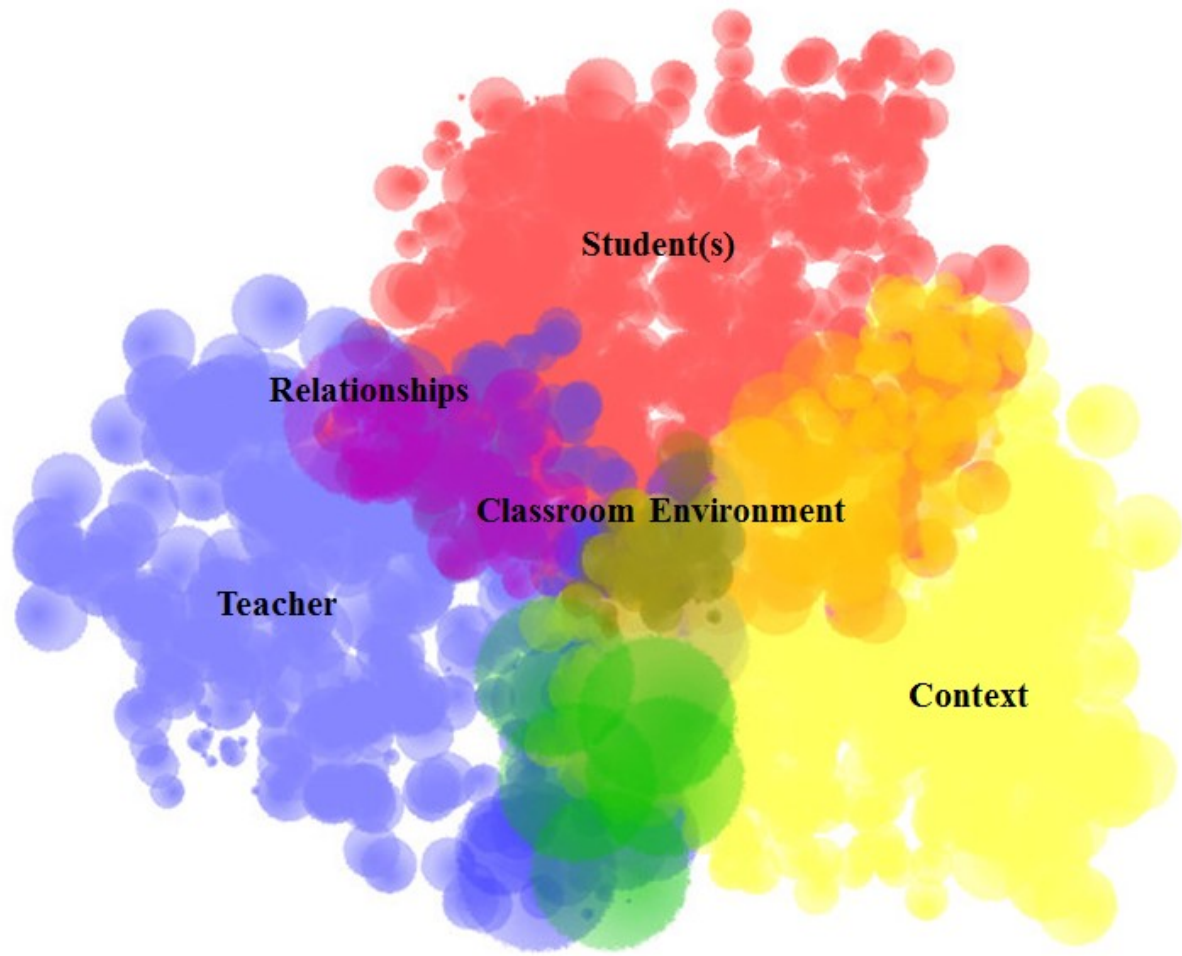


Figure 7-1 Four emergent factors that influence the assessment process: Teacher, student(s), relationships, and context.

7.1 Emergent Factor: Teacher

Shakespeare had famously noted that the world's a stage and all the men and women are merely players. I believe that, as teachers, we are not only the actors in, but also writers of, our own lived experiences. From conversations with Fernanda, Cadence, and Casey, I could see that their ephemeral assessment processes were affected by how they saw themselves, what experiences they had, and what mental state they were in. This emergent factor includes some of my participants' beliefs about themselves and about teaching that I described in Chapter 5.

However, the intention of Chapter 5 was to help the reader better understand who the participants were. In this section, I explore, in more detail, how various beliefs about themselves, as well as their access to resources and considerations of their states of mind might influence the assessment process. In summarizing this emergent factor of 'teacher,' I found the words identities, resources, and orientations helpful for categorizing these elements.

Teacher identities.

Leaning on the work of Gee (2000) as well as interviews with my participants, I define identities as how teachers see themselves being seen, and thought of, by others around them. Identities are created by people and are constantly created and recreated through the interactions between people (e.g. Bauman, 1996; Jenkins, 1994; Roth, Tobin, Elmesky, Carambo, McKnight & Beers, 2004; Sfard & Prusak, 2005).

Casey seems to believe that her identity is something that she could change and control. For example, Casey believed that being a female teacher allowed her to interact with Sabrina, who was selectively mute, in ways that Matt, her co-teaching partner in a grade 9 applied mathematics class, could not. This resulted from both how Sabrina perceived Casey as an individual, as well as how Casey carried herself as a female teacher. Casey saw herself as someone that Sabrina could rely on, and therefore felt responsible to check in with Sabrina's mathematical thinking regularly throughout the semester. Casey continued to explain that as she got to know the students, she was able to put on a different face for each student. She explained that initially she would make a conscious effort to approach Sabrina differently, but that eventually it became a natural way that she would carry herself in order to reach Sabrina.

Cadence appears to be impacted by student perceptions of who she is. These perceptions subsequently may influence how she engages students. During the focus interview, Cadence

mentioned that students saw her as more than just a mathematics teacher. She explained that she also teaches native studies to the majority of the students and when the students were in grade 9, she was also involved with the same students in the garden project at the school. As a result, Cadence believes that students saw her as a native studies and eco-teacher as well as the mathematics teacher. Students would often recall experiences with Cadence in native studies or with the garden project. These student perceptions of her roles as more than a mathematics teacher were important to Cadence because it helped her see that she was ‘more than a mathematics teacher.’ This belief about ‘who she is’ supported her ability to get at student thinking through conversations because it made her feel okay about drawing on experiences with students outside of the mathematics classroom.

Teacher resources.

While participants were discussing why they did what they did, and why they thought what they thought, they often referred to ideas that I summarize as teacher resources. These resources include knowledge and experience of mathematics, of the mathematics curriculum, and of pedagogy. While all three participants mentioned all of these types of resources, they seemed to differ on their emphasis of these resources during the interviews.

Fernanda, Cadence, and Casey spoke about the importance of knowing the mathematical concepts and curriculum and discussed how this knowledge affected interactions with students. For example, Fernanda explained that her knowledge of the various aspects of linear functions helped her recognize important conversations and questions that she might pursue in the classroom, as well as understand where those conversations and questions might lead. She credited her understanding of the curriculum for deciding to pursue student questions about parallel lines. Similarly, Casey explained that her knowledge of the relationship between cosine

and sine helped her identify where conversations might go when students were engaged in building both functions from spaghetti. As she visited a group and saw that students had just finished building the sine function, she knew to pose questions about the cosine question in order to get at their thinking.

All three participants also believe that knowledge of pedagogical approaches was helpful for initiating and continuing student conversations. For Cadence, she spoke about number talks during the first interview. She explained that through using number talks²⁴, she was able to better understand the different strategies students used, as well as showcase those strategies to the class and subsequently engage them in conversations. For Casey and Fernanda, they began to incorporate vertical non-permanent surfaces in their classrooms sometime between our first and second individual interviews. They both identified this pedagogical approach as influential for the way that they were able to attend to elicited information in the moment. Casey explained that in her Grade 9 Applied mathematics class, she used to always get the same students who responded to questions. With the vertical non-permanent surfaces, her students were engaging in conversations with each other which allowed her to attend to a variety of conversations.

Teacher orientation.

When asked about what contributed to how they thought or acted in the moment, Fernanda, Cadence, and Casey also suggested ideas that related to what I came to call teacher orientation. Teacher orientation is how a teacher has oriented toward a conversation or observation. For example, whether a teacher is distracted by other events unrelated to an interaction with students, or whether a teacher is prepared to listen to a student strategy that she

²⁴ Cadence seemed to describe her number talks as an activity where students offer a variety of strategies for solving arithmetic problems.

had not anticipated. I summarize teacher orientation in two interrelated ideas of frame of mind and manner of listening.

Fernanda, Casey, and Cadence provided examples of when their frames of mind impacted their thinking and their acting in the moment. Fernanda, for example, spoke about how negative interactions before class can impact how she carries herself in subsequent conversations. She explained that after she had just disciplined a student, she became caught up in anger and needed time to cool off. As she was calming down, she was unable to focus on promoting mathematical thinking in student conversations. Casey spoke about how the iPad changed her frame of mind. Casey went around with a single iPad and recorded student conversations. As a result, with the electronic device and the intention to record, she found that her interactions with the students were different than normal in many ways. Casey found that she was asking the students to elaborate more for the video, when she would have normally pushed their thinking and moved on. In addition, Casey felt that she was often distracted by the management of the iPad and did not pursue conversations as she normally would. Cadence suggested that there are rhythms that teachers and students get into. These rhythms that she described have aspects that related to the teacher's frame of mind. Cadence explained that often these rhythms that she gets into can impact how well she reacts to student thinking in the moment.

The participants also placed importance in their manner of listening, which could be habitual or impacted by their frame of mind. During the focus group, all three participants spoke about the difficulty of not jumping to rescue the students by answering questions immediately. Instead, they emphasized the importance of listening to students. For example, Casey explained that she would often remind herself to word her responses so that she wouldn't give away the answer. Instead, she would try hard to guide the students according to what they were saying.

Cadence added that often listening carefully and not responding right away also helps give thinking time to the students. She gave an example of her experience with an aboriginal student, Tyler. Cadence explained that Tyler would often act out unless he felt that he was listened to. In many of her interactions with Tyler, then, Cadence would simply stop and listen to what Tyler had to say instead of immediately offering support. Fernanda agreed with really thinking about wait time when listening to students. She believed that it is important to listen to students even if they are wrong.

Thoughts from the participants aligned with Davis' (1994, 1997) work on listening, where teachers may engage in evaluative, interpretive, and hermeneutic listening. When one engages in evaluative listening, one is listening in order to achieve a specific goal or a specific response. Interpretive listening, on the other hand, is the manner of listening where the listener attends to the sense-making of the student. Hermeneutic listening requires engaging in the messy process of negotiation of meaning and understanding. My conversations with Fernanda, Cadence, and Casey revealed that they all consciously strive to listen interpretively and hermeneutically.

7.2 Emergent Factor: Student

By the emergent factor of student, I mean teacher considerations for, and assumptions about, the student(s) that they are interacting with. This emergent factor of 'student' was prevalent in much of what Fernanda, Cadence, and Casey discussed. In a way, it is closely related to impression-building in the interpreting phase. However, as I will elaborate in this section, this emergent factor extends beyond simply interpreting students and where they are coming from. It also impacts the ephemeral assessment process more broadly: from how my participants elicited information, to how they acted accordingly. I have structured the emergent

factor of ‘student’ similarly to the structure of the emergent factor of ‘teacher.’ In other words, this emergent factor of ‘student’ includes the interrelated elements of student identities (as perceived by the teacher), student resources (as perceived by the teacher), and student orientation (as perceived by the teacher).

Student identities.

All three participants spoke about the importance of knowing how students saw themselves in their relationships with mathematics. They also explained that being aware of how students saw themselves helped shape their decisions in the classroom. In their descriptions, Cadence, Casey, and Fernanda emphasized different ways that considerations of student identities have influenced their interpretations and actions.

Being at an alternative school with students who have been unsuccessful in a regular program, Cadence is sensitive to past experiences that students may have had (or not had) with mathematics. She noted that her students were jaded with school in general, and they often have not experienced success with mathematics. For Cadence, considerations of how students saw themselves made her more careful in engaging students in conversations to prevent students from feeling embarrassed. These considerations also led her to intentionally and publicly celebrate achievements whenever she could.

Casey noted that it was common for her to hear students say ‘I hate math’ when she walked the hallways. As a result, she sought strategies that might support students building positive relationships with mathematics. She explained that she had found group work and hands-on activities to be helpful for this cause. Over the course of our interactions, Casey had also found vertical non-permanent surfaces to be helpful in making students comfortable in sharing their mathematical ideas with each other. For Casey, her perception of student identities

had prompted her to structure her lessons in ways that would improve student relationships with mathematics.

Fernanda explained that she juggled her knowledge of what students understood with student perceptions of their mathematical abilities. She gave an example with Nancy, one of her grade 12 students. Previous interactions with Nancy had indicated to Fernanda that Nancy was capable of more than she gave herself credit for. As a result, she had a conversation with Nancy to explicitly talk about her achievements and how to better represent her mathematical thinking. For Fernanda, she compared how she felt students saw themselves with how she felt about their mathematical capabilities.

Horn (2008) noted that students' "mathematical identities are not forged in a single classroom...[they] are constructed over time and across numerous contexts" (p.230). Fernanda, Cadence, and Casey all believe they are contributing to the building of students' mathematical identities. Moreover, considerations of these mathematical identities influence how they approach students, set up tasks, or build impressions to help students' mathematical thinking.

Student resources.

Besides considering their own knowledge of mathematics and curriculum, my participants also explained that they consider student knowledge of, and experiences with, mathematics. When asked about why they did what they did, Cadence and Casey explained that they often drew from past experiences with students in order to remind themselves of what students may have seen or appear to have previously understood.

While Cadence was having a conversation with her student, Barbara, about percentages, she began by listening to what Barbara seemed to have understood. In that moment, she recalled her past interactions with Barbara in the mathematics classroom, and knew that Barbara was

strong with basic operations, such as addition and multiplications. She also knew that Barbara had overheard her example using students in the classroom with Amy. As a result, she quickly confirmed that there were no arithmetic errors, and continued prompting Barbara with an example using the students in the classroom. In that moment, Cadence made use of her understanding of Barbara's understanding of basic operation, as well as Barbara's experiences with an example using students in the classroom.

Knowing that students had worked with unit circles, Casey decided on an activity that would further promote thinking about the relationships between the unit circle and the graphical representations of sine and cosine functions. Casey not only considered students' knowledge when she decided on the activity, she also kept the details of what students seemed to have understood in the previous classes when she visited the groups during the activity. She intentionally changed the way she asked the questions depending on which group she visited. For Callie and Elizabeth, she knew that the two had understood the concept of a unit circle, and so she pushed them to explore the relationship between the representations. For another group of students, Jacqueline and Barry, Casey knew that the two students had previously struggled with the unit circle. As a result, she focused on the details of how a unit circle is constructed when she was asking Jacqueline and Barry questions.

Student orientations.

From conversations with my participants, they also indicated that they were considering student attitudes, moods, or whether students were listening. It made sense to me to use similar words that I used to describe teacher orientations. Student orientations, then, also consist of frames of mind and manners of listening.

Just as the teacher's frames of mind can affect a conversation, participants all explained that their students' frames of mind can also impact what students do during a task, an activity, or a conversation. In illustrating this point, Cadence elaborated on an example involving Fergus, a student who refused to share his ideas during number talks. Fergus had just arrived to class from a lunch break. According to Cadence, she saw that Fergus was in a bad mood and was not interested in doing mathematics. Noticing Fergus's frame of mind, Cadence offered him an opportunity to cool off by working on some other tasks that he felt more comfortable doing. This provided Fergus with a break that he needed in order to get back into a frame of mind that was more helpful for participating in mathematics. In doing this, Cadence believed that she avoided a potential disaster that may have cost her any future interactions with Fergus. An awareness of Fergus's frame of mind informed Cadence's actions during class.

My participants also indicated that they often considered whether and how the students listened. Casey and Fernanda both spoke about the importance of recognizing what the student has heard in order to move forward. Casey gave an example of when she was elaborating on three-dimensional trigonometric problems. Casey posed a problem to her grade 11 students by identifying three objects and providing related distances and angles. After she provided the numbers, she noticed that some students had a blank look on their face, as well as some students who were not paying attention. After seeing this occur, she challenged the students to physically represent the three objects that she had just described. She then went around to support the students that seemed to need it. Casey altered her course of actions based on her interpretation of students that either did not hear or understand the instructions.

7.3 Emergent Factor: Relationships

An earlier section discussed interpersonal functions as an important part of the acting phase. In this section, I elaborate on how considerations for relationships impacts the entire assessment process, including teacher decisions on how they elicit and act, as well as what they think about during the moment. By relationships, I mean the relationship between teacher and students as well as relationships between students.

Relationship between teacher and students.

Having a positive rapport with students was important to all three participants. They believed that a good rapport allows them to better support student thinking in the classroom. In the conversations with my participants, I saw them describe an intricate dance of being friendly, promoting mathematical thinking, and being respected. During the focus group, Cadence emphasized the importance of getting to know the students and building a positive rapport. At the same time, she also believed that building rapport can be tricky. She explained using an example with one of her students, Maddie. She mentioned that in the desire of making Maddie feel a sense of achievement, she said to Maddie “you got it!” However, Cadence believed that this prevented Maddie from pushing her thinking further during the activity since Maddie thought she had finished. She lamented the fact that she celebrated Maddie’s achievements too early. She felt that she often acts too quickly to build a positive rapport, and unintentionally shut down the student’s mathematical progress.

Casey agreed with the idea that rapport can be a tough balancing act, and attributed the difficulty to the desire of teachers to be helpful:

Casey: and truly, we’re a profession who likes to help (Casey, focus group, March 3, 2016).

Besides being too helpful, Casey also worried about student perceptions of the teacher not being helpful enough. She added that students can also get frustrated if they feel like they are not getting help from the teacher, and that this interaction may also prevent mathematical conversations in the future:

Casey: because sometimes [students] just get frustrated because they just wanted an answer [...] and they might also just shut down (Casey, focus group, March 3, 2016).

Relationship between students.

Fernanda and Casey also indicated that they paid attention to the relationships between students and how that might affect conversations in their classrooms. Fernanda, for example, spoke about the careful considerations that went into her grouping decisions. For example, for her grade 9 students, she explained that she often put students in groups based on their comfort level with each other. She also thought about whether student interests might mesh. She believed that these considerations help students listen and talk to each other when they are working on mathematics.

For her grade 12 students, Fernanda encouraged students to learn to work with peers that they do not normally work with. She explained to students that it is important to learn to build new relationships so that they can find support in a university setting. She illustrated what she said to students in the following quote:

Fernanda: you have to experiment when you're comfortable here, before you go into those big [universities] (Fernanda, initial interview, January 26, 2016).

Casey also spoke about paying attention to the dynamics between students in her classroom. In particular, she spoke about negative interactions that could occur between two students in her grade 11 university mathematics course. She explained that one student, Jasmine, liked to talk while she was thinking through a problem. The other student, James, did not like

this and preferred to think more quietly. Taking this interaction into consideration, Casey often deliberately separated Jasmine and James so they were not working together in a group. Casey believed that interactions between Jasmine and James often escalate and that she did not want to have to tend to them on a regular basis:

Casey: [their interaction often] escalates, and so [I don't want to have] to put out fires between those two on a regular basis (Casey, initial interview, December 1, 2015).

7.4 Emergent Factor: Contexts.

The previous factors that I have summarized to be teacher, student, and relationships, all involved aspects that participants felt they could control or contribute to. At the same time, Fernanda, Cadence, and Casey also talked about aspects that they felt that they could not control. I found that the word 'contexts' captured these reflections. The emergent factor of 'contexts' include time, curriculum, and accountability. These factors of context influence how and what my participants did during the ephemeral assessment process.

Time.

All three participants spoke about time. Fernanda, in particular, elaborated on how she often felt pressured by time. Her considerations for time included juggling between curricular content and building classroom culture, time for group work versus individual work, as well as time to commit to better understanding student thinking. There appeared to be differences in how she spoke about her grade 9 academic mathematics class and her grade 12 calculus and vectors class. In comparing the two classes, she admitted that she often felt that she had significantly less time in her grade 12 class to build culture, or to do group work. In other words, Fernanda believed that time affected the different ways that she might elicit information about student learning, as well as affected her ability to establish favourable conditions for eliciting.

Fernanda also wished she had more time to reflect on how her students think as she interpreted in the ephemeral assessment process, or after the events have taken place. She explained that teachers are often caught up in the ‘doing,’ that often there isn’t enough time available to properly reflect on what was done. Lastly, she also described a difficulty to fully follow up on student thinking due to the limits of class time. This meant that her actions were influenced by available time in the classroom. Fernanda’s concerns for time, perhaps based on her perception of time, then, affected all three phases of her ephemeral assessment processes in the classroom.

Curriculum.

Fernanda, Cadence, and Casey also indicated that they are always thinking about the curriculum: The participants believed that these considerations of curriculum apply to the participants’ design of their activities, as well as during their ephemeral assessment processes. For Fernanda, thinking of the curriculum reminded her of what she might be able to relate to while listening and responding to student thinking. For Casey, occasionally revisiting the curriculum helped her look at designing lessons differently. For Cadence, the mathematical process in the curriculum helped her think about important aspects in mathematics such as problem posing:

Fernanda: It’s about doing that little bit more during [students’] learning. I mean, we’re all dictated by curriculum, right? (Fernanda, second interview, April 18, 2016).

Casey: [thinking about the curriculum] allows you to completely refine the course and actually look at it with fresh eyes when designing lessons (Casey, initial interview, December 1, 2015).

Cadence: like with those mathematical processes. [...] When you pose questions, when you ask questions, these are in your mind (Cadence, focus group, March 3, 2016).

Not all of their mentions of the curriculum were of a positive nature. Fernanda, who often taught grade 12 courses, explained that curriculum also created a pressure. She believed that there was a large amount of content in courses such as grade 12 Calculus and Vectors, and that she subsequently felt restricted in what she could do during class:

Fernanda: it's just [pause] I know how much we have to get through and we can't always spend a lot of time on everything (Fernanda, second interview, April 18, 2016).

Accountability.

Cadence and Fernanda also spoke about the pressures of accountability. While Cadence indicated that she felt that she was able to utilize observations and conversations to serve summative functions, she admitted that she did not have parental pressures that a teacher at a regular school setting might have. During the focus group interview, Fernanda confirmed Cadence's sentiments about parental pressures, and explained that she believed it would be difficult to incorporate observations and conversations in the same way as Cadence in her grade 12 calculus and vectors course. Fernanda explained that there is also a sense of responsibility to her students. She believed that she needed to properly prepare her students for the expectations of universities.

7.5 Interactions Between the Emergent Factors and the Ephemeral Assessment Process

Why do teachers think what they think, and do what they do, during the ephemeral assessment process? Throughout my research journey, this emergent 'why' question influenced my explorations. As I have outlined in this chapter, many factors that influence the assessment process have emerged from my conversations with Fernanda, Cadence, and Casey. While these factors may not influence all three phases (eliciting, interpreting, and acting) all the time, they

are potential factors that teachers may consider consciously or subconsciously in the moment. As such, these factors were helpful in better understanding the reasons behind my participants' interpretations and actions. These factors are not meant to be an exhaustive list of all possible influences. Instead, they represent examples that have emerged from my conversations with my participants. At the same time, I hope that the way that I have structured the factors into teacher, student, relationships, and contexts, allow for further investigations into how they may manifest in other classrooms.

Chapter 8 : Possible Implications and Conclusion

In-the-moment assessments are important but difficult to capture. Through examining lived experiences of four secondary mathematics teachers including myself, this study was my way of better understanding the ephemeral assessment process, as well as addressing the questions I described in the introduction. Throughout the previous chapters, I have clarified my motivations for exploring ephemeral assessment opportunities, and established how I envision and understand the assessment process. In order to address my questions about how teachers establish opportunities for ephemeral assessment processes, how teachers interpret the happenings, and what they do with interpretations, I discussed emergent themes relating the three phases of assessment. I also categorized emergent factors that seem to influence ephemeral assessment processes, as an attempt to address my question about why teachers do what they do, and think what they think. These emergent themes and emergent factors add additional layers of consideration and complexity to the conceptual framework presented in Chapter 2.

Assessment, as I have framed it in this thesis, is extensive. It covers most tasks that teachers are faced with – not only in their day-to-day interactions with students, but also their preparations for, and reflections upon, the moments in the classroom. In other words, the nature of assessment, as I have described it to be, corresponds with Hayward's (2015) suggestion that assessment is learning. This was evident in my participants' elaborations on their practices and their beliefs about learning. In the first layer of analysis, I explored details for what and how teachers think and do in the classroom during what I categorized as phases of assessment.

In the eliciting phase, the emergent themes were *generate* and *attend*. My participants' intentional and unintentional actions in the classroom generated information about student thinking. These actions included establishing tasks and activities, as well as conversing with

students and asking questions. Fernanda, Cadence, and Casey then needed to attend to the information that became available. Not only did my participants *listen to* their students in order to better understand their thinking, they also attended to pauses and body language.

In the interpreting phase, the emergent themes were *sense-making* and *impression-building*. After my participants had attended to the generated information about student thinking, they then began their interpretations by making sense of the happenings. My participants identified different ways through which they made sense of their memorable exchanges in-the-moment: teaching experience, knowledge of mathematical content and learning goals, past experiences with students, as well as interpretations of gestures, pauses, and eye contact. Once sense was made, participants then built impressions of what their students understood, what their beliefs are about mathematics and about themselves, and what strategies were effective for each group of students.

In the acting phase, *interpersonal functions* and *coherence* emerged as themes. My explorations of the data led me to recognize interpersonal functions as important aspects of teacher actions. It was important for my participants to act in ways that build a positive rapport with their students because they believed that positive relationships supported formative or summative functions of their assessment practices. Fernanda, Cadence, and Casey also believed it was important for their actions to be coherent across time and across the three functions (interpersonal, formative, and summative).

In the second layer of my analysis, I discussed emergent factors that influenced my participants' ephemeral assessment processes. These emergent factors tie into many aspects of mathematics education research. With respect to teachers, considerations include their perceived identities, their resources (e.g. knowledge and experience), and their orientation (e.g. frames of

mind and manners of listening). With respect to students, considerations include students' identities, resources (e.g. knowledge and experience), and orientations (e.g. frames of mind and manners of listening) as perceived by the teacher. With respect to relationships, it includes teachers' considerations of their perception of various relationships within the classroom (e.g. student-teacher relationship, student-student relationships). With respect to contexts, it includes teacher perception of time, curriculum, and accountability.

Perceived in this way, it makes sense that many researchers perceive 'assessment' as the bridge between teaching and learning (e.g. Wiliam, 2013), since assessment is the process through which teachers attend, interpret, and respond to students' thinking.

But then is this too broad a topic to be of use to teachers and education researchers? Simon (1971) believed that the richness in sensory data in the moment can be overwhelming: "a wealth of information creates a poverty of attention" (p.40). How might this work be useful to researchers and teachers? In this Chapter I discuss possible implications. I begin in section 8.1 by elaborating on how the work in this thesis may be interesting for researchers. In Section 8.2, I explore how this work may be useful for teachers. In section 8.3, I discuss limitations and possible future directions. Finally, in section 8.4, I offer some concluding thoughts.

8.1 Possible Implications for Researchers

The ephemeral assessment process lies at the intersection of many areas of mathematics education research. I believe that this study may be helpful to researchers in at least three ways.

First, the various visual representations that have helped me throughout this study may also be helpful to others. This includes the general structure for assessment processes, and the elaboration involving ephemeral forms of information. The visual representations involving influential factors (Figure 7.1) may also be helpful for better understanding how they affect what

and how teachers think and act in the classroom. The ideas discussed throughout my work relate to, and build on, several existing frameworks on assessment (e.g. Black & Wiliam, 1998; Harlen, 2006; Harlen, 2012; Wiliam & Black, 1996) as well as work on noticing (Jacobs et al., 2010; Mason, 2002). In the first layer of my analysis, aspects of eliciting, interpreting, and acting were explored. Similar to findings from others, the three phases are strongly interrelated (Jacobs et al., 2010; Sleep & Boerst, 2012), but interpretations and actions can be dissonant (Son & Sinclair, 2010). Through explorations of my participants' lived experiences, I elaborated on additional examples that demonstrate the interrelatedness between eliciting, interpreting, and acting. In the second layer of my analysis, the exploration of the emergent factors also corresponds to findings that identify the teacher as an important source of influence with respect to the assessment process (Chen et al., 2012; Colestock & Sherin, 2009; Watson, 2000; Watson, 2006; Webb, 2004). I also expanded the influential factors to include students, relationships, and contexts, which relate to some of what Stiggins (2007) identified as the unconquered frontier of assessment. Considerations of these factors are also consistent with constructivist and socio-cultural perspectives on learning (Confrey & Kazak, 2006; Packer & Goicoechea, 2000; Sfard, 1998). As a result, the framework and elaboration through examples presented in this study may add interesting ideas and conversations for researchers about assessment.

Second, this study brings attention to aspects of teaching and learning that are difficult to capture. By focusing on ephemeral assessment opportunities, this study naturally emphasizes the importance of what and how teachers think and do moment-to-moment in the classroom.

Through this study, many complexities involved in the moments of the classroom have surfaced. These ideas may add to existing efforts, such as the work on noticing (Jacobs et al., 2010; Sherin et al., 2011), to explore the rich information contained in flashes of classroom time. In my mind,

there are many similarities between noticing and assessment. Researchers may find it worthwhile to orient their attention to further explore classroom interactions in the context of assessment processes.

Third, I believe it is possible to view assessment as an overarching theory in education. For me, this has certainly become the case at this point of my research journey. Assessment, to me, is about how and what teachers do in order to support student learning. Assessment processes also include many other aspects of education that influence the teacher, the student, or the learning environment. As a result, I believe there may be value in using assessment as a functional²⁵ overarching concept to better understand and unpack interactions in the classroom.

8.2 Possible Implications for Teachers

Throughout these chapters, I have painted a complex picture of what and how teachers do and think about in the classroom – in other words, their assessment processes. In addition, in order to address ‘why’ teachers do what they do and think what they think, I also began to outline interrelated categories of influential factors that might affect what and how teachers do and think in the classroom. As a secondary mathematics teacher, reflecting on my journey raises the question: So what?

How does this study help me as a classroom teacher?

In this section, I offer ideas for how this study may be helpful for other mathematics teachers. These ideas are based on how this research journey continues to be helpful for me as a secondary mathematics teacher.

²⁵ By functional, I mean how theories (e.g. about identity) impacts how and what teachers do in the classroom.

Complexity offers opportunities

Silver and Smith (2015) pointed out that, for students, it is important to keep tasks cognitively demanding in order to “promote mathematical problem solving, reasoning, and understanding” (p.6). This is because if tasks are not cognitively demanding, they would not require decision-making or justification (Silver & Smith, 2015).

I believe a similar argument can be made for teachers in the classroom. That is, in order to improve pedagogical decision-making in the classroom, it is important to recognize that the assessment process is complex, and therefore cognitively demanding. The processes of assessment described in this study are complex. Besides details within eliciting, interpreting, and acting, there are also many factors that influence the assessment process. This makes sense because learning is complex. If assessment were simple, then we may not be assessing the important aspects of learning. Acknowledging this complexity offers rich opportunities for teachers to reflect upon how they think about, and make, pedagogical decisions in the classroom in a meaningful way. Instead of intimidating, having a teacher recognize the limitless possibilities for how she might improve her decisions, can be freeing.

Opportunities need to be perceived as opportunities

Teachers may be impressed by academic research, but they are not influenced by it. They demand that ideas be translated into classroom action. This in turn can only be judged through one’s own perception and interest, by the transferability of the approach to oneself, by its relevance as estimated by one’s conceptions, values, and preconceptions (Gattegno, 1970, p.59)

I do not perceive Gattegno’s (1970) observations as reasons for why teachers may be resistant to change. Instead, I believe his statement provides insight into how educational research may provide areas of growth. It makes sense to me that teachers demand a direct relationship between research and action. This is because even if they wade through the waters

of research, they are still faced with the realities of the classroom every single day. For example, in the case of Cadence, she would need to think about how she might respond to a student's questions about percentages while considering how this interaction impacts the student's confidence, the student's social conduct, the dynamics for the rest of the class, the sequence of her future lessons, the relationship between her and the student, and more.

In order for any research to have an impact on a teacher's practice, it needs to resonate with what matters to the teacher during the moment of reading and interpreting the research. I came across many of these turning points during my research journey. For example, when I began to define assessment as how and what I think and do in the classroom, it changed how I read the word *assessment* and how I considered my decisions in the classroom. In another example, when I came to relate factors such as identity to the assessment process, I began to reflect on how these influential factors affect my everyday actions in the classroom. In other words, the visual representations and categories I developed throughout my research journey, helped me make sense of why and how these concepts may apply.

I believe my description of the assessment process and its influential factors in this study may help teachers recognize the relationship between research and practice. This description may thus help teachers recognize two kinds of opportunities. First, the opportunities for relating their experiences to research, professional development activities, and anecdotes from colleagues. Second, the opportunities for recognizing the complex possible areas of growth while reflecting on their every day actions.

Opportunities for what?

In the later writings of Heidegger the "now" is the mere point of contact between the past and the future....it is ...a continual losing of the future to the past – in the flash of the moment of the now. No matter how the moment of the now is conceptualized, the point is that we are always too late to capture it, and therefore

we will never know its full meaning and significance. Indeed, its significance not only lies always already in the past, it also lies in the latency of its future. Our experiences may sometimes carry significance that we may only experience later, sometimes much later when certain events haunt us or return to us in memories that seem to come not from the past but from the future – a future latency of past event (Van Manen, 2014, p.59).

Events in the classroom are never independent of their pasts. During the semester, interactions with students always build on interpretations from assessment processes in the past, and are influenced by various factors discussed in chapter 7. Even in the beginning of a semester with a new group of students in the beginning of a teacher's career, her actions are still impacted by, for example, her own experiences with school, mathematics, or social situations.

For me, the ideas developed in this study provide an outline of opportunities for where teachers may grow their professional practice. For example, within the assessment process, I described how we, as teachers, continue to build impressions of how and what students understand. Recognizing that impressions occur consciously and subconsciously, may help teachers seize opportunities of becoming more aware in their practice. This realization can be powerful. Once teachers identify aspects of their practice as bursting at the seams with opportunities, they may then seek to reflect and improve their practice through their own lens of what they deem important and valuable in education. Creating these opportunities for reflection and subsequently acting on them is consistent with existing work on noticing (Mason, 2002) and awareness (Mason, 1998; Mason, 2011; Mason and Davis, 2013).

Acting on opportunities

All doing is knowing and all knowing is doing (Maturana and Varela, 1987, p.26, italics in original)

Recognizing the potential for acting differently in the moment is not the same as actually altering our actions. Just as opportunities need to be recognized as opportunities by teachers themselves, only teachers themselves can act on these opportunities.

In Chapter 2, I shared an anecdote about my experience with a teacher who would leave the class while students are engaged in activities. I believe that it is often not *whether* a strategy, labelled by the teacher enacting the strategy, *works* in the classroom, Rather, successes are more meaningfully attributed to *what the teacher does* when he or she enacts the strategy, given her/his contexts. The descriptions of the assessment process and the influential factors in this study may help emphasize this complexity, and thus promote careful reflections of how strategies are implemented.

Summary of implications for teachers

In summary, I believe that this study helps elaborate on the complexity involved in the assessment process as well as its influencing factors. Within this complexity, opportunities for improving one's practice may be recognized by teachers. Recognition of opportunities may then translate into practice when teachers not only become more aware, but also seek alternatives to their actions and how they think about their actions.

In chapter 7, I posited the metaphor which suggests that if the world's a stage, then teachers are not only actors, but also writers of their own lived experiences. I extend this metaphor to also say that we must also be the audience and critic of our lived experiences. We ought to not only be aware of what and how it is we think and act during moments in the classroom, but also consider the various factors that may have impacted these thoughts and decisions.

Ultimately, the only one who is able to elaborate and meaningfully explore the concepts in this study is the teacher herself. It is then impossible for others to determine and predict what it is a teacher would do in a given situation. As a result, it is more meaningful to suggest an expansion of awareness that allows for reflection in/of/through action (Mason, 2002; Schön, 1983), with which teachers develop their own powers of refining their practices.

8.3 Limitations and Possible Future Directions

Limitations.

There are several limitations to this study.

First, the allowed time and scope of a master's level study limited my ability to thoroughly establish a phenomenological description of lived experiences through two interviews and a focus group interview with three participants. In a way, this thesis merely represents the sights I have been privileged to encounter at this point of my journey. Since I currently perceive assessment as a central theme in education, and I believe in lifelong learning, it is impossible for this study to serve as a complete representation of my learning. In other words, this study cannot serve summative functions since it is merely a truncated version of an infinite divergent series²⁶. It is perceivable that the way I understand the assessment process as well as its influential factors may change as I continue my journey.

Second, interviews were conducted with participants who are experienced in teaching mathematics (each with more than 17 years of teaching experience), and who volunteered to participate in the research. Therefore, there may be differences between the participants and

²⁶ A series is the sum of the term of an infinite sequence (e.g. $a_1 + a_2 + a_3 \dots$ where a_n represent terms of the sequence). A series is divergent if there is no one value that the total sum is equal to. While all learning can be described as incomplete, I believe it is up to the individual's belief to determine whether it is so. Since I believe that I will continue to learn more about lived experiences with respect to the ephemeral assessment process, it follows that this study cannot serve summative functions for me. At the same time, I recognize that it may serve summative functions for others.

teachers at large. For example, their experience may have led to the fact that none of the participants identified mathematical content as an important aspect of their considerations in the moments of the classroom. The fact that they volunteered to participate in the study also suggest that these teachers have confidence in their teaching and have actively sought opportunities for thinking about their teaching. These factors may have influenced how they constructed the moments in the classroom, as well as how they have reflected upon them. In other words, a different sense of the key elements of ephemeral assessments might have resulted from a different group of participants.

Third, participants teach in areas where there has been support for the consideration of observations, conversations, and student products in provincial policy documents (OME, 2010). As a result, all three participants have thought about observations and conversations in some capacity, even if they did not immediately link these terminologies to everyday interactions in the classroom. The conversations with interview participants may have caused different themes to emerge if this was not the case.

Possibilities for future research

At this point of my research journey, I can conceive of four possibilities for future research.

First, there may be modifications of, or elaborations on, various aspects of my visual representations of the ephemeral assessment process, and influencing factors. Take, for example, the factor of identities described in the second layer of my analysis. How exactly do these impact in-the-moment decisions in the classroom? Conversely, how do events in the assessment process contribute to how one perceives mathematical identities (of their own and of others)? While influential factors may not impact teachers in the same way, it may be helpful to examine

examples of how that may occur. During the interview process, the participants and I had difficulties identifying how they interpreted the situation and how they arrived at a decision to act. These difficulties may relate to the factors described in the second layer of my analysis. An exploration targeted at the interactions between influential factors and in-the-moment decisions may be illuminating.

Second, it may also be helpful to explore students' lived experiences of an ephemeral assessment process. At the end of my anecdote in Chapter 1, I posited that even if I travelled back in time, a moment that occurred would no longer be the same. This moment in time also would not be the same if I were not myself. If I were Alf, or Beth, or Caitlin, I would have a different set of circumstances. And therefore, the moment would no longer be the same. As a result, it may be helpful to simultaneously explore how a teacher and her students might experience the same moment in the classroom. These possible future explorations of student perspectives may provide more insight into the details of the ephemeral assessment process.

Third, it may also be helpful to explore how an expanded awareness of the opportunities and possibilities of a moment might affect teacher actions. Mason (2002) believes that "all professional development could be described as changes in sensitivity to notice and accumulation of alternative actions to initiate" (p.147). It may be illuminating to better understand how this impacts the ways that teachers act and reflect. Perhaps a study where participants actively practice ways of improving awareness may be worth exploring. During the individual interviews and focus group, participants commented on how this study and its focus on in-the-moment thinking had really helped them think about how they thought in the classroom. For example:

Cadence: I have been able to get out of this project,... that,... teaching math has to be through conversations. The most important thing about this project [is] the

learning through it, whether or not it produces [a result].... And this is a good project to just think, right? (Cadence, second interview, April 5, 2016)

Casey: You've made me think about my teaching and that's actually really important.... [lots of questions about] how do we manage assessment. There's a lot rolling around in my brain. So thank you! (Casey, second interview, April 22, 2016)

Since the process of interacting with the participants had an impact on their practice, it may be interesting for future studies to explicitly work with teachers on improving awareness.

Lastly, it may also be interesting to further explore the role of technology as it relates to the assessment process and the four categories of emerging factors. In Chapter 6, I described Casey's experience with using iPads to record student conversations. The use of a recording instrument, in Casey's case, distracted her on two different levels. On the first level, she was caught up in the technical issue of keeping the student work within the frame of the recording. She believed that this caused issues for her in terms of keeping up with the conversations in ways that she normally would. On another level, having the instrument there also seemed to change her role as a facilitator of learning. She found that she was attempting to record a beginning, middle, and end to the story of students' learning, instead of quickly getting an idea of where students were at in order to support them. This corresponded to findings from Sherin, Russ, and Colestock (2011) mentioned in Chapter 3, where teachers noticed that their active recording of moments in the classroom changed how they behaved in the moment. It may be interesting for future studies to explore the impact of technology on ephemeral assessment processes for teachers who have become accustomed to recording their students in some way.

A focus on ephemeral assessment helps identify the interactions in the classroom at the centre of mathematics education research. I believe it is important to continue to emphasize these interactions. Not only is assessment a bridge between teaching and learning, I believe that

better understandings of assessment processes (and their influencing factors) also provide roads to continuing improvements to teachers' professional practice.

8.4 Concluding Thoughts

This research journey has been an incredible experience of soul-searching and self-discovery. My path to the completion of this thesis has not been a linear path. It contained many twists and turns that have allowed me to marvel at the rich terrain of mathematics education that I may continue to explore. Whether the icebergs of assessments that I have climbed, or the landscapes of mathematics I have taken pictures next to, these were awe-inspiring scenery with much more hidden from my view. With every read, I felt that there was more to discuss. With every discussion, I felt that there was more to read. Nonetheless I cherished every moment of my writings and thinkings and did not want them to end. While this thesis may end, my journey continues. I look forward to more somersaults through the field of mathematics education. No matter how dizzy it might make me.

I end this thesis not with a period, but with question marks. These are some questions that have emerged for me throughout this journey, and continue to occupy my mind: how might I authentically invite student conversations about social justice or the environment in my mathematics classrooms? How might I do this in a way that adds to my students' learning of mathematics? If I engage students in these issues, how does that impact how I listen and respond to student thinking (in other words, my ephemeral assessment process)? How might conversations of these sorts support my students' mathematical identities?

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Appendix A

Dear Mathematics Teacher:

This is to inform you about a Masters research project conducted by Jimmy Pai, a graduate student supervised by Dr. Christine Suurtamm of the University of Ottawa. The following describes the project:

This research project focuses on teachers' use of *observations and conversations* in the secondary mathematics classroom. Thus, I am looking for teachers who include opportunities for observations and conversations in their teaching. If you agree to participate, you would take part in two interviews as well as one focus group with two other teachers. During the interviews and the focus group, you will be invited to discuss of one or two moments from your class in detail: how you create opportunities for observations and conversations, how you interpret these, and what you do with these sources of information. The discussions will be facilitated by Jimmy Pai, a secondary mathematics teacher and a graduate student at the University of Ottawa.



This project has been approved by your school board as well as the University of Ottawa Ethics Committee, but is being conducted independently from your school and school board. I hope that your participation will be of benefit to you as it will allow time and space to think about assessment approaches and strategies. Results will also provide important information - relating to observation and conversations in the classroom - to policy makers, other teachers, and researchers in the area of mathematics education. If you might be interested in participating and would like more information, please contact me at (----@uottawa.ca). Selection process will seek to create diversity amongst the participants. Thank you for your consideration.

Thank you.

Jimmy Pai,

University of Ottawa

Appendix B

Guide for first semi-structured interview

Not to be followed verbatim

Audio-recorded

Date/Time:

Location:

Participant:

Thank participants and encourage them to use their artefacts, logbooks or anything else during our conversations. Remind participants of confidentiality for the upcoming focus group.

Questions:

1. How many years have you taught mathematics?
 - a. What grades... types of courses...etc.
2. What are the courses that you are currently teaching?
3. Tell me about how you create situations that allow you to observe student work or listen to student conversations about their learning.
 - a. Say more about... (relate to a recent experience perhaps)
 - b. What do you mean by...
4. Describe an instance of observation that provided information of student learning.
 - a. What went through your mind when... (relate to a recent experience perhaps)
 - b. What was rest of the room like?
5. What do you think you considered while you were observing or listening?
6. What did you do with this information?
 - a. What did you say to the student(s)?
 - b. How did that instance affect your decisions? Short term decisions? Long term decisions?
7. How do you incorporate your understanding of student learning with grading and reporting?
8. What are some of the supports and challenges in these informal assessment process that involve observation and conversation?

Appendix C

Guide for focus group

Not to be followed verbatim

Audio-recorded

Date/Time:

Location:

Participants:

Thank participants and remind of confidentiality. Have participants introduce themselves

Prompts:

1. I noticed that you've all talked about – building a community and comfort level for the students and so on – and that this sets up an environment possible for observation and conversations. I wonder if you all could talk about that - how do you do that
2. I'd like you to recall (I wonder if you could recall) a particular conversation or observation you had with a student, where the way you thought the students' understand really shifted. Can someone share? (give time)
3. Interpreting – the things we think of when we encounter moments – what goes into this?
What do we interpret – how do we interpret. Explore this a bit.
4. So professional judgement – how does this play into it?

Appendix D

Guide for final semi-structured interview - Cadence

Not to be followed verbatim

Audio-recorded

Date/Time:

Location:

Participant:

Thank participants and encourage them to use their artefacts or anything else during our conversations.

Prompts:

1. Throughout this project we have talked about various aspects of observations and conversations through moments in your experience. Are there any things that come to mind that we haven't talked about?
2. Are there things that you have been thinking of since we last met during the focus group, or any reflections that you would like to share?
3. During our first interview and at our focus group, you mentioned something like how you can look at an expectation or learning goal and know where a specific student is at. I was wondering if you could elaborate on this?
 - a. Perhaps think of a particular student and describe the things that might help lead to your sense of where he is at.
4. Toward the end of our first meeting you mentioned the word rhythm. I think you were talking about rhythms that teachers get into. Can you expand more on this? (flesh out the habit vs awareness...etc. here)

5. I've been writing a few papers for conferences and have been working on the analysis.

And what I've found that... eliciting, acting – are easier to capture. I am having a harder time getting at our thinking during the moment. Was wondering if you could help me with this – what do we think about when we are in the moment, and what kinds of things affect how we think?

Appendix E

Guide for final semi-structured interview - Casey

Not to be followed verbatim

Audio-recorded

Date/Time:

Location:

Participant:

Thank participants and encourage them to use their artefacts or anything else during our conversations.

Prompts:

1. Throughout this project we have talked about various aspects of observations and conversations through moments in your experience. Are there any things that come to mind that we haven't talked about?
2. Are there things that you have been thinking of since we last met during the focus group, or any reflections that you would like to share?
3. During our meetings you mentioned that with your grade 9s, you have these mini interview sessions with them where you get to dig deeper at their thinking. Can you say more about that? (flesh out as much details as possible here) Maybe you could recall a recent moment when you did this? (flesh out how she arrives at logging levels 1, 2, 3, 4 for the students)
4. I've been writing a few papers for conferences and have been working on the analysis. And what I've found that... eliciting, acting – are easier to capture. I am having a harder time getting at our thinking during the moment. Was wondering if you could help me

with this – what do we think about when we are in the moment, and what kinds of things affect how we think?

Appendix F

Guide for final semi-structured interview - Fernanda

Not to be followed verbatim

Audio-recorded

Date/Time:

Location:

Participant:

Thank participants and encourage them to use their artefacts or anything else during our conversations.

Prompts:

1. Throughout this project we have talked about various aspects of observations and conversations through moments in your experience. Are there any things that come to mind that we haven't talked about?
2. Are there things that you have been thinking of since we last met during the focus group, or any reflections that you would like to share?
3. During our first interview, you mentioned that events leading up to the moment matters and changes how we approach these moments. You gave the example of teaching them at 8:15 in the morning... or whether you just reamed somebody out... and those kind of dynamics. Can you tell me a bit more about this?
4. You mentioned that the moment you described to me last time – prompted you to think differently about not planning too much for lessons. Like not planning questions as much. What are your current experiences and thinking about that now that you're in the middle of the new course

5. I was wondering if you could think of a student in the class who you are more confident about where he or she is at, and then tell me about what you think contributed to you knowing this? Or how you got this impression of where they're at?
6. I've been writing a few papers for conferences and have been working on the analysis. And what I've found that... eliciting, acting – are easier to capture. I am having a harder time getting at our thinking during the moment. Was wondering if you could help me with this – what do we think about when we are in the moment, and what kinds of things affect how we think?