

Mathematic Teachers' Lived Experiences of Teachable Moments

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## **Dedication**

### **Hoai nimānī tañ pāvā pūrī satgur pās**

*(Becoming humble, I receive honour in the presence of the True Guru.)*

### **Vidyā vichārī tañ parupkārī**

*(True wisdom is that which is reflected upon—and then used in service of others.)*

This work is dedicated to the women and men—known and unknown—whose love, labour, and quiet courage shaped the ground upon which I stand. Your stories, sacrifices, and dreams live in me. Every act of care, every step taken in the face of adversity, has made this journey possible. To the women in my lineage—who carved strength from struggle and grace from challenge—you are the roots from which I grow. Your resilience echoes through generations. To the men who walked beside you in humility and solidarity—your support created space for new possibilities to take hold.

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## Abstract

This study emerged from a deeply felt tension rooted in my lived experiences as a teacher—moments when unexpected insights and connections surfaced in the classroom, calling forth profound questions about their essence and transformative potential. The study sought to interpret K–12 mathematics teachers’ lived experiences with teachable moments. More specifically: What is it like for K–12 teachers teaching mathematics to experience teachable moments? How is it like for these teachers to notice teachable moments? In what ways do these teachers take up teachable moments? The study adopted a pragmatic hermeneutic phenomenological approach, offering a dialogical pathway that illuminated the essence of participants’ lived experiences while embracing the relational and contextual nuances of their teaching practice. Open-ended interviews captured six participants’ lived experiences, with thematic analysis distilling their essence into crafted narratives from which eight themes emerged: noticing students’ gaps in mathematics understanding, noticing students’ needs, engaging in dialoging and discussing with and among students, noticing students’ mistakes and opportunities to learn, questioning and broadening teachers’ understanding of mathematics content, bringing real-world applications into teaching, practicing self-reflection and continuous self-improvement, and noticing the emotional aspect of learning mathematics. Findings revealed teachable moments as relational and interpretive, transforming the ordinary into meaningful learning through shared engagement. Teachers described noticing as a reflective, attuned process requiring awareness of subtle classroom dynamics. These moments emerged as adaptive, collaborative practices, fostering empowerment, belonging, and capability beyond transactional teaching.

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## CHAPTER 1: ORIENTATION TO THE PHENOMENON OF TEACHABLE MOMENTS

This research derived much inspiration from Max van Manen's (1991) insightful appraisal in *The Tact of Teaching*:

In all of our interaction with children, we are constantly involved, whether we like it or not, in distinguishing between what is good and what is not good for them (in contrast, educational research is usually more interested in distinguishing between what is effective and what is in-effective). Yet even (or especially) the best educators temper their practice with the knowledge that we all often fall short and do not know what is best. (p. xii)

In my years of experience as a mathematics teacher at the Junior/Intermediate level (Grades 6 to 8), I often reflected on my purpose of teaching mathematics and, in wondering how I could become a more effective mathematics teacher, questioned if I should teach math content, teach in particular ways using certain pedagogical tools, or teach the student. Initially, I strived to challenge and develop students' mathematical thinking by focusing on "rich tasks"; however, I felt that my students were missing a sense of connection to mathematics. When I consulted the literature to find out what experts in the field suggested, I was drawn immediately to the concept of *humanizing mathematics*, which I tried to incorporate real-life examples into my lessons that I thought students could relate to—which they did, sometimes beyond my expectation. But even when students connected to mathematics at a human level and associated their "being" with math, I still questioned my ability to guide their thinking; though I had both an Honours degree in Mathematics and a Master of Education, I fell short when dealing with students on moment-to-moment and day-to-day bases. Much like van Manen described in the opening citation of this chapter, I wondered if other teachers shared similar experiences.

With this in mind, I turned to the literature and discovered that in order to make sense of my experiences by relating to other teachers' experiences, I first needed to unpack and collect my personal story of my *own* experiences with the phenomenon. The following story is one of many that exemplifies what I discovered in my teaching practice.

\* \* \*

### **My First Story: Circling Back to Cleopatra**

During my first year of teaching mathematics, I tried to make math more realistic and humanistic through storytelling. On Halloween day, I decided to talk about the invention of the concept of circle and its impact on the world. I dressed up like Cleopatra to bring a historical perspective to the topic, and discussed how the circle might have developed. First, I talked about how one day, someone might have realized that there is a such thing as a line, which might have led to the idea of two lines intersecting and developing a corner. Next, I talked about the idea of four lines in which two pairs of lines intersected, leading to the development of four-sided figures like rectangles and squares. Further, I said that one day someone might have asked, “can a line intersect itself?” and then might have connected the two ends of the line and made a circle, which may have contributed to the invention of the wheel. The moment I made the connection of circles and wheels, a lively class discussion ensued during which one student said, “it may also be the reason why Christopher Columbus discovered the world because he might have realized that there are other shapes than four sided figures.” Another student then made a reference to spirituality and said, “It could also be when people realized the karma ... you know, what goes around is what comes around.” At this point, I was aware that my role was no longer didactic. The students changed from being passive consumers of mathematics to participants in knowledge creation—a change that empowered them. As their teacher, I was amazed by this

class discussion—but did not know what to do with it other than to say, “That’s interesting.” And, what did this have to do with teaching mathematics? Even though my intention was to bring a humanistic aspect to mathematics, I knew then that what had just happened was greater than my intention.

\* \* \*

### **Turning to the Nature of the Phenomenon of Teachable Moments**

Researchers in mathematics education have asked: what does it mean to teach mathematics? Another query has often underpinned this question, too: what contributes to effective teaching of mathematics? In this sense, researchers have tended to focus on both teacher knowledge—such as content or pedagogical knowledge (or the integration of the two), curriculum knowledge, and knowledge of the student(s)—and teachers’ emotions (e.g., mathematical self-efficacy, math anxiety, attitudes). When looking at what contributes to effective or ineffective mathematics teaching in terms of teachers’ knowledge, Muir (2008) suggested that teachers seeking to communicate a subject effectively and comprehensively should have in-depth content knowledge to provide alternative explanations for a given concept or topic. However, having such content knowledge in mathematics does not necessarily equate to teaching it effectively (Muir, 2008). Foote et al. (2011) argued that successful mathematics teachers “must develop multiple expertise in knowledge of mathematical content, pedagogy for teaching mathematics, and knowledge of students” (p. 71). Other researchers have questioned how the two categories of knowledge—mathematics (subject matter) and teaching (pedagogy)—can be integrated, as Shulman’s (1986) work on pedagogical content knowledge discussed. Building on Shulman’s work, Ball and Bass (2000) elaborated on pedagogical content knowledge using the term *mathematics knowledge for teaching* to capture the complex

relationship between knowledge of mathematics content and knowledge of teaching. Yet, having “adequate” knowledge of teaching does not necessarily pinpoint the characteristics of an effective or ineffective mathematics teacher.

When examining the characteristics of an effective mathematics teacher, particularly in terms of teacher emotions, it is essential to first clarify what is meant by “emotions” in this context. Emotions are not merely fleeting feelings but are deeply embodied, relational experiences that shape and are shaped by the lived realities of teaching (Hargreaves, 2000). They influence teachers’ actions, decisions, and interactions with students, intertwining with constructs such as self-efficacy, beliefs, attitudes, and math anxiety. These constructs, while distinct, come alive in the dynamic interplay of classroom life, where emotions become integral to the teacher’s capacity to notice, respond, and adapt in the immediacy of teaching. Rather than isolating emotions as discrete factors, they are better understood as part of a broader humanistic approach that situates teaching within the relational and interpretive dimensions of lived experience.

The question of what it means to teach mathematics effectively has often been explored through a humanistic lens, which emphasizes the relational, narrative, and emotional connections between teachers, students, and mathematical content. Mathematics researchers, such as Apostolos Doxiadis (2003), argue that teaching mathematics requires humanizing the subject for learners. Doxiadis proposed that “education is—should be, at its best—a process involving the complete human being” (p. 2). Humanizing mathematics invites educators to engage with students’ narratives—their experiences, perceptions, and backgrounds—while delivering educational content with learners’ interests and abilities in mind (Cernajeva, 2012). This perspective challenges conventional views of mathematics as a detached discipline, calling

instead for a pedagogy that invites stories of “doing” mathematics, where students relate to the subject through dialogue and shared inquiry. Doxiadis emphasized that unless mathematics incorporates learners’ perspectives, it risks losing its humanity. This approach also aligns with John Mason’s (1998, 2002, 2015) concept of awareness, which involves harnessing emotion and knowing how to act in the moment. Chapman (2008) highlighted storytelling as “a way of specifying experience, a mode of thought, a way of making sense of human actions or a way of knowing” (p. 16), while Tennant (n.d.) noted that humanizing mathematics bridges disciplines, integrating diverse methods of learning to make mathematics more meaningful and accessible.

Within this humanistic framework, teacher emotions are not peripheral but central to the lived experience of effective mathematics teaching. The literature consistently emphasizes the profound influence of teacher emotions on instructional effectiveness and student learning.

Burton (2004) described the cyclical relationship between confidence and success in mathematics, stating that “[s]uccess in mathematics breeds confidence. Confidence in mathematics breeds success” (p. 357). Over the past two decades, research on affect in mathematics education (Hannula, 2002, 2015; Hannula & Laakso, 2011; Hannula et al., 2004; Zan et al., 2006) has illuminated the ways emotions shape problem-solving, mathematical thinking, and classroom interactions.

Building on this understanding, emotions in teaching are not static; they arise dynamically in response to the unpredictable and relational nature of classroom practice. Zan et al. (2006) observed that affect enables individuals to interpret their learning outcomes and anticipate future success. However, while emotions provide a lens to understand what might be happening “inside” the mathematics teacher, they do not fully capture the complexities of teaching in the moment. Teaching requires educators to “temper their practice with the

knowledge” (van Manen, 1991, p. xii), navigating the immediate demands of classroom life while balancing professional knowledge and emotional attunement. In the dynamic and relational context of teaching, educators must constantly interpret and respond to the emergent needs of the moment, reflecting the deeply embodied nature of their work.

Although researchers have widely agreed on the importance of teacher knowledge and the role of emotions in both students’ learning and teachers’ teaching, there is little consensus about what constitutes an effective or ineffective mathematics teacher. Askew et al. (1997) observed that teachers’ knowledge, together with their implicit beliefs and theories, shapes how they interpret classroom events. This interpretive capacity directly influences their ability to notice and take up teachable moments—what Mason (2015) described as “knowledge available in the moment.” Clarke et al. (2002) found that effective mathematics teachers use such moments, whether expected or unexpected, to create connections to previously taught ideas and experiences. Muir (2008) defined a teachable moment as a “teacher’s simultaneous act in response to a student’s answer, comment, or suggestion and is utilized to either address a possible misconception or to enhance conceptual understanding” (p. 362). Mason (2015) emphasized that becoming aware of teachable moments (which he referred to as “unexpected things”) represents an “awakening” that sharpens attention, enriches noticing, and opens up fresh possibilities for action. Mason further argued that “what matters even more than noticing an opportunity is how that opportunity is taken up, how the released energy is used” (p. 110). In other words, how teachable moments are noticed and taken up, which is the focus of my research. Given the importance of teachable moments in mathematics teaching, I wondered how mathematics teachers experience these moments. This study focuses on mathematics teachers’



lived experiences of teachable moments, exploring how they notice, interpret, and take up these opportunities.

### **Formulating the Research Questions**

Mason (2002) observed that transforming professional practice into a focused research study first entails convincing others of what one has discovered. With this in mind, and in conjunction with van Manen's (1991) suggestion for researchers to begin with a personal story, I began my proposed research with my story (see "My First Story: Circling Back to Cleopatra"). In my process of wanting to make math meaningful for my students, I decided to teach by telling and creating math stories in my math class. For me, this way of teaching had to do with my own way of learning, which stems from my experience of learning from my grandfather who, too, used stories to teach and explain things to me. This, in turn, prompted and provoked my way of learning, which is learning by interpreting the stories presented by my grandfather—and this also contributed to our bond. Due to these experiences as a learner, where I became aware of how stories humanized the teaching and learning process for both the learner (me) and teacher (my grandfather), the research on humanizing mathematics resonated with me. When I started teaching mathematics, I tried to humanize mathematics for my students in the same way I had experienced it myself, which was through storytelling. Bruner (1986) saw storytelling as a way in which people translate their own experiences of understanding into a public form. Researchers such as Egan (1986, 1992, 1993), McEwan (1995), and Mello (1997, 2000a, 2000b, 2001) have distinguished storytelling as an educative activity through which individuals can share their personal understanding with others, thus initiating a negotiated transaction. In my experience as a teacher, storytelling led to a positive classroom climate, similar to the bond that I experienced with my grandfather.

Sharing mathematical experiences through storytelling gave my class a new tone, and made the subject come alive. I saw my students enjoy having a glimpse of the human side of their teacher, as well. Although not all the class sessions were about storytelling—there also were other pedagogical strategies used such as problem of the week, a flipped classroom model, traditional lessons given by the teacher (me), one-on-one and small group teaching, as well as math exercise work—I noticed that humanizing mathematics through storytelling impacted class discussion. It provided an opening that inspired reciprocity and helped create an atmosphere in which students were more willing to share their ideas. For me as a teacher, I sought to create teachable moments as they are the most cherished prize of teaching. Still, though I may have noticed the teachable moments, I often struggled with what to do with these moments. I began to wonder about teachable moments in mathematics teaching and what to do with them. I wondered how other teachers noticed and took-up teachable moments, and what those moments looked like to them.

### **Study Purpose and Research Questions**

To investigate the notion of teachable moments, researchers must orient themselves to the meaning of teachable moments, which can be derived from the experience of teachable moments: “We need to search everywhere in the lifeworld for lived experience material that, that upon reflective examination, might yield something of its fundamental nature” (van Manen, 1991, p. 53). van Manen offered several approaches to gathering or collecting lived experience, through their recording in various forms (e.g., interviews, direct observations, fictional accounts). For my research, I focused on the personal experience of teaching mathematics as a lived experience that materializes from reflecting on teachable moments. In this sense, my research study sought to explore mathematics teachers’ lived experiences of teachable moments.

This study defined the term *teachable moment* as an opportunity that arises when a connection has been made to advance learning, recognize learning, and/or recognize the gap in learning by a learner and/or a teacher. More specifically, the term *moment* is distinctly defined as an expected or unexpected occurrence that allows learners and/or teachers to deepen their understanding of when such a connection is made. The main research question of this study was: what are the lived experiences of K–12 teachers in their moment-to-moment teaching of mathematics?

Specifically, the study addressed the following sub-questions:

- What is it like for K–12 teachers teaching mathematics to experience teachable moments?
- How is it like for these teachers to notice teachable moments?
- In what ways do these teachers take up teachable moments?

### **Methodology: Hermeneutic Phenomenology**

The question *what are the lived experiences of K–12 teachers in their moment-to-moment teaching of mathematics* was a highly subjective investigation. It called for a hermeneutic phenomenological research design. Firstly, a *phenomenological research study* describes a “lived experience” of a phenomenon. Phenomenology then becomes *hermeneutical* when its method is taken as more interpretive rather than descriptive, as in other forms of phenomenology such as transcendental phenomenology (van Manen, 1997).

The participants in this study included K–12 teachers with experience teaching mathematics, ranging from beginners, mid-career teachers, teachers nearing the end of their career, and teachers who have retired from teaching, to ensure balance. The data was collected using semi-structured interviews. Specifically, data was collected from the personal stories of the K–12 teachers with experience teaching mathematics, which teachers shared by answering interview questions. Interviews were recorded and transcribed. As in hermeneutic

phenomenology, the lived experiences of participants are then presented into two types of stories: first, there are participants' stories, which are the stories they tell by answering interview questions (presented in the transcripts), and second, there are stories crafted from the transcripts by the researcher after delving into participants' stories to understand the phenomenon. As the researcher, I then reflected and interpreted the crafted stories to bring forth the themes of this study, which will help in understanding the phenomenon of teachable moments and assist in ultimately answering the research questions.

### **Significance of the Study**

The concept of “teachable moments” is viewed as a somewhat intangible pedagogical prize: a teacher might know what it feels like to experience it first-hand yet may not explicitly identify its characteristics. Educators, such as mathematics teachers, seek moments of openness and creativity with their students so they can personally experience “the psychic rewards” of teaching (Lortie, 1975, pp. 106–108). Too often, such moments happen suddenly and slip away just as quickly, leading some teachers to conclude that such occurrences are a matter of chance. This study therefore sought to illuminate teachers' lived experiences of teachable moments in mathematics education to deepen teachers' understanding of such teachable moments and use them in their practice.

By focusing on the lived experiences of mathematics teachers, specifically within a specific element of teaching (i.e., teachable moments), this study will contribute to mathematics education research, which prior studies have not thoroughly addressed. Teaching is a complex phenomenon encompassing ever-changing situations and teachers who are constantly challenged and called upon to positively deal with unanticipated and unexpected circumstances. The study is significant for mathematics teachers and practitioners because it enhances our understanding of

how moment-to-moment teaching occurs. More specifically, the study identifies the ways in which teachers make meaning of their lived experiences of these teachable moments which, in turn, can inform teachers and teacher educators alike about what teachable moments are and what it means to teach mathematics on a moment-to-moment basis.

### **Limitations of the Study**

This research employs a hermeneutic phenomenological approach, which, while highly effective in capturing the nuanced and deeply subjective experiences of teachers during teachable moments, introduces certain limitations. Firstly, the inherently subjective nature of the collected data means that interpretations and meanings derived are deeply entwined with individual experiences and may not be generalizable across different contexts or populations. Reflecting on the entire research process, other limitations beyond the chosen methodology also become apparent. For instance, the selection of participants was constrained by accessibility and may not fully represent the diversity of educational settings where teachable moments occur. Additionally, the study's focus on specific incidents of teachable moments may overlook broader, systemic factors that influence these experiences, such as institutional policies or cultural expectations within the educational system.

Moreover, as the research evolved, it became clear that while the qualitative, interpretive nature of hermeneutic phenomenology deeply explores individual perceptions, it does limit the ability to quantify the frequency or distribution of teachable moments across larger populations. This methodological focus inherently restricts the empirical generalizability of the findings. Furthermore, the validity of the findings in hermeneutic phenomenological research can be complex to establish. As Patton (2002) suggests, it is crucial for researchers to communicate the data in a manner that aligns with the intended purposes of the study. In this context, the findings

of this study are intrinsically linked to the participants' specific experiences of teachable moments and may not reflect a broader educational setting.

Commenting on the evolving nature of researching teachable moments, it is also essential to consider this study's approach as a foundational step that invites further research. While initially exploring this phenomenon through a phenomenological lens sets a rich, qualitative groundwork, it paves the way for subsequent quantitative studies. Such studies could employ hypo-deductive methods to test hypotheses derived from this research, potentially leading to broader generalizations and a more diversified understanding of the phenomenon. In this light, the methodological choices made in this study, while presenting certain limitations, also serve as significant assets. They establish a detailed, contextual foundation from which future research can build, potentially incorporating mixed methods to enhance both the depth and breadth of understanding teachable moments.

By acknowledging these limitations and framing them within the broader trajectory of educational research, this study contributes to a thoughtful and comprehensive exploration of teachable moments, offering valuable insights while recognizing the bounded scope of its conclusions and the potential pathways for future inquiries.

### **Outline of the Remainder of the Document**

The remaining chapters of this document illuminate the phenomenon of teachable moments through a hermeneutic phenomenological lens. Chapter 2 engages in a thoughtful review of the literature, situating the phenomenon of teachable moments within the broader discourse of mathematics education and exploring its theoretical and practical dimensions. The chapter establishes the foundational context for understanding teachable moments as a dynamic and interpretive phenomenon. Throughout the study, the phenomenon of teachable moments is

approached as a transformative interplay of teacher awareness, student engagement, and mathematical content. *Transformative* here means a mutual impact for both teacher and student: it enables students to forge deep, personal connections with mathematical concepts, altering their educational perspectives and experiences, as highlighted by Bowles and Scull (2015). Simultaneously, it provides teachers with deeper insights into students' learning processes, thereby refining their instructional strategies and enhancing their reflective teaching practices (Palincsar & Brown, 1984; Wang & Eccles, 2023). Such moments are explored as pivotal opportunities that hold the potential to reshape understanding, foster critical thinking, and deepen relationships between teachers and learners.

Chapter 3 delves into the methodological framework of the study, describing the research design, processes of participant recruitment, data collection, and analytical interpretation, while also addressing the procedural limitations and ethical considerations inherent to this study. The chapter situates the methodological approach as an interpretive act that aligns with the complexity and situated nature of teachable moments in K–12 mathematics classrooms.

The interpretive nature of this study is central to its methodological approach. Data analysis is presented as a process of “reading and re-reading” participants' narratives, allowing for deeper meanings of teachable moments to emerge. This reflective process is informed by the researcher's own positionality, ensuring a dialogical relationship between the participants' experiences and the researcher's interpretations. Chapter 4 thus invites the reader into the lived worlds of the participants through the presentation of verbatim narratives and researcher-crafted stories, which serve as rich, textured portrayals of their experiences with teachable moments. The chapter also unpacks the emergent themes that arise from these narratives, offering a nuanced interpretation of how teachable moments are noticed, experienced, and acted upon by teachers.

These crafted narratives not only provide insights into participants' lived experiences but also highlight the contextual and situational factors—such as classroom dynamics, curriculum constraints, and cultural considerations—that influence the emergence and uptake of teachable moments. By grounding the discussion in these contexts, the study underscores the deeply relational and responsive nature of these moments.

Finally, Chapter 5 brings the inquiry to a reflective and interpretative close, presenting discussions that engage with the findings from this particular phenomenological exploration. While conclusions are carefully articulated to distill the essence of teachable moments as transformative within the specific contexts of the study, the implications are proposed with a recognition of the contextual boundaries of these insights. This nuanced approach highlights the need for further hermeneutic inquiry to explore their broader applicability in diverse educational settings. Thus, the chapter underscores the significance of these findings for practice, research, and policy, encouraging a continuous dialogue across various educational landscapes

Each chapter is designed to deepen the understanding of teachable moments, maintaining fidelity to their interpretive, situated, and reflective nature within the context of hermeneutic phenomenological inquiry. This study not only presents findings, but also invites readers into a shared reflective space, where they may consider their own experiences and interpretations of teachable moments. Each chapter is a step toward unraveling the layered meanings of these fleeting yet profound pedagogical instances. By tying each chapter to the overarching research questions, the study provides a cohesive journey that reflects the transformative potential of teachable moments in K–12 mathematics classrooms.



## CHAPTER 2: REVIEW OF THE LITERATURE

Throughout my years as a mathematics teacher at the Junior/Intermediate level (Grades 6 to 8), I frequently reflected on my purpose in teaching mathematics. In my quest to become a more effective teacher, I grappled with whether my focus should be on teaching math content, employing specific pedagogical strategies, or prioritizing the individual student. Initially, I aimed to challenge and develop students' mathematical thinking by incorporating "rich tasks," but I soon realized that my students often lacked a meaningful connection to mathematics.

Seeking guidance from the literature, I was immediately drawn to the concept of humanizing mathematics (Bishop, 1998) because it resonated with my own experiences. In my journey to make math meaningful for my students, I found myself turning to storytelling, inspired by my grandfather, who used stories to teach me and, in doing so, created a strong bond between us. Those moments with him taught me how storytelling could make learning feel personal, relatable, and engaging—qualities I wanted to bring into my own teaching. When I introduced storytelling into my classroom, I saw how it transformed the learning environment. Math became more alive, my students were more eager to share their thoughts, and our classroom felt like a community where ideas flowed freely. While I also used other strategies like problem-solving activities and flipped classrooms, storytelling stood out as a way to build connections and create meaningful learning experiences.

However, even with these successes, I often found myself struggling when unexpected moments emerged. I could sense their importance, those fleeting opportunities where real learning and understanding could happen, but I wasn't always sure how to act on them. This gap left me questioning: What do teachable moments look like to other teachers? How do they notice them, and what strategies do they use to respond effectively? These uncertainties sparked a deep curiosity in me and a desire to explore the phenomenon of teachable moments in mathematics teaching.

As I grappled with these questions, I found resonance in van Manen's (1991) reflection presented in this dissertation's opening citation. It prompted me to wonder whether other teachers had encountered similar experiences. Moreover, I realized that even seasoned and well-qualified teachers "temper their practice with the knowledge that we all often fall short and do not know what is best" (van Manen, 1991, p. xii). In essence, the elements researchers have identified as critical for effective teaching did not fully prepare me for the unpredictable, moment-to-moment nature of classroom teaching.

The word "effective" originates from the Latin term *effectivus*, which means "creative, productive, or efficient." In the context of effective teaching, this etymology underscores the capacity of teachers to produce meaningful and transformative learning experiences. For me, the term emphasizes not just the outcomes of teaching but the dynamic process through which I actively engage with my students and the subject matter to foster understanding and connection.

In this chapter, I present the literature on effective teaching, and note that "transferable knowledge" alone (which is often part of teacher training programs) does not fully prepare teachers for moment-to-moment teaching, which includes noticing and taking up the teachable moments. In hermeneutic phenomenology, a literature review is an interpretive act that situates my research within the broader scholarly discourse on effective teaching and teachable moments. It reveals gaps in existing knowledge while fostering a dialogical engagement that deepens understanding. By critically reflecting on the literature, I examine my preunderstandings, ensuring openness to the phenomenon as it reveals itself. This reciprocal process establishes a foundation, enriches the interpretive rigour of my inquiry, and connects my work meaningfully to the ongoing scholarly conversation.

I review literature that discusses how teachers' knowledge has evolved over the last few decades, as well as teacher knowledge in mathematics education, the humanistic perspective of

teaching mathematics, and the role that emotions play in mathematics teaching. By weaving these threads together, this review identifies gaps in existing research and underscores the need to explore the lived experiences of teachers as they encounter moment-to-moment teaching—teachable moments. Finally, I explore the literature on Mason’s (2015) concept of “Knowing to act in the moment” and the role it plays in understanding moment-to-moment teaching. Unlike static forms of knowledge, “knowing to act” bridges intention and action, allowing teachers to transform fleeting moments into meaningful, relational, and impactful learning experiences. For me, this concept highlights the interpretive, emotional, and intuitive dimensions of teaching, where professional knowledge is activated in the immediacy of classroom interactions

I concur with John Mason about the need for research that focuses on knowing to act in the moment, which may stem from one’s lived experiences of acting in the moment. However, while Mason’s work illuminates aspects of surprise and attentiveness, it leaves an interpretive opening—unanswered questions about how such moments are lived, carried forward, and sustained within pedagogical practice. It is these questions that guide this inquiry. From a hermeneutic phenomenological standpoint, teachable moments are not merely practical challenges; they are opportunities to re-interpret the lived realities of teaching and learning. They invite me to open myself to the uncertainties of the moment, engaging with my students’ experiences, emotions, and questions to create new possibilities for meaning-making. Thus, my hermeneutical phenomenological enquiry is guided by the research question: what are the lived experiences of K–12 teachers in their moment-to-moment teaching of mathematics? More specifically: What is it like for K–12 teachers teaching mathematics to experience teachable moments? How is it like for these teachers to notice teachable moments? In what ways do teachers take up teachable moments?

## Research on Effective Teaching

Teacher knowledge is a complex topic encompassing the underlying components of teaching and learning, the concept of knowledge, and the ways in which teachers' knowledge is put into action in the classroom. Engaging with this body of literature as a teacher, I find myself reflecting deeply on how these perspectives align or diverge from my lived experiences in the classroom. This leads me to the foundational question: what does it mean to be an effective teacher, and how does effective teaching manifest in the complexities of everyday practice? Understanding teacher knowledge is not merely about identifying categories but also about interpreting how it emerges and transforms within the lived complexities of moment-to-moment teaching—a dynamic aspect often overlooked in static frameworks. Questions emerge as one begins to explore various concepts of teacher knowledge: What is teacher knowledge? How does a researcher study it? What are the implications of defining it and studying its effect on teaching practice and student learning? All these questions are rooted in one main question: what type of knowledge must a teacher have to be an effective teacher? According to Miriam Ben-Peretz (2011), the definition of teacher knowledge has expanded and broadened significantly over the last few decades. In this section, I provide a background on how the scholarly understanding of teacher knowledge has developed since the previous century, how teacher knowledge itself has evolved, along with the commonplaces of education such as subject matter, learner, teacher, milieu, and different kinds of teacher knowledge (Schwab, 1969/1978).

From a hermeneutic phenomenological perspective, the inquiry into teacher knowledge invites me to reflect on my lived experiences and interpret how theoretical constructs resonate with the dynamic, relational, and interpretive nature of my practice. This perspective compels me to question not only what effective teaching entails but also how teachers make sense of their

knowledge and apply it in real-time to foster meaningful student learning. Rather than categorizing knowledge, I am drawn to understanding how my own teaching experiences continually shape and reshape my understanding of what it means to teach effectively. The literature compels me to explore the interplay between theoretical knowledge and the immediacy of my day-to-day classroom interactions.

As a Junior/Intermediate mathematics teacher, I find myself particularly drawn to understanding how this literature relates to the moment-to-moment teaching of mathematics and the identification of teachable moments. In order to make sense of my teaching, especially when I noticed that my students were disengaged, I turned to the literature to seek insights and strategies for re-engaging them. Through this process, I realized how my static understanding of teacher knowledge did not fully prepare me to navigate the dynamic nature of moment-to-moment teaching. Although I know all this about static teacher knowledge, I still found myself struggling with moment-to-moment teaching as, at times, I did not know which knowledge to call upon while facing the moment. This realization became an interpretative lens through which I began to see the gaps in static frameworks and their inability to account for the relational, immediate, and evolving nature of guiding students in the classroom. As I delve into this literature, I find myself returning to my own practice, constantly interpreting and reinterpreting my experiences as a mathematics teacher. This reflective engagement aligns with the interpretative nature of hermeneutic phenomenology, where the focus is on understanding how teachers make meaning of their knowledge in action.

Building on the broader philosophical inquiry into teacher knowledge, I find Lee Shulman's (1986) work particularly resonant as it provides a lens through which I can interpret my own teaching practices. His framework categorized teacher knowledge into three types:

content knowledge, pedagogical content knowledge, and curricular knowledge. Content knowledge refers to the body of knowledge and information that teachers teach, and which students are expected to learn in a given subject or content area, such as mathematics. Content knowledge generally refers to the facts, concepts, theories, and principles that are taught and learned in specific academic courses, rather than the skills which are taught in school.

Pedagogical content knowledge focuses on the combination of subject area knowledge with teaching knowledge of how to teach. Finally, curricular knowledge focuses on teachers' understanding of how the subject area fits with the educational program in which it is taught.

Reflecting on Shulman's framework, I am drawn to the relational and interpretative processes that take place in my classroom. As I engage with this literature, I find myself continually interpreting how Shulman's ideas about teacher knowledge play out in the lived realities of my teaching, where each moment demands a careful balancing of content, pedagogy, and student engagement. My teaching emerges as an evolving act of meaning-making shaped by my students' lived experiences and my own. Pedagogical content knowledge, then, becomes more than a blend of content and pedagogy—it becomes a space where the teacher's knowledge interacts with students' lived experiences and understandings. However, despite its importance, these types of knowledge often leave teachers uncertain about how to respond in the moment. For example, there have been times when a student's confusion about fractions led me to reconsider how I present the topic. Initially relying on abstract definitions, I found greater success when I introduced concrete examples like slicing a pizza or measuring ingredients for a recipe. This moment illustrated the dynamic interaction between pedagogical content knowledge and students' lived experiences, as described by Shulman's (1987) blending of content and pedagogy. Yet, in that moment, I struggled with identifying which aspect of my knowledge to

draw upon, highlighting the limitations of static frameworks in addressing the immediacy of classroom interactions. It also underscores the importance of professional noticing in adapting instruction to meet students where they are.

While focusing on teacher knowledge in terms of subject knowledge, Tamir (1991) integrated a general definition of knowledge that honoured personal experiences and the knowledge gained in teaching. Tamir distinguished between teachers' professional and personal knowledge, with the former being a "body of knowledge and skills which is needed in order to function successfully in a particular profession" (p. 263)—which in this case is the teaching profession, where the knowledge is both general and personal/experiential. Connelly and Clandinin (1988) conceptualized personal knowledge as grounded in experience, framing teachers as knowledgeable and knowing individuals. This perspective aligns with the notion of "personal practical knowledge," which situates teaching as an interpretative act where past experiences inform present and future practices.

Personal practical knowledge is found in teacher's past experience, in present mind and body, and in the future plans and actions. It can be found in teacher's practice. It is, for any one teacher, a particular way of reconstructing the past and the intentions of the future to deal with the exigencies of a present situation (Connelly & Clandinin, 1988, p. 25). This perspective resonates deeply with my experiences in the classroom, where my past encounters with students and subject matter often inform my interpretative processes in the present. Reading Connelly and Clandinin (1988), I find a mirror for my own journey as a teacher, reconstructing past experiences to make sense of present challenges and to envision future possibilities. This act of interpretation highlights the relational nature of teacher knowledge and affirms the value of reflecting on my lived experiences as integral to my growth.

While focusing on the importance of what teachers know and how such knowing is expressed in teaching, Connelly et al. (1997) stated that “teacher knowledge research is part of a revolution in how educators think about classroom practice” (p. 666). Here, again, the focus is on personal and practical knowledge that incorporates the idea of experience, allowing researchers to situate teachers as knowledgeable and knowing persons. Such an approach assumes that the most important element in terms of teachers’ knowledge is “what teachers know and how their knowing is expressed in teaching” (Connelly et al., 1997, p. 665).

Edwards and Ogden (1998) expanded this understanding by looking beyond subject matter as the cardinal factor in teacher knowledge to include the connection between subject matter and curricular demands. Their findings emphasized the dynamic and evolving nature of teacher subject-matter knowledge in relation to student tasks and learning. This relational aspect resonates deeply with my own teaching experience, where curriculum-driven changes often require me to interpret and reframe my pedagogical approaches to meet the lived realities of my students’ learning journeys. For example, I found that integrating technology into math instruction required me to rethink how I approached both content and pedagogy in my classroom. Yet, the ability to adapt in the moment to unforeseen challenges remains an area where existing knowledge frameworks provide little guidance.

As I interpret these insights, I see a recurring theme: the transformative potential of teacher knowledge lies not in its static accumulation but in its dynamic application and evolution. This reflection deepens my exploration of what constitutes effective teaching, highlighting that it requires more than a mastery of knowledge—it demands the ability to interpret, adapt, and respond to the unique needs of students in real time. For example, during a lesson on algebraic expressions, a student’s offhand comment about patterns in nature sparked a



discussion that deepened the entire class's understanding of the subject. In that moment, I struggled with knowing which part of my knowledge to rely upon to guide the discussion effectively. Such moments emphasize that effective teaching is not a static process but a relational, interpretative, and responsive act that evolves in context.

Grossman and Richert (1988) identified characteristics of essential teacher knowledge as “a body of professional knowledge that encompasses both knowledge of general pedagogical principles and skills and knowledge of the subject matter to be taught” (p. 54). Their study revealed that having a broad understanding of a subject alone was not enough; teachers need a specialized body of knowledge. In this sense, teaching involves teachers coming to terms with what it means to teach a particular subject matter—the very question I asked as a first-year math teacher when I realized that students were not connecting to math in my classroom.

Shulman (1987) referred to this as pedagogical content knowledge, which he defined as a “blending of content and pedagogy into an understanding of how particular topics, problems or issues are organized, represented and adapted to the diverse interests and abilities of learners, and presented for instruction” (p. 8). This blending, in my experience, requires an ongoing interpretative process—a hermeneutic engagement where the teacher continuously makes sense of their own knowledge in relation to students' needs and contexts. Yet, even with this understanding, the unpredictability of classroom dynamics often left me questioning which knowledge to prioritize in a given moment.

Clarke and Hollingsworth's (2002) model of teacher change offers additional insight into this interpretative process. Their four domains—the personal domain (knowledge, beliefs, and attitudes), the domain of practice (professional experimentation), the domain of consequences (salient outcomes), and the external domain (sources of information, stimulus, or support)—

resonate deeply with my teaching experience. This model reflects the hermeneutic cycle of interpreting and reinterpreting my classroom experiences to foster my growth as a teacher. Yet, as Mason (2015) suggests, knowing to act in the moment demands more than static knowledge; it calls for an embodied awareness that bridges my theoretical understanding with the immediacy of practice. However, these frameworks still do not fully address the immediacy of deciding how to respond to unexpected teachable moments.

Tang's (2003) research on pre-service teachers' professional learning in international settings further highlights the role of experience in teacher knowledge. Tang found that reflection on professional learning in diverse contexts—including the action, socio-professional, and supervisory aspects of teaching—was crucial for developing professional competence. This finding resonates with my own reflections on how cultural and institutional differences shape the way I approach teaching and learning.

As I reviewed the literature on what constituted teachers' knowledge, I found that much of the research paid attention to the knowledge required by teachers to make sense of the current world for their students. Holden and Hicks (2007), for example, explored global education, which highlights the interconnectedness of systems and cultural appreciation. While this perspective is valuable, it also points to the broader skills teachers need to develop in order to address both academic and societal issues effectively. Holden and Hicks (2007) adopted Tye's (1999) definition of global education, which

involves learning about those problems and issues which cut across national boundaries and about the interconnectedness of systems—cultural, ecological, economic, political, and technological. Global education also involves learning to understand and appreciate our neighbors with different cultural backgrounds from ours; to see the world through the

eyes of others; and to realize that other people of the world need and want much the same things. (p. 17)

In this context, Mason and Spence (2000) stated that “knowledge is often thought to lead to, or be concomitant with, understanding” (p.136). Reflecting on this, I interpret understanding not as a static endpoint but as a dynamic, ongoing process shaped by the lived realities of teaching. For me, the act of making sense of a student’s struggles with a concept or their sudden insight into a problem underscores how understanding emerges relationally and interpretatively in the moment. Burton’s (1995) notion that “knowing why” transforms mathematics into a meaningful human activity also resonates deeply, prompting me to continually reinterpret how I make mathematics meaningful for my students.

This still raises the question of whether the types of knowledge discussed above sufficiently prepare me to act in the moment and to identify and utilize teachable moments effectively. Understanding, from my hermeneutic phenomenological perspective, is an ongoing, interpretative process shaped by the relational and temporal dynamics of teaching. These reflections also lead me to consider: what qualities truly define an effective teacher? Effective teaching seems to go beyond implementing predefined strategies; it involves navigating the unpredictability of classroom life while fostering student engagement and learning. Bridging these theoretical insights with the unpredictability of my real classroom underscores the importance of professional noticing and my ability to humanize mathematics by connecting abstract concepts to my students’ lived experiences.

Such gaps highlight the urgent need to humanize mathematics education further, enabling teachers to connect abstract concepts with students’ lived experiences in ways that are deeply meaningful and transformative. In the following sections, I discuss humanizing mathematics and

explore the role of emotions in teaching and learning. This discussion builds on the recognition that while static knowledge frameworks offer valuable foundations, they fall short of addressing the interpretative and relational dimensions of teaching. By situating teachable moments within the broader context of teacher knowledge, I aim to illuminate how teachers can navigate the unpredictable, emotionally charged, and relational aspects of moment-to-moment teaching to create meaningful learning experiences.

### **The Role of Emotion, Beliefs, and Self-Efficacy in Effective Mathematics Teaching**

In exploring the intricate relationships between emotions, self-efficacy, beliefs, and effective mathematics teaching, it becomes clear that these elements are deeply interwoven and mutually influential. As Arthur Combs (1999) pointed out, what an individual believes about themselves is often a fundamental factor in their educational success or failure. This notion aligns with Carl Rogers's (1951, 1959, 1961) humanistic perspective, which posited that personal growth and self-actualization occur when individuals feel empowered to pursue their goals in an environment that offers genuineness, acceptance, and empathy. Such an environment allows individuals to develop a sense of congruence between their self-concept and their ideal self, which is pivotal for emotional growth and academic achievement.

In the context of teaching and learning, emotions encompass feelings such as joy, frustration, anxiety, and confidence that arise from the interaction between individuals and their environment (Burton, 2004). Emotions, particularly those related to self-worth, self-image, and self-efficacy, play a crucial role in shaping this developmental process. In mathematics, learners' and teachers' emotions profoundly impact both teaching and learning outcomes. Previous experiences with the subject deeply influence individuals' emotional responses, which in turn affect their cognitive processing and overall performance. As Sylwester (1994) emphasized,

managing emotions is essential for creating a conducive learning environment in mathematics, advocating for non-judgmental, non-disruptive ways of expressing feelings. Cernajeva (2012) and Doxiadis (2003) further proposed that humanizing mathematics through storytelling allows individuals to connect with the subject emotionally, transforming it from a purely logical discipline into an experience filled with personal meaning and emotional resonance.

The role of emotions in learning and teaching mathematics extends beyond the classroom atmosphere. Researchers have suggested that classroom environments should foster discussions, teamwork, and an openness to errors, creating a space where learners feel safe to ask questions and make mistakes. Such a nurturing environment helps students build a more robust understanding of mathematical concepts while also enhancing their emotional connection to the subject (Burton, 2004; Toor, 2011). Emphasizing effort over grades, encouraging autonomy, and addressing misconceptions are also key strategies for building self-efficacy and fostering positive emotional experiences in mathematics (Stipek et al., 2001).

The connection between emotions and cognitive functions in mathematics is also central to understanding how individuals engage with the subject. As Zan et al. (2006) noted, emotions can influence cognitive processes like attention and memory, making them essential for problem-solving and long-term retention of mathematical knowledge. Damasio (1999) further clarified that emotions are not merely peripheral to cognition but play an integral role in helping individuals process and store information. The ability to make emotional connections with mathematical concepts can significantly enhance learning outcomes (May & Fray, 2010; Schukajlow et al., 2012). Without this emotional engagement, individuals struggle to retain information or apply it meaningfully, as emphasized by McGeehan (2001), who highlighted the importance of emotional hooks in the learning process.

This emotional-cognitive connection is foundational in the study of self-efficacy, particularly in mathematics. Bandura's (1986, 1993) social cognitive theory asserts that individuals' beliefs about their own capabilities—self-efficacy—determine how they approach tasks and challenges. In mathematics education, both learners' and teachers' self-efficacy beliefs shape their attitudes and behaviours, which directly impact their performance and interactions within the classroom. Educators with high self-efficacy are more likely to create positive learning environments and employ strategies that foster student success. Similarly, students who believe in their mathematical abilities are more likely to persist in solving problems and engage deeply with the content.

The emotional aspects of teaching also intertwine with teachers' personal beliefs about the discipline and their role in shaping students' learning experiences. Teachers' beliefs about their subject matter and their students influence their instructional decisions and teaching strategies (Loewenberg Ball, 2000; Pajares, 1992). These beliefs are not only based on pedagogical knowledge but also on emotional connections formed through their own experiences as learners. Teachers often carry guiding images of what teaching should look like, shaped by their past experiences and beliefs about how students learn (Goodman, 1988). These beliefs influence how they approach teaching mathematics and, consequently, how they shape students' emotions and beliefs about the subject.

Furthermore, as Pajares (1992) argued, teachers' personal beliefs about mathematics and teaching can significantly affect their classroom behaviour. For instance, teachers who view mathematics as a rigid, error-free discipline may discourage students from taking risks or engaging with the material emotionally. In contrast, teachers who recognize the value of emotional engagement with mathematics are more likely to foster an atmosphere where students feel comfortable making mistakes and learning from them, thus building their self-efficacy.

In line with these findings, Bandura (1993) emphasized that self-efficacy is central to both cognitive development and academic success. Educators who believe in their ability to support students' learning foster environments that encourage mathematical growth. When teachers are emotionally attuned to their students' needs and beliefs, they can better motivate them to engage with challenging mathematical concepts and build the confidence required to succeed.

The interplay between emotions, self-efficacy, and beliefs in the mathematics classroom points to the importance of adopting a more holistic approach to teaching. As the literature suggests, emotional engagement is not only crucial for student success but is also a key factor in shaping how both students and teachers perceive their roles in the learning process. By acknowledging the emotional dimensions of teaching and learning mathematics, educators can create more effective and supportive environments that enhance both cognitive and emotional development, fostering success for all learners.

According to Lewis (1990), the foundation of all knowledge is rooted in one's beliefs, with ways of knowing intertwined with choosing values. This perspective aligns with the notion that beliefs are a key determinant of instructional decisions, as evidenced in Brown and Cooney's (1982) study on how mathematics teachers learn to teach. Their research revealed that pre-service teachers' beliefs about mathematics significantly influenced their teaching practices, often inhibiting their ability to apply learned pedagogical knowledge. This limitation stemmed from a disconnect between their cognitive understanding of mathematics and the emotional engagement necessary to teach it effectively. Without an emotional connection to their knowledge, these pre-service teachers struggled to translate theory into practice.

The relationship between emotions, beliefs, and self-efficacy is further illuminated by Calderhead and Robson (1991), who argued that pre-service teachers' images of teaching—

shaped by their experiences as students—profoundly impact how they interpret instructional strategies and implement them in practice. These images often guide teachers' choices, but they may not necessarily align with approaches that meet the emotional demands of effective mathematics teaching. This disconnect underscores the importance of addressing emotional factors in teacher preparation programs, as self-efficacy and emotional resilience are critical for navigating the complexities of teaching mathematics.

Emotions play a pivotal role in shaping teachers' beliefs, efficacy, and instructional decisions. Kort et al. (2001) highlighted that mathematics instruction often presents material in a polished manner, omitting the natural process of learning from failure. This omission neglects the emotional experiences—confusion, frustration, recovery, and perseverance—that are essential to authentic learning. By failing to model and teach the emotional rigor of “doing” mathematics, teachers inadvertently convey that emotions associated with failure are barriers rather than stepping stones to deeper understanding. May and Fray (2010) emphasized the need for mathematics educators to intentionally incorporate emotional experiences into their teaching, as doing so fosters a growth mindset and equips students to manage the emotional challenges inherent in mathematical problem-solving.

The literature collectively underscores the interplay between emotions, self-efficacy, and beliefs in effective mathematics teaching. Emotional engagement enhances teachers' ability to connect with their content and their students, fostering a classroom environment where both teacher and learner can navigate the emotional and intellectual challenges of mathematics. By recognizing and addressing the emotional dimensions of teaching and learning, educators can bridge the gap between knowing about and knowing to act, transforming mathematical instruction into a holistic, humanizing experience.



However, despite the extensive exploration of the roles of emotion, beliefs, and self-efficacy in mathematics teaching, a notable gap exists in examining moment-to-moment lived experiences of teachers as they navigate these dimensions in real-time classroom settings. The existing literature primarily focuses on broader conceptual frameworks and generalized practices, such as fostering emotional resilience, building self-efficacy, and aligning beliefs with pedagogical strategies. However, the intricate, nuanced processes by which teachers *notice*, *interpret*, and *respond* to teachable moments—where emotions, self-efficacy, and beliefs intersect—remain underexplored.

### **Teachable Moments**

From a hermeneutical phenomenological perspective, the exploration of teachable moments is deeply intertwined with how educators interpret and make meaning of the lived realities of teaching. This approach emphasizes that understanding the literature involves not only cataloging ideas but also contextualizing them within one's own experiences and perceptions, revealing layers of meaning that emerge from the dynamic interplay between theory and practice.

As a junior/intermediate mathematics teacher, I often engage in a deeply interpretive process to make sense of moment-to-moment teaching and the elusive concept of the teachable moment. These experiences compel me to reflect and reinterpret my role in the classroom as I navigate the complexities of teaching. My understanding of these moments continues to evolve through the interwoven narratives of my professional journey and the unique challenges of mathematics education.

John Dewey's conception of education as a medium for fostering intellectual and practical capacities resonates profoundly with my understanding of teaching. Dewey's emphasis

on creating environments that nurture intellectual diversity and adaptability aligns with the dynamic and often unpredictable nature of classrooms (Danforth, 2008). When Havighurst (1953) introduced the concept of teachable moments, describing them as tasks learned at opportune times, it became clear that teaching requires a profound sensitivity to these critical points—an attunement that emerges through lived experience and reflective practice.

In my teaching journey, I have encountered moments that defy planning yet hold transformative potential. Neubert's (2008) definition of teachable moments as "occasions, means, resources, and situations of constructive exchange" (p. 5) resonates deeply. These are not static opportunities; they emerge as fluid interactions where cognitive and emotional energies intersect. Reflecting on Pacifici and Garrison's (2004) description of teachable moments as spaces where doubt and inquiry converge, I interpret these moments as shared vulnerabilities between teacher and student, where authentic engagement transcends traditional pedagogical boundaries.

The preconditions outlined by Neubert (2008) offer practical guidance. First, being attentive to the multiplicity of learners' contexts resonates with my belief in embracing cultural and individual diversity. Understanding students' lived histories and interests provides a richer lens through which to interpret their needs. Second, cultivating openness to learners' authenticity reinforces my own growth as an educator. As Dewey (1988) emphasized, learning is an individual approach to a shared world. This perspective challenges me to reinterpret my role as a co-participant in students' learning journeys rather than as a mere transmitter of knowledge.

The unpredictable nature of teachable moments is a theme echoed throughout the literature. Mason (2002, 2015) and others highlight the difficulty in predicting when and how these moments will arise. My own experiences corroborate this: a spontaneous student question or an unexpected observation often opens up new dimensions of understanding. Reflecting on

Rowland and Zazkis's (2013) framework for contingent teaching, I see flexibility as a form of interpretive engagement—a willingness to reshape the narrative of the lesson in response to emerging insights. Ignoring or sidelining a student's contribution risks losing opportunities for deeper engagement. Instead, acknowledging and incorporating these contributions fosters a richer classroom dialogue, as supported by Stockero et al. (2017).

Mason's (2015) identification of various forms of unexpectedness—mathematical, pedagogical, and more—invites me to consider the interplay of these dimensions in my practice. Mathematical unexpectedness, for instance, often challenges my students and me to reframe problems and explore alternative solutions. These moments reveal the relational and dynamic aspects of mathematical reasoning, often rooted in personal relevance. Mason's observation that connections between disparate topics often spark moments of clarity resonates with my experience of interpreting these connections as transformative insights. These moments enhance both comprehension and appreciation, as supported by Fry and Hillman (2018).

Movshovits-Hadar (1988) emphasized that every mathematical problem contains an element of surprise, which can be used to foster curiosity and engagement in students. I interpret this as a call to design tasks that invite students to confront the unexpected, engaging their sense of wonder and enabling them to construct new meanings through these moments of revelation.

Behavioural, affective, and attentional unexpectedness also feature prominently in my classroom experiences. When students appear disengaged or confused, I am reminded of van Es and Sherin's (2021) call to expand the dimensions of noticing. Recognizing these subtle cues requires a heightened sensitivity to the classroom's emotional and intellectual climate. Similarly, institutional unexpectedness, such as unexpected inspections or assessments, tests my ability to maintain composure and adaptability—a skill Choy and Dindyal (2020) emphasize in their work on teacher preparedness.

Blömeke et al. (2022) argued that the development of professional noticing skills occurs along a continuum, where reflective practice plays a central role. I interpret this continuum as a developmental trajectory, where novice teachers grapple with the unpredictability of classroom events while experienced teachers draw upon rich past experiences to reframe and reinterpret these moments with greater fluidity.

The emotional dimension of teaching, as highlighted by Mandler (1989) and others, cannot be ignored. I have often felt the physical and emotional impact of unexpected classroom moments, from increased heart rate to a sense of frustration. Managing these responses, as Hoth et al. (2022) suggest, requires both interpretive awareness and reflective practice. These experiences underscore the importance of transforming emotional reactions into constructive insights, enabling me to engage more fully with the lived realities of teaching.

Wallin and Amador (2019) noted that video-based reflection can help teachers analyze their responses to unexpected moments, enabling them to refine their noticing practices. Incorporating such reflective tools into professional development programs offers a means of exploring and reinterpreting the narratives of teaching.

Mason and Spence's (2000) notion of "knowing to act" resonates deeply with my own teaching philosophy. They argue that awareness in the moment—distinct from other forms of knowledge—is essential for effective teaching. I interpret this as the ability to "read" the moment through a lens of attentiveness, reflection, and readiness. My experiences affirm this idea: moments of "freezing" or defaulting to routine actions often stem from a lack of attunement to the present. As Mason (2015) observes, seeing unexpectedness as an opportunity rather than an obstacle is a mindset cultivated through reflective and interpretive practices.

Santagata et al. (2021) emphasized that expanding teachers' repertoires of noticing practices enables them to make adaptive instructional choices during moments of

unexpectedness. This aligns with Sánchez-Matamoros et al. (2019), who demonstrated that interpreting students' reasoning is a crucial aspect of professional noticing that impacts classroom interactions. I see these moments as invitations to reinterpret both the content and the context of learning, creating a richer narrative of shared understanding.

The intersection of action, feeling, and thought, as articulated by Mason (2015), provides a holistic framework for understanding teachable moments. This perspective aligns with my own approach to teaching, which integrates cognitive, emotional, and situational factors. By collecting and reflecting on my own and others' experiences, I aim to develop a richer understanding of how to recognize and utilize these moments effectively. Stories of lived experiences, as Kaiser et al. (2015) suggest, serve as valuable resources for learning and growth.

Despite these insights, there remains a significant gap in understanding the lived experiences of teachers during teachable moments. While theoretical frameworks exist, little research focuses on how teachers personally navigate and interpret these moments in real time. This gap is particularly pronounced in mathematics education, where challenges like fostering conceptual understanding and addressing unexpected contributions require unique pedagogical approaches. Furthermore, there is limited exploration of how cultural and contextual factors shape teachers' responses to teachable moments, especially for educators from diverse backgrounds.

As a Junior/Intermediate mathematics teacher, understanding how to notice, reflect on, and act during teachable moments remains a personal and professional journey that aligns with the broader need for research into these lived experiences. From my perspective, recognizing teachable moments involves more than identifying opportunities for instruction. It requires an openness to alternative actions, a readiness to engage with the unexpected, and a commitment to

reflective practice. My cultural background, which emphasizes holistic understanding, further informs this approach. By viewing students as whole individuals, I strive to create learning experiences that resonate deeply and foster lasting growth. Ultimately, the hermeneutical phenomenological lens reveals that teachable moments are as much about the teacher's self-awareness and interpretation as they are about students' readiness to learn.

In this sense, there is a clear distinction between an act coming-to-action, an emotion coming-to-feeling, and a thought coming-to-intellect. As Mason (2015) stated: "In order to comprehend and appreciate what happens when something unexpected happens in the classroom, I suggest that it is necessary to distinguish these different [action, feeling, and thought] sources" (p. 121). This multidimensional view of classroom interactions is aligned with findings by Kaiser et al. (2015), which reveal the complexities of teachers' professional noticing skills and their integration of cognitive, emotional, and situational factors. For me, acknowledging these different sources means collecting my experiences in the form of stories—crafted stories that narrate others' lived experiences with teachable moments. Looking at my teaching experiences of trying to make math meaningful for my students, when in the moment I did not know how to guide their thinking, curiosity, or learning, I wonder what the process of "acting freshly rather than habitually" and of adopting alternative actions looks like. In other words: what is it like for mathematics teachers to experience teachable moments? This interplay of awareness, reflection, and action forms the foundation of effective teaching, allowing educators to transform the ordinary into the extraordinary.

### **Summary of the Literature Review**

As I engaged with the literature, I found myself drawn into the dynamic interplay between what is known about teaching and the lived realities of teaching itself. Traditional lenses

of teacher knowledge—content knowledge, pedagogical knowledge, pedagogical content knowledge, curriculum knowledge, and knowledge of students—initially seemed comprehensive. Yet, as I reflected on my own experiences, I began to see their limitations. While foundational, these perspectives often fail to account for the interpretive and relational aspects of teaching—the moments that demand more than planned strategies or static knowledge. This realization deepened my curiosity and guided my exploration of teachable moments, especially as they relate to the broader phenomenon of what teachers truly need to be effective in their roles.

Drawing on my personal journey as a Junior/Intermediate mathematics teacher, I approached the literature not just as a source of information but as a lens to make sense of my experiences. Much of my teacher training emphasized tools and strategies that could be transferred across contexts. However, as I sifted through these interpretations, I recognized a gap: what these lenses lacked was an acknowledgment of the unpredictability and human complexity of teaching. It is in those unscripted, relational moments that I have often felt the most challenged yet the most fulfilled as a teacher. These teachable moments, I came to realize, were often the most transformative in both my practice and my students' learning. This personal reflection became the foundation for how I interpreted the literature and raised a critical question: What do teachers need—not just in theory, but in lived practice—to be truly effective?

One concept that resonated deeply with me was Mason's (2015) idea of knowing to *act-in* the moment. As I read about this interpretive perspective, I found myself nodding along, recognizing how it mirrored the embodied awareness I rely on during spontaneous classroom interactions. Mason's perspective challenged me to think beyond static understandings and instead focus on the interpretive, intuitive, and emotional dimensions of teaching. Through this lens, I began to see teaching as an art that requires being fully present, attuned to the moment,

and ready to respond in ways that are both thoughtful and relational. Yet, as I reflected on this, I was left with important questions: How do teachers come to recognize these teachable moments? What does it feel like to notice and act in these situations? How does this awareness evolve over time? And, more broadly, how can teachers develop the capacity for such responsiveness, which seems essential to their effectiveness?

As I continued to explore the literature, Bishop's (1998) concept of humanizing mathematics struck a chord with me. I recalled moments in my own practice where students seemed disengaged from the subject, despite my efforts to design rich, challenging tasks. This disconnection led me to question how mathematics could be made more relevant to their lives. Bishop's work helped me make sense of my instinct to integrate real-world examples into my teaching—a move that often sparked deeper engagement from my students. However, this reflection also illuminated another gap: while connecting students to mathematics through real-world contexts was valuable, it did not fully address the immediate, relational challenges I encountered when guiding their thinking in real-time. This realization further underscored the complexity of what teachers need to navigate the multifaceted demands of effective teaching.

Emotion emerged as a recurring theme in my readings, and it resonated deeply with my personal experiences. I began to see how my own emotional states—whether moments of frustration, joy, or uncertainty—shaped my interactions with students. The literature confirmed that emotions are not peripheral to teaching but central to recognizing and responding to teachable moments. This realization helped me make sense of my own teaching journey, particularly those instances where emotional connection seemed to unlock deeper, transformative learning for both myself and my students. It also highlighted how emotional attunement and relational awareness are critical elements of what teachers need to be effective.



Engaging with the literature through a hermeneutical lens also made me more aware of my own assumptions and preunderstandings as a researcher. I noticed how my personal experiences influenced the way I interpreted the texts, often seeing them as mirrors or provocations for my reflections. This awareness allowed me to critically examine my biases, ensuring that my inquiry remained open and grounded in the richness of the lived experiences I sought to explore.

Ultimately, this review became more than an academic exercise—it became a dialogue between my lived experiences and the broader scholarly discourse. Through this process, I identified significant gaps, particularly in how the literature addresses the moment-to-moment realities of teaching mathematics. These gaps reaffirmed the importance of my research question: What is it like for K–12 mathematics teachers to experience teachable moments? This realization underscored for me that these moments are not merely incidental challenges; they are profound and transformative opportunities to reimagine teaching as an interpretive, relational, and deeply human practice.

### CHAPTER 3: METHODOLOGY

The method utilized in research centers upon a strategy of inquiry, moving from the underlying assumptions to research design and data collection (Myers, 2009). Phenomenological research involves two types of inquiry: empirical and reflective. *Empirical inquiry* aims to explore the range and varieties of pre-reflective experiential material that is appropriate for the phenomenon under study. *Reflective inquiry* aims to interpret the aspects of meaning or meaningfulness that are associated with the phenomenon. There's a distinction, too, between methodology and methods (empirical and reflective methods): *methodology* corresponds to a philosophical or general attitude, while *methods* refer more to procedural methods or activities that the researcher may employ in particular investigations. Polkinghorne (1983) believed in the use of the term methodology rather than method to describe the use of hermeneutic phenomenology. A methodology thus is not a correct method to follow but, rather, a creative approach to understand particular questions and subject matter. According to Madison (1988), the notion of method motivates the researcher on exact knowledge and procedure, whereas methodology gives room for the reflective practices and judgment that is responsible for principles rather than rules to guide the research process. Hermeneutic phenomenology, then, is an ongoing, intuitive, dialectical approach that challenges predetermined rules and research procedures, thereby freeing a researcher from the dichotomous "right" and "wrong" ways of conducting research (Crowther et al., 2016). According to van Manen (1990), this use of methodology requires the ability to be reflective, insightful, sensitive to language, and constantly open to experience.

According to van Manen (1990), "[p]henomenology describes how one orients to lived experience, hermeneutics describes how one interprets the 'texts' of life, and semiotics is used

here to develop a practical writing or linguistic approach” (p. 4). The *texts of life* are the unspoken meanings, which are gathered in and through one’s personal experience (e.g., teachable moments). Here, it is necessary to point out that individuals’ clarification can increase their thoughtfulness and practical resourcefulness, only if they engage with the criteria that enable them to transcend the egotism of them believing that *what* they think and do is what they *should* think and do. The aim of a phenomenological researcher is to be a rationalist—where the focus is on becoming more aware of human nature through the study of lived experiences. In the case of this research, the focus is then on *who I am as a teacher through the study of teachable moments*. According to van Manen (1990), “to be a rationalist is to believe in the possibility of understanding the world by maintaining a thoughtful and conversational relation with the world” (p. 16). van Manen (1990) noted that “a research method is only a way of investigating certain kinds of questions. The questions themselves and the way one understands the questions are the important starting points, not the method as such” (p. 1). Hermeneutic phenomenology as a methodological approach is about how one attunes to, questions, and thinks in and through evolving methods rather than being bounded by structured stages of a method (Crowther et al., 2016).

Further, according to van Manen (1990, 1997, 2016), research data in hermeneutic phenomenology is generated through a number of sources, including: gathering descriptions of lived experiences from those who either live or have lived through an experience of the phenomenon being investigated; conducting intensive case studies; constructing anecdotal accounts from one’s own life experiences; consulting other phenomenological writings as insight cultivators; and utilizing experiential materials from different sources so as to increase the depth of understanding. In this study, the data was generated from constructing anecdotal accounts

from my own life experiences with teachable moments (e.g., the personal story outlined in this paper's introduction section) and by gathering stories of others' lived experiences with teachable moments.

Reflecting on my life, particularly my academic and personal experiences, I've always felt a deep curiosity about the nature of lived experiences and what it means to undergo certain pivotal moments. As van Manen (1990) suggested, "the way in which one articulates certain questions has something to do with the research method that one tends to identify with. So there exists a certain dialectic between question and method" (p. 2). This insight resonated with me, as I considered my own questions about the phenomenon of teachable moments—not just as a teacher, but as someone who has been a child, learning from my parents and grandparents. This connection between my experiences and the questions I pose aligned well with hermeneutic phenomenology, a method that feels intuitive and deeply suited to my approach.

In my research on teachable moments within mathematics education, then, I adopted an interpretive paradigm, using hermeneutic phenomenology to explore teachers' lived experiences. This approach reflected my belief that reality is not singular or objective but, rather, constructed individually—a notion that makes qualitative methods ideal for capturing the diverse perspectives teachers hold. By using hermeneutic phenomenology, I aimed to understand teachable moments as they organically arise, allowing for interpretation rather than confining understanding within rigid theoretical boundaries. This perspective supported an exploration of teachers' subjective experiences, honouring the unique contexts and socio-historical influences that shaped their understanding. In this study, I adopt a pragmatic approach to hermeneutic phenomenology, leveraging its flexibility to explore the lived experiences central to my research. Instead of adhering rigidly to philosophical ideals or prescribed methodologies, I employ

hermeneutic phenomenology as a dynamic tool that balances philosophical depth with methodological adaptability. This enables me to interpret the meaning of lived experiences while remaining attuned to the unique cultural, relational, and temporal contexts of my participants and the phenomenon under study.

Positioned as both a researcher and a classroom teacher, I bring a personal understanding of the nuances involved in teaching and learning. My own journey through education—first as a student, then as a teacher, and now as a researcher—deepened my commitment to exploring these moments that often arise spontaneously and carry profound meaning. My research avoided imposing predefined categories; instead, it favoured a reflective and iterative process that aimed to uncover the essence of teachable moments. Grounded in an interpretive understanding, my study sought to reveal how teachers perceive, interpret, and respond to these moments, recognizing teaching as a deeply human practice filled with complex layers of meaning. In the following section, I outline the methods of data collection that I used for this research study

### **Constructing Anecdotal Accounts From My Own Life Experiences**

My research question on teachable moments stemmed from my own lived experiences. My interpretation of these lived experiences was not bound by space (in class or out of class) and was influenced by my identity (Indian, Punjabi, teacher, learner, woman, child, girl, immigrant, etc.). Given this, it became possible for me to truly question teachable moments and bring about such an interpretation. If the question comes from the heart of our existence (which is the core of our experiences) or if we are animated by the question in the very life we live with children (van Manen, 1990), this brings about the need for a closer look at others' experiences, too. Here, questions arise. If my interpretation of my lived experiences can be part of understanding others' lived experiences, then when and where do I include my experiences in my research? How do I

take into consideration the fluidity of my lived experiences? How do I bracket my experiences from my research, when my research questions are rooted in my personal experiences? With these questions in mind, I further explored the literature on phenomenology.

van Manen (1991) considered phenomenology as the most appropriate method to study the phenomenon of pedagogical significance, which elaborates phenomenology as a response to how one orients to lived experience and questions the way one experiences the world. van Manen (1990) stated that “a phenomenological researcher cannot just have a question—he or she must live it” and that

lived experience is the starting point and end point of phenomenological research. The aim of phenomenology 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 reflexive 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. (p. 36)

Because lived experience is both the starting point and ending point of phenomenological research, a true phenomenological questioning is not possible until researchers display their interest in the phenomenon as lived. van Manen (1990) stated that

the questions of knowledge always refer us back to our world, our lives, to who we are, and to what makes us write, and read, and talk as educators: it is what stands ironically behind the words, the speaking and the language. (p. 46)

According to Morse (2015), in hermeneutic phenomenology research, data may originate from researchers’ own experiences. A hermeneutical approach asks for researchers to engage in a process of self-reflection in which their biases and assumptions are not bracketed or put aside but, instead, are embedded as an essential aspect of the interpretive process (Crowther et al.,

2016). Hermeneutic phenomenologists thus find themselves in the middle of a murky existential experience, which researchers can overcome by using data in a way that reveals what caught their attention in the first place and provoked further thinking. Here, it is important to point out that the intention in hermeneutic phenomenology is not to provide a definitive description of experience or a final interpretation; rather, it points to the meaningful possibilities that surface from stories of those experiences related to the phenomena (Crowther et al., 2016). With this in mind, I began this proposal by telling a story of my teaching which illuminated what caught my attention in teaching and provoked me to further think about the teachable moments in class, and now, I present another story here for that same purpose.

\* \* \*

### **My Second Story: Dimensions of Teaching**

During one of my lessons on geometry with my Grade 6 students, I was showing three-dimensional objects to my students. The purpose of the lesson was to help students understand the relationship between an object and its net. While using real-life examples like chocolates boxes and lunch boxes, I demonstrated for my students (while holding a three-dimensional object in my hand) that opening up all the sides of the object (box) and laying it flat it will result in a net, and that putting together all the sides of the net will result in a three-dimensional object. Next, as a class, we discussed the characteristics of a net which, upon folding, can result in a three-dimensional object. In addition, we talked about what type of net may not make a three-dimensional object (i.e., missing face in net). After our discussion, students were challenged to create various types of net and then to check what type of three-dimensional object their net would turn into. While students were working, a student asked me, “Ms. Toor, what is a side?” I responded to her by saying, “it is one of the faces of an object.” She asked again, “no Ms. Toor, what is a definition of side? Is a side always straight ... because if it is straight, then why do we

call a side of a road *side* when the road is curvy?” At this point, I knew that she was thinking beyond what I intended to teach. I was aware that without knowing about different branches of mathematics, she was talking about the difference between Euclidian and non-Euclidean geometry. Consequently, I knew that she had also become a participant in knowledge creation of mathematics. However, I did not know how to guide her thinking so that she would not be overloaded with differences of Euclidian and non-Euclidean geometry, causing her to become a knowledge consumer of mathematics.

\* \* \*

Reflecting on my experience as a teacher, I found it interesting that my various university qualifications did not prepare me to notice and take up the teachable moments discussed in the two stories presented thus far in this study, even though I repeatedly was encouraged in my pre-service teacher program to plan my lessons with an end goal of becoming an effective mathematics teacher through the creation and implementation of such teachable moments. As a teacher, I continue to reflect on my practices and ask myself: what does it mean to be an effective mathematics teacher? What does it mean to experience teachable moments in the classroom on moment-to-moment bases? What does it mean to teach mathematics? Although I often tried various things in class to resolve these questions, I continually felt that I did not know how to be in the moment. Further, I discovered that even qualified and experienced teachers “temper their practice with the knowledge that we all often fall short and do not know what is best” (van Manen, 1991, p. xii). Few studies focus on the day-to-day, moment-to-moment nature of teaching mathematics. It is clear from my teaching experiences that further research is needed to identify how decisions are made, then, during the moment-to-moment teaching of mathematics.

The following section presents my research methodology in terms of collecting,



describing, and reflecting on others' lived experiences of teachable moments. In this study, for the purpose of collecting, describing, and reflecting on others' lived experiences on teachable moments, I have presented and discussed two types of stories. First, there are participants' stories, which are the stories they tell by answering interview questions. Second, there are stories crafted by the researcher after delving into participants' stories to understand the phenomenon. From the crafted stories come the themes, which will help in understanding the teachable moments and help investigate the research question of my study: What are the lived experiences of K–12 teachers teachable moments teaching mathematics? More specifically: What is it like for K–12 teachers teaching mathematics to experiences teachable moments? How is it like for these teachers to notice teachable moments? In what ways do these teachers take up the teachable moments?

### **Collecting and Describing Others' Lived Experiences**

In hermeneutic phenomenology, there is always the tension between the practical methods of gathering and reporting data and the ontological orientation. This tension is seen in conflicting views on the notion of “story” in relation to the analysis of verbatim data derived from this ontological rather than epistemological or ethnographical orientation. Here, stories are referred to as *speech events* which are gathered in interviews for the purpose of collecting and analyzing data to uncover the phenomenon—that is, in this study, teachable moments.

When it comes to a given event or phenomenon, it is assumed that individuals may experience it in unique and individual ways; however, a story always brings a multi-perspectival wholeness with the possibility that may exceed, yet include, individualized or specific details. In other words, “a story” is always a paradoxical play of the many and the individual (Nancy, 2000). Hermeneutic phenomenology accepts that phenomena are never fully concealed or

unconcealed to anyone (i.e., the researchers, the participants, or the readers). The hermeneutics orientation is not about forming a hierarchy of truths, where one version of the truth is taken as more significant than another. Gadamer (1997) spoke of a *thematic pluviosity/polygema* or multiplicity of meanings in a story. Thus, each story of an individual can be understood as holding multiple meanings while further uncovering a phenomenon.

According to Crowther et al. (2016), “[n]o one telling or listening of a story by any one person will ever reveal all there is to know about a phenomenon and claim to provide the whole ‘Truth’” (p. 4). This is because, as hermeneutic phenomenology acknowledges, individuals (participants, researchers, and readers) are always in relationship to others and therefore, every story involves two or more others (Gadamer, 1960/1975; Ricoeur, 1988, 2005); in other words, here, the story refers to collective individual experiences. Stories provide a sense of continuity and unity in shared human experience which involves relations with others, places, as well as times (Eberhardt, 1996). Additionally, according to Derrida (1972/2004), a story is always larger than the sum of its differing vantage points. That is, “[a] story is living and changing with an abundance of interpretation that requires openness to possibility. The story has interchangeable meanings that speak (and remain silent), that ebb and flow over time, and in different contexts with different listeners” (Crowther et al., 2016, p. 3).

The descriptions of others’ lived experiences, in a hermeneutic phenomenological research context, warrant the use of crafted stories that are supported by the philosophical underpinnings of hermeneutic phenomenological methodology and its purpose. This section of the study has highlighted that the crafting of stories encompasses two overlapping, yet distinct, undertakings: the method of crafting the story (the “how to”) in the practical sense, and the ontological sense of “attunement to” the crafting of story. In hermeneutic phenomenological

research methodology, crafted stories are extracts taken from verbatim data provided by participants during interviews. In this sense, crafted stories as a methodological device in hermeneutic phenomenological research gives testimony to past events and experiences (Crowther et al., 2016). In other words, these crafted stories communicate the way one makes sense of events and relationships, both with oneself and with others.

Through a story, one encounters oneself in dialogue and experiences oneself in different ways. In this sense, crafted stories from verbatim data are part of the interpretive analysis (Zambas, 2016) and not a separate undertaking. As Gadamer (1976) explained, “we are at once interpreting and making the story our own; understanding a story is to ‘always and already’ understand and recognize ourselves within it” (p. x).

The collection of verbatim data consists of open-ended and in-depth conversational interviews with research participants, and/or the participants’ own written experiential accounts. The aim of an interview is to obtain detailed first-person accounts of the lived experience of the phenomenon under investigation. Interviewing research participants requires skill, practice, and good luck, where the researcher must be willing to relate with the participants in a way that allows them to speak freely and confidently about their experience. The questions, statements, and summaries used by the researcher are designed to elicit specific and detailed descriptions (Pollio et al., 1997). Additionally, the researcher mindfully guards against influencing the interview in the direction the researcher may either have seen, heard, read, imagined, or thought about the phenomenon. Instead, the researcher delicately and tactfully practices thoughtfulness in the choice of reminiscent questions and statements to help participants share their experiential description with the researcher as faithfully and closely as possible to the original experience related to the phenomenon. Researchers must immerse themselves in the participants’ experiential description to get a sense of what it would be to have such an experience.

Crowther et al. (2016) advised researchers involved in hermeneutic phenomenological research to enter the interview space assuming that the story shared by study participants is an account of the researchers' understanding of participants' experience, acknowledging that the whole story will never be told or heard, as truth is never fully revealed. In other words, amplifying or minimizing thus speak to what is felt as important and understood by the participants to emphasize in any given moment; that is, how the participants choose to "appear" is an integral part of the story. Ultimately, researchers should be aware that they can never fully know participants' thinking nor capture the past exactly as it happened (Koch, 1996, 1998)—and neither can the participants themselves.

When it comes to hermeneutic phenomenological analysis of verbatim data, a researcher needs to embrace and dwell within the data while awaiting glimpses of the phenomenon. In this sense, an attuned researcher takes more than the words in the transcriptions. Researchers involved in this type of research craft rich and meaningful stories which become "allegorical exemplars, using a semantic quality of language that resonates with the reader vividly describing and revealing the nuances of contextualised experience" (Crowther et al., 2016, p. 2).

A well-crafted hermeneutic phenomenological story can reveal ways of being, thinking, and acting in the world that shed light on what is known but covered over, or forgotten. In this sense, crafted stories in hermeneutic phenomenology analysis are provocative and bring powerful means of evoking shared pathic responses (Crowther et al., 2016). Additionally, inherent in hermeneutic phenomenology is the place of the researcher's understandings in the interpretive process. Crafted stories act as a medium for researchers to invite readers to acquire deeper insight and awareness about participants' and researchers' experiences. It is important that researchers pay attention to the way they pose questions and read/hear participants' stories,

as it is integral part of who they are as humans and how they come to understand the world in a dialectic movement.

### **Participants**

Phenomenon determines the methodology of a study, including the type of participants (Groenewald, 2004). Purposeful sampling is the most significant type of sampling in the identification of primary participants for qualitative research. The sample for my study was selected based on my judgment as a researcher and, for the purpose of the research, included participants who have had lived experiences related to the phenomenon under study. Participants in this study were K–12 teachers with experience teaching mathematics.

I invited teachers from my network, such as the Ontario Association for Mathematics Education (OAME), the Canadian Mathematics Education Study Group (CMESG), and other professional circles of K–12 mathematics teachers who I am in contact with. I also made use of snowball sampling to draw additional participants, which is a method of expanding the sample by asking participants to recommend others for interviewing (Groenewald, 2004).

The aim in participant selection in this specific hermeneutic phenomenological research study was to select participants who had the lived experience of teaching mathematics, who were willing to talk about their experience, and who were diverse enough from one another to enhance the possibilities for rich and unique stories of the particular experience—in this case, teachable moments—to emerge (Polkinghorne, 1983; van Manen, 1997). To ensure balance, I selected participants ranging from beginning teachers, mid-career teachers, teachers nearing the end of their career, and teachers who had retired from teaching. This range was intended to capture diverse perspectives and experiences with teachable moments at different stages of a teaching career.

The number of participants necessary for studies of this type varies depending on the nature of the study and the saturation of themes that emerge from the data (Groenewald, 2004). While six participants were included in my study, the selection process was guided by the concept of data saturation—that is, the point that no new insights emerge during data analysis. This diversity in career stages among participants also contributed to ensuring that theme saturation was reached efficiently, as it allowed for a wide range of experiences to be explored within the sample. This approach ensured that the data collected was sufficiently rich and comprehensive for the purposes of this research.

### **Interviews**

Participants were generally asked to describe, in detail, their experience with the topic of teachable moments. The specific question asked was open in nature, with follow-up discussion led more by the participants than by the researcher. Openness is critical, and the exchange may be entirely open, with few direct questions asked (Koch, 1996). The reason for this is to encourage the interview process to stay as close to the lived experience as possible. Geertz (1973) described this process as getting at what participants really experienced, from the inside out, not simulations of what they thought they experienced. Additionally, Sandelowski (1986) suggested that researchers should continue to engage in interviews with participants until they believe they have reached a point of saturation, in which a clearer understanding of the experience will not be found through further discussion with participants. The interview process should take place in a safe and non-judgmental environment that will be established at the outset and maintained throughout. The interaction in the interview should take place within the context of a relationship, which is central to what is ultimately created (Polkinghorne, 1983).

The study used open-ended and in-depth conversational interviews (see Appendix A).

The interview questions emerged from the literature review, as well as through my reflection on the experiences of teaching and collecting my personal stories related to the phenomenon of teachable moments. An invitation letter was sent out by email to various K–12 mathematics teachers whom I knew from my professional network. The purpose of the interview was to obtain an in-depth understanding of mathematics teachers’ experiences at the K–12 level, which in turn, would inform their lived experiences of teachable moments in mathematics. The duration for each interview was approximately 60 minutes, and interviews were conducted using an online platform (Microsoft Teams) at the participants’ preferred time. Ample opportunities were given to each participant to express their lived experiences with teachable moments as they happened. Included in the interview script were prompts, where appropriate, to elicit more specific information from each participant. In addition to this script, I developed and used questions or made spontaneous remarks during the interview to capitalize on the knowledge, experience, or insights of each participant related to the topic of my study. Data collection through interviews continued until the topic was exhausted or saturated; that is, when interviewees cease to introduce new perspectives on the topic. Interview conversations were recorded and transcribed verbatim using Microsoft Teams. Furthermore, within 2 weeks after an interview, each participant was asked to review an exact transcript of their interview for verification purposes (i.e., a *member check*). All participants were given a corresponding 2-week period within which to respond with any inconsistencies they noted. After 2 weeks, it was assumed that the transcribed data was correct.

### **Field Notes and Researcher’s Journal**

Field notes are contemporary notes of observations or conversation taken during the qualitative research process. Depending on the circumstances of the study, I allowed myself to

take some brief notes before, during, and after the interviews, which I could later expand upon.

Given that I am a mathematics teacher just like the participants, as a researcher, my recollection of my experiences as an intermediate mathematics teacher may emerge during the study, such as during data collection and analysis. For this reason, as a researcher, I intended to include my reflections in the final write-up of the study to make my own thoughts explicit. I thus kept a journal as a written record of my own reflections.

### **Describing and Reflecting on Lived Experiences of Teachable Moments**

Data collection and analysis in phenomenology occur more or less concurrently. The aim of hermeneutic phenomenology is to explore in detail how participants make sense of particular lived phenomena (Savin-Baden & Howell Major, 2012)—which, in this study, was K–12 teachers’ lived experiences with teachable moments in mathematics. As a researcher, I was involved in the process of crafting stories from the verbatim data, which required my involvement in the interpretive process while being attuned to the phenomenon of teachable moments in mathematics at the K-12 level. According to Crowther et al. (2016), a researcher immersed in a hermeneutic phenomenology needs to adopt an attitude or stance that considers unfolding and evolving questions. This process encourages researchers to be open-minded by embracing data in emergent ways (Diekelmann & Diekelmann, 2009; Ironside, 2005; Smythe, 2011), while giving room to be surprised by how researchers’ own thinking about a phenomenon transforms over time as the data unfolds (Vagle, 2014; van Manen, 2014).

According to van Manen (1997), once the researcher has gathered participants’ experiences, the researcher strives to transform participants’ accounts into evocative texts, trimmed of all extraneous aspects, such that whatever remains reawakens the readers’ basic experience of the phenomenon being described. Therefore, the phenomenological approach of



working with and reporting data is about keeping an open, questioning stance. In other words, “attuning to a phenomenological stance allows one to become receptive to nuances and changes in the phenomenon of interest as these arise rather than being drawn into prescribed methods and anticipated meanings” (Crowther et al., 2016, p.2). These constructed accounts are referred to as *phenomenological anecdotes*, which according to van Manen (as cited in Crowther et al., 2016), have an evocative capacity to mediate between the particularity of a phenomenon and the generality of its meaning.

Using the anecdotes, I embarked on thematic reflection, while uncovering the essence of participant’s lived experiences with teachable moments. This required me to use my field notes, to go over the interview transcription while staying attuned to the essence of participants’ lived experiences with teachable moments in the crafted story. According to van Manen (1997, pp. 92–93), such thematic reflection can be achieved in three ways: (a) the *holistic or sententious approach*, in which the researcher identifies sentences or phrases that capture the fundamental meaning of the text as a whole; (b) the *selective or highlighting approach*, in which the researcher crafts the participant’s story based on data collected from interview, and selects/highlights statements or phrases that seem particularly essential or revealing to the experience being described; and (c) the *detailed or line-by-line approach*, in which the researcher analyzes each sentence or sentence cluster to establish what they reveal about the experience being described. In this study, I utilized the *selective or highlighting approach*, where I crafted stories of the participants’ lived experiences with teachable moments, based on the transcriptions of the interviews, and selected and highlighted the statements or phrases that seemed essential to the phenomenon of teachable moments.

According to van Manen (2011), to bring the reader closer to the participants’ lived experiences, the researcher must employ the process of methodological reduction with the aim of

re-achieving direct contact with the phenomenon under consideration. Methodological reduction involves bracketing all established investigative techniques and seeking or inventing an approach that seems to fit most appropriately with the phenomenon under investigation. This means that the method of inquiry must be constantly invented anew and cannot be reduced to a general set of strategies or research techniques (van Manen, 2011). The expression that “there is more than one way to skin a cat” holds true for the methodology of phenomenology: it involves the suspension of prejudgments, the bracketing of assumptions, the deconstruction of claims, and the restoration of openness with the aim of getting back to the phenomenon in its original givenness (van Manen, 2011). The ongoing process of data analysis involves “bracketing data into meaningful parts for the purpose of examining them” (Savin-Baden & Howell Major, 2012, p. 434). In this sense, for the current study, the process of bracketing involved identifying and reflecting on my preconceived beliefs and opinions about the phenomenon of teachable moments.

This is why I initially started putting together my proposal for this study by collecting my personal stories (as van Manen suggests) and reflecting on them. Including my story in this chapter serves several purposes: they provide transparency about my positionality, demonstrate how my experiences inform my interpretive lens, and align with hermeneutic phenomenology’s emphasis on the researcher’s involvement in meaning-making. Through this process, I was able to examine how my own experiences informed my understanding of the phenomenon, positioning me to engage with participants’ narratives in a way that was both interpretive and open to new meanings.

While discussing the phenomenological philosophical stance, Savin-Baden and Howell Major (2012) stated:

Understanding is necessarily biased because it is grounded in individual perceptions and

an event or experiences. It is also biased because of the researcher's experience of history and traditions. Indeed, since traditions shape what we are and how we understand the world, the attempt to step outside them would be like trying to step outside of our own skins. (p. 61)

Being mindful of this stance, in my research, I bracketed myself by reflecting upon and recording my ongoing experiences in my research journal. By doing so, I strived to understand and find meaning in the lived experiences of participants while being aware of how my own perspective broadens. As a result, this reflective process not only prepared me to engage meaningfully with participants' narratives but also highlighted the shared complexities and transformative potential of teachable moments.

### **Ethical Considerations**

All procedures and methods in this study were subject to the highest ethical standards established by Brock University's Research Ethics Board (inclusive of the invitation email and consent form in Appendix B and C). During the interview, participants could have felt embarrassed, judged, distressed, or become emotional when reflecting on their experience with mathematical content and pedagogical knowledge. In the consent form for this study, then, I reassured the participants that the interview was not to be seen as evaluative or judgmental, as the study was only interested in their perception of day-to-day, moment-to-moment effective mathematics teaching. Through the consent form, participants became aware that they would not, in any way, be criticized or judged by the researcher. Participants also had the option of letting me know if they wanted to withdraw or take a break during the interview.

The second area that required ethical consideration was the collection and use of the email addresses of the interview participants. On the consent form, and before beginning the

interview, the interview participants were informed that only the supervisor of the study and the researcher would know their email addresses, which would be deleted after completion of the study. In this study, anonymity and confidentiality were addressed very carefully. Although maintaining anonymity during interviews would not be possible, this was not seen as a challenge because the participants willfully volunteered. However, privacy and confidentiality were addressed by using pseudonyms for the names of participants in transcripts, presentations regarding the research, and in all written reports. The use of specific identifying characteristics that could lead to the identification of participants would also be avoided in any reports generated from this research.

### **Chapter Summary**

In this chapter, I articulated the methodological foundation of my study, which explores teachers' lived experiences with teachable moments in mathematics through the lens of hermeneutic phenomenology. Methodology provided the philosophical grounding for understanding the dynamic, interpretive nature of teachable moments, while methods outlined the practical steps for gathering and interpreting participants' lived stories. Hermeneutic phenomenology, with its emphasis on revealing and interpreting meaning within lived experience, offered a framework that embraced the relational, contextual, and evolving nature of teachable moments.

To ground the inquiry, I reflected on my own experiences as a student and teacher, acknowledging how these shaped my connection to the phenomenon. Hermeneutic phenomenology emphasizes the interplay between the researcher's pre-understandings and the phenomenon, situating the researcher as a co-participant in meaning-making. By sharing personal anecdotes, I approached the study with attunement and relational empathy, ensuring the inquiry remained deeply connected to the lived realities of teaching.

To ensure diversity and depth, I used purposeful and snowball sampling to recruit participants from a range of teaching contexts and professional backgrounds. This strategy enabled the inclusion of voices from varied experiences, enriching the interpretive process. Ethical considerations, including confidentiality, informed consent, and the cultivation of a trusting environment, were integral to the study, creating a safe space where participants could share their narratives with openness and authenticity.

For data collection, I conducted semi-structured interviews with K–12 mathematics teachers, inviting them to share storied accounts of their experiences with teachable moments. These semi-structured interviews provided the flexibility to follow participants' reflections while ensuring alignment with the study's purpose. They became spaces for collaborative meaning-making, where participants articulated and reflected on their experiences in their own words. From these conversations, I engaged in crafting storied narratives, preserving the uniqueness and richness of participants' experiences while highlighting the relational, temporal, and emotional dimensions of teachable moments. These narratives were not mere retellings but, rather, were interpretive reconstructions, allowing deeper meanings to emerge.

Throughout the process, I maintained a reflective journal to document my evolving interpretations, emotional responses, and observations as a researcher. This journal became a hermeneutic tool, allowing me to move between the parts (individual narratives) and the whole (thematic patterns) in an iterative engagement with the hermeneutic circle. This reflective practice deepened my understanding of how participants' stories revealed the essence of teachable moments.

In analysis, I used thematic reflection to identify key phrases, moments, and patterns that illuminated the transformative potential of teachable moments. By integrating crafted narratives

with thematic insights, I uncovered themes that revealed the capacity of these moments to challenge assumptions, foster dialogue, and connect mathematical concepts to students' lived experiences.

This chapter established the philosophical, relational, and interpretive foundation for exploring teachable moments as a lived phenomenon. Through crafted narratives and thematic reflection, I sought to illuminate the layered, relational, and transformative essence of these moments. This groundwork leads into the subsequent chapters, where I have presented the emergent themes and insights derived from participants' stories, offering a nuanced understanding of how teachable moments shape and are shaped by the practice of teaching mathematics.

## CHAPTER 4: RESULTS

The prior chapter outlined the study's research methodology, design, study population and sample, data instruments, collection, and analysis procedures. The chapter was guided by the literature review in Chapter 2 and the theoretical framework set forth in Chapter 3. In this chapter, I present findings from the data analysis. The results are presented in two ways. To begin, I share the results from the individual participants' lived experiences in the form of stories crafted from the interviews. Following that, I identify eight emergent themes related to these lived experiences with teachable moments which emerged from my analysis of the aforementioned individual crafted stories.

### **Individual Teachers' Lived Experiences: Crafted Stories**

In this section, I present six crafted stories of participants' experiences with teachable moments. Initially, I provide insights into each participant's background—including their reasons for pursuing a career in math teaching, their educational history, their beliefs about mathematics, and their primary objectives as math educators. Following this, I present crafted stories for each individual, offering a lens into their unique lived experiences with teachable moments. Through these crafted stories, I aim to reveal the depth and richness of their moment-to-moment experiences in teaching mathematics. Crafting a story isn't about fictionalizing their experiences, but rather, intricately intertwining the participants' words, my interpretations as a researcher, and the broader context to craft a narrative that truly represents the essence of their experiences.

#### **Ms. Adam**

Ms. Adam is a Grade 6 teacher, who has been teaching for 5 years. She decided to become a mathematics teacher because she believed there is a different way to teach math other

than just having students memorize formulas (which was her own personal experience with learning math). Ms. Adam believes that math should be taught so that students understand the concept. She stated:

I want them to see there are multiple ways to get to an answer. It's not just my way, it's your way as well. It's how you come to it. So, it's just showing them that flexibility, that there's so many things you can notice and that just be open to it.

She believes that her role as a math teacher is not only to teach math concepts, but to also positively impacts students' attitudes toward mathematics.

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### **Recalling the Moment With Ms. Adam**

I was doing the tutoring for the Grade 6s and 7s at the after-school tutoring program. I was looking at how to convert between percentages to fractions to decimals. I remember trying to show students an example on the board. I was trying to get them to tell me how percentages, fractions, and decimals are related. I realized that Grade 6s, some of them, they're looking at these three concepts, and they don't see that they're related. First off, they think they're separate things. So for me, I am thinking, *what do they mean they are separate?* Everything in math is related. What do they mean that percent, fractions and decimals are separate? It's not separate.

So I thought, *it's about just getting them to see.* What it is this? How to say it? And I'll show them the fraction. I remember I had something like  $14/100$ . And then they said it: they said "14 over 100." I said, "Okay, can you show me that as a decimal?" And they're like, "No, that's a fraction." I realized that these kids are obviously not seeing that they are connected. That's one thing. And then I also realized that maybe their place value knowledge is not where it's supposed to be. So in my head, it was like in that moment, things are clicking for me as it's happening and



I'm realizing, *wait, there's a gap here; wait, there's something*. And it's just happening automatically. I can't even describe it to you. It's like almost as if it's automatic: it's like my brain is on autopilot and I'm not really thinking about my next question. It's just like, *this is happening, this is happening now* and my brain is just saying "do this."

The next thing I did was ask, "Can you tell me what place these numbers are in, on the place value chart?" so we started going through it like that. We looked at the decimal part of the number and I realized they don't know their tenths and hundredths. The way they said it was ones, tens, hundreds. They thought it was a whole number slide. It's like, *no, this is a decimal number. You can't say it like that*. And really what we got out of that lesson was: one, percentages, fractions and decimals are all connected; and two, if you learn how to say a fraction properly or you learn how to say a decimal the right way, like 58 hundredths, you can now write it as a fraction as 58 hundredths ( $58/100$ ). And so when that started clicking, then you're like *oh, they are like, ... they started seeing the relation and they actually start seeing the place values*. That's a big part of it.

But there were gaps that I was seeing that needed to be filled. To me, when I think about a teachable moment, how do we define it? Is it basically just a moment in time where there's an opportunity to change the thinking, or is it that a kid made a mistake and now we're trying to fix it? Is it not possible to go back and still be as effective in fixing this moment? To me, the answer is that you can go back. As teachers, we work with these kids 6 hours a day. We have conversations with them all the time. I don't see why we can't go back. So if I miss a moment, I do go back and I talk to those kids. I began my recalling with them, like, you know, "Yesterday remember, we were talking about this and that, and I noticed this." And then that's when I tried to fix the moment.

For me when I think about moments in classroom, I feel like that last part of what I said—about how there's different types of moments set up, both unexpected and expected—it happens all the time and I feel like there are teachable moments where you can make *anything* a teachable moment. Really. If you wanted to in the 6 hours, there's a gazillion. So, imagine the amount of moments we do miss that we don't come back to that we didn't reflect upon, or even see it as a moment because it was automatic. So, I think there are missed opportunities that you don't even get to go back to because you didn't think of it. You know what I mean? But yeah, that's about, that's about it. That there's all these different teachable moments in some we get some we don't.

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Ms. Adam's story reveals what it was like for her to experience a teachable moment. The story shows that for her, the teachable moment happens in her moment-to-moment interaction and working with her students around mathematics concepts—in this case, about fractions, percentages, and decimals. We see that it was in that moment in her interaction with her students that she realized that students did not understand mathematics, and that there was a gap in students' knowledge that prevented their understanding of the concepts. The story reveals the nature of a teachable moment: the way it happens as a fleeting moment and, yet, with a burst of emotions and energy. This is something we see in Ms. Adam's story when she describes the following:

And then I also realized that maybe their place value knowledge is not where it's supposed to be. So in my head, it was like in that moment, things are clicking for me as it's happening and I'm realizing, *wait, there's a gap here; wait, there's something*. And it's just happening automatically. I can't even describe it to you. It's like almost as if it's

automatic: it's like my brain is on autopilot and I'm not really thinking about my next question.

Even though the teachable moment happens quickly, for Ms. Adam, the teachable moment reveals to her an awareness that calls for action, the knowing to act in the moment as Mason (2015) alludes. She noted, for instance, “[it]’s just like, *this is happening, this is happening now* and my brain is just saying ‘do this.’”

Finally, Ms. Adam’s story reveals that even though the teachable moment happens in a fleeting way and in action, it is not just something that can just be acknowledged and left as is. For Ms. Adam, teachable moments need to be both taken up *and* revisited with students.

### **Ms. Baker**

Ms. Baker has been teaching math for 5 years. Math is not a subject that she initially wanted to teach, as she never viewed herself as a math teacher, which had stemmed from her own schooling experiences as a student. As a student, she experienced traditional ways of learning where she would mimic what the teacher would be doing on the blackboard. Further, as a student, she never identified with any of her teachers, because her teachers were not representatives of her ethnic identity.

Her view of mathematics changed when she was placed in the math classroom during her teacher training. For her, experiencing math was from observing her mentor teacher’s point of view where the teacher made math meaningful, engaging and fun: where she saw students enjoying math. This new experience with math as a pre-service teacher in a classroom inspired her to complete additional qualifications in math and to get involved in working with an instructional math coach on building thinking math classrooms for her current math class. She focused on developing problem-solving skills and critical thinking, with application to real-world

applications. For her, being a math teacher is about helping student to become problem-solvers where they are able to ask critical thinking questions. She wants her students to become brave to take on math challenges without worrying that they're incorrect. By doing this, she believes that she can help students with their math anxiety.

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### **Recalling the Moment With Ms. Baker**

Okay, there are *two moments* that I can think at the top of my head, because they happened this year. Just for some context, I'm teaching French Immersion—Grade 6 this year, and I teach them Math and English, Health and Drama. Furthermore, the kids I'm teaching this year, both of my classes, have been online exclusively for the last two-and-a-half years due to COVID. So, it was quite a different learning environment, or learning space for them to be in class physically. They've been used to seeing the screen for two-and-a-half years, and now, they're physically in a classroom. So, there were a lot of changes being in person for the first time since the pandemic started.

The first moment took place at the beginning of the year. I would say this was kind of like an “ah-ha!” moment, not only for them, but for me as well because it was a new learning experience for me, something I never really considered before. So, we were starting our numbers strand where we were talking about the place values system. We started by reviewing it, and I remember they remembered all the different parts of place values. Then, as I'm listening to some of them read out numbers, I'm noticing that they were putting commas in between their numbers. Every single one of my students was doing this, and I did not know why. It's not something I was used to hearing. They would read the number like “1000, comma 493.” I was like, “Why are you saying ‘comma,’ you're not supposed to?” And again, this is not making any sense to me.

I'm not used to commas. It wasn't one student, it wasn't two students. It was multiple students in the class. I'm like, *Okay, maybe it's just something that they picked up online.* I was like, *I'll come back to this* and I decided to move on just for a little bit. So, we started writing the numbers because they were reading them. So, I'm like, "Look, when I'm writing them, I'm not adding commas." And they're like, "But don't we add a comma?" So that comma thing kept coming back. It wasn't gonna go away because it was different for me. It was different for them. So, we stopped and we Googled.

*Why we don't use commas here in Canada?* Turns out that my kids were being taught by a teacher from Montreal, from a francophone province. Whether you do use commas and their numbers, I didn't know that because we are in Ontario. We just leave a space and we use the decimal point. It was really funny. And that moment, I think, was really enlightening for me, because I was like, *I've never looked at numbers like that my entire life.* But for them, they were taught by the same teacher over the last two-and-a-half years who was using the commas, so they didn't understand why I wasn't using commas anymore. And what was really funny to me is we went on a little walking trip to the shopping center for some financial literacy. There were going, "Look at the prices" and then again, someone said something about "Notice, no commas." So that kept coming back, which was really interesting and it was an amazing learning experience for all of us. We learned about francophone areas of Canada and anglophone areas of Canada and the different ways to write numbers. So, I think that was kind of an "ah-ha!" moment for both of us, which resulted because they had been learning another math from the perspective of another language.

The second moment actually just happened last week, when we were learning about the area formula for a parallelogram. So, I had them sitting in groups of three; I like to do

randomized grouping where when they all come in, I'll click the randomize generator, and they'll notice that they're sitting at a different group. This is my way of having them moving in different spaces of the classroom and sitting with different students. I've been trying to design different classroom configurations, where I am standing on one side or standing at the back, and so on. So, I projected an image of a parallelogram at the front of the class, but I'm standing at the back. They all identified it as parallelogram. At this point, they knew the area of a rectangle and they knew about the triangle, as well, as we reviewed them again. The kids are coming in and they're like, "Parallelogram"—like great, so I say "We know the shape like we know the area of a rectangle. We know the area of a triangle. Take a look at this shape. What other shapes do you see?" I gave them a couple minutes to kind of discuss in their little groups. Now, as I'm going around, I'm hearing things like "Triangles. There's only triangles, there's no other shape." I ask them to split it down the middle and to regroup again and they're sharing the ideas they're coming up with. They're telling me how to split that shape, how to decompose it in different ways. No one thought of the combination that I was thinking in my head. And that was very intentional. But it was very interesting to see the ways of decomposing the shape they were coming up.

And then I hear one student say, "Well, it's just a slanted rectangle" and I am thinking *interesting*. So, I move on, I get little patterning blocks and I put them down. Using the document camera and patterning blocks, I project the image. I'm like, "This is what I see. I see two triangles and I see a rectangle." So, I kind of lay them on top of the parallelogram and they're like, "Oh, we didn't notice that." I'm like, *right*. I'm like, "I'm trying to use the shapes we just learned about to see if they fit in."

And then I'm like, "I'm going to leave this up here, see if you can come up with the area

formula.” And then I even said, “You’re allowed to rearrange the shapes.” They all heard me because they repeated it when I said, “What did I just say?” “You can rearrange it.”

Did any of them rearrange them? Absolutely not. They all went around, dived in. “Okay, area, length times width, you know, I’ve a rectangle, triangle.” They’re coming up with these very innovative formulas, you know, like “Length times width divided by 2” and so on. You know, complicated, elaborate reasoning to support their answers.

And then I’m like, “Okay.” I’m like, “I love, I love the ideas. They’re fantastic.” But I’m like, “You want me to tell you, like, what was that one word I said that you were allowed to do?” And then after a moment of silence later, they said, “Oh, rearrange!” Now they’re rearranging and again, it’s not looking like how I wanted it to look like, but that’s fine. I’m going to get them to explore and understand where that formula comes from. So sure enough, I go up and I just move one triangle over to the other side, that looks like a straight rectangle. They’re like, “Oh my gosh, it was that easy.” I’m like, “Yeah, all it took was that one little move.” Then I said, “What do you think the formula is going to be?” And then after a while, they figured it out. That is that. But it was a great moment for them because they realized where that formula comes from.

Just me giving them the formula would be good, but then I’m doing same as my teachers did. I’m just having them mimic the process and the steps. They’re just plugging in the numbers. But this way, they understand, “Oh, that’s why this formula works” and now they were saying, “Oh, that’s how we did it. Rectangles and triangles first before parallelograms.” Like, “Yeah. So you understand the sequence.” They understand that *everything builds on itself*.

The thing is, though: it was really simple, it was a really simple task and a really simple activity. But the fact that they talked about it several times after a student made an animation

about it, you know, splitting up the parallelogram and moving it like *great, it was clearly impactful enough for you to now understand it*. I definitely wanted them to see these shapes can be decomposed and can be moved around. I didn't want to shut down their ideas because had I just given them the formula, then I'm not having them become critical thinkers, which is what I wanted them to be. I want them to problem-solve. So, I told them "I don't care for wrong answers. That's fine. It's the thinking behind it" because then it all made sense to them. And then they're going back and the little groups are going, "Oh, we could have just done this all along." We did. And now they're discussing their solutions and where their little miscalculations happened – which wouldn't have happened if I just said "Here, today we're doing area for a parallelogram. Here's my formula."

So, I think for me this year, those were my two "ah-ha!" moments. For me, when I think of the topic of teachable moments, I—as someone who didn't have such a positive experience learning math—I think it is a very important topic. I got a lot of anxiety and disinterest in the subject altogether. I think it's important to look at it from not just student's point of view, but also the teacher's point of view. I know several colleagues that are hesitant to teach math because they feel like they're not capable enough.

Even in my conversations with the instructional coach, when we're working on building a thinking classroom, I told her, "I read the book. It's a great book, but am I able to apply this theory into the classroom? That's a whole other element." I feel like they require a lot of time, a lot of energy, really getting to know your kids and being brave to take those risks even as an educator. I think that was something I had to do: while I disliked the subject, it turns out I actually really enjoy teaching it now. So, I think that's why it makes this topic really important.



You know, cherishing those “ah-ha!” moments, I think they’re very important in the classroom because it gets the kids excited, you know, when you’re celebrating their little successes.

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Ms. Baker’s story brings forth her experience of how she experienced teachable moments. The story shows that for her, the teachable moment happens in her moment-to-moment teaching, or during her interactions with her students when she realizes something surprising happens. Her story of two teachable moments revealed that for her, teachable moments happened when she notices her students not doing things as she expected or planned for. For her, teachable moments happened when things happened beyond the outcome she imagined or hoped for. For her first moment, for instance, she said:

Every single one of my students was doing this, and I did not know why. It’s not something I was used to hearing. They would read the number like “1000, comma 493.” I was like, “Why are you saying ‘comma,’ you’re not supposed to?”

Similarly, regarding her second teachable moment, she explained:

Did any of them rearrange them? Absolutely not. They all went around, dived in. “Okay, area, length times width, you know, I’ve a rectangle, triangle.” They’re coming up with these very innovative formulas, you know, like “Length times width divided by 2” and so on.

From her storying both moments, we can see that she planned her lesson to go a certain way but she was surprised by noticing what her students were doing or choosing to do so differently.

Upon continuous self-conversation and dialog with students, she realized the diversity of students (i.e., French Immersion background or their innovative way of looking at the parallelogram) impacted students’ learning of mathematics.

Although in both of the moments in Ms. Baker's story, the teachable moments happened when she was surprised to see how things unfolded in comparison to what she intended her lessons to be, her story still shows her awareness of her moment-to-moment teaching of her lesson that calls for action. For the first moment, Ms. Baker notices her students using commas for place value and calls for actions by engaging in conversation with students and researching about where commas are used and why students were using it. This led her to broaden her own understanding about number representation outside of the English language. For her second moment, she noticed her students not rearranging the shape of the parallelogram to derive its formula, which led her to go to the projector on the board and move a piece physically to initiate the student exploration that was necessary to derive the formula of parallelogram. It is her awareness of the moment-to-moment teaching of her lessons which is what Mason (2015) referred to as *knowing to act in the moment*.

It is interesting to note that Ms. Baker viewed teachable moments in two categories: teachable moments for her as a teacher, and teachable moments for her students:

I would say this was kind of like an "ah-ha!" moment, not only for them, but for me as well because it was a new learning experience for me, something I never really considered before.

Finally, Ms. Baker's story revealed that even though she planned her lesson to go in a certain way, the teachable moment happened in a surprising manner where either the issues of comma placement kept emerging, or students got stuck figuring out the formula for the area of a parallelogram.

For Ms. Baker, teachable moments need to be dealt with by engaging in conversation with students—for instance, about the use of comma for place value or by reminding students, in conversation, about the importance of rearranging shapes to derive a formula for a geometric shape.

**Ms. Carter**

Two contrasting education systems influenced Ms. Carter's entry into teaching. Firstly, in India, she was part of a rigorous, traditional private school setup that emphasized performance through standardized exams from a young age. This environment appreciated repetition but also cherished arts, cultural traditions, and religion. On the other hand, her Canadian education was less competitive and more exploratory. The emphasis here on repetition was reduced, and while facts mattered, the environment nurtured a student's ability to explore. As a result, she transitioned from being a high achiever among other high-achievers in India to a top student in mathematics in Canada. This confidence, and her proficiency in vocabulary and language, solidified her inclination towards the Canadian educational system.

The school environment, coupled with her mother's active involvement in her education, confirmed to Ms. Carter that teaching was the right place for her. Teaching, for her, is a blend of academic, social, and emotional experiences which make the experience fulfilling. She chose to teach mathematics because of her confidence in the subject and the opportunities that existed within the teaching profession with it. Additionally, there's a prestige associated with being a mathematics teacher, which appealed to her.

Over time, Ms. Carter's perspective on being a mathematics teacher evolved. To her, teaching mathematics is not just about imparting facts and formulas; rather, it's about helping students build confidence through repetition and challenges, making them see the beauty in the subject, and teaching them the discipline and values associated with it. This discipline isn't just about memorization, but about using mathematical knowledge to understand and make sense of the world.

When asked about the essence of teaching mathematics, Ms. Carter emphasized the complexity of the task. While it involves teaching units or strands, it's also about inspiring

students, motivating them, and making the abstract tangible. The challenge for a mathematics teacher lies in balancing factual knowledge with exploration. Using the example of the Pythagorean theorem, she spoke about making connections that help students see the real-world applications of mathematical concepts. Teaching is also about acknowledging and addressing the students' questions and concerns, ensuring that they see the relevance of what they're learning. Drawing inspiration from the ancient philosopher Pythagoras, she touched on the concept of the *guru-disciple relationship*, where the student completely submits to the teacher's understanding. However, she recognized that today's teaching environment is vastly different: students today are more inquisitive and demand to know the relevance of what they're learning.

In conclusion, for Ms. Carter, teaching math isn't about adhering strictly to a defined method. It's about adapting, connecting with the students, and making the subject meaningful and relevant to them.

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### **Recalling the Moment With Ms. Carter**

I was teaching the concept of 10. I had a broad spectrum of students: I had some students who knew how to count 1 to 5; some who did not know how to count, but knew—but could not recognize – random numbers; students who could read 1 to 20; a couple students who knew 1 to 100 and could recognize them as numbers. I was trying to teach House 10 being a special number and how we have like 10 hands, 10 fingers. My underlying idea in my mind was *I just want them to know that 10 is special*. You know, it's the base of 10, like, counting by 10s. Daily, we would do counts from 1 to 20 and then we would go "10, 20, 30, 40..." all the way to 100. It seemed that this was something that certain students just knew, like they had really practiced it. It came to them easier. And so, I thought, *Okay, let me just get students to explore 10 and the*

*friends of 10*. So, I tried to add in a little bit of addition. This is me still learning how to introduce while I'm still going through making my long-range plan for what to teach first, second, etc. I was not too sure: *should I actually explicitly teach addition?* I thought, *Okay, let me talk about the friends of 10*. We used our fingers.

We had like 1 and then, "How many more to get to 10?" And then the word "more" was something that certain students had not understood. So, there were a lot of different missing pieces that I understood as an adult, of course, but as a Grade 1 teacher, I had not seen the actual concept of numbers being understood by younger students.

So, I gave the students a paper which had a number plus blank equals 10 and I said, "However many blocks you see, put that number of blocks on top of the number, and then in the other box, see how many more you need to make 10 so that we can see the friends of 10." For some, it was enough that they got an idea. Certain students were saying, "See, it's plus, it's like this plus this." So, I knew they had an understanding of addition. I saw some students who just knew it, and I could tell they had learned kind of a rope method of understanding the mathematics—you know,  $6 + 4$  is 10. They had these facts.

I saw other students who were still understanding how to get to 10, and some who did not understand the concept of more, the concept of addition. I thought that this was going to be kind of a fun activity to explore 10 and how different numbers make 10. But what I did not expect, and what was the surprise for me, was how anxious students got because of (I guess) the idea of having to make 10. They were not understanding. "What do you mean by 'make 10?'" Every word I said was questioned, and it was an activity that I thought was going to be an explorative activity which turned out to be really challenging for some. I realized in that moment that I really did not know how difficult it is to understand and how abstract it is to understand a number for

little children. I saw a student crying because she did not understand why she did not understand it. She was seeing something that she saw should have been understood as just like, a big fact of life, and it's actually an abstract concept. But she was seeing it as something where, you know, it really defeated her.

I felt like I had just done too much at once, for sure. I realized that I overwhelmed students. When the student started crying, I think the first thing that struck me was, *I cannot believe how emotional this is making a student*. I was wondering, *Is it just the comparison to other students or is it that I have pushed the confusion in this student too far beyond their comfort zone?* I do try to give a challenge as a mathematics teacher, but then I have to know when to pull them back so that they are still appreciating the challenge. The key issue for me was, in what order am I supposed to teach math? In what order do I teach? Numbers, the addition of numbers, the concept of 10, and then leading to 10s? I mean, my issues were: am I going too fast? Am I teaching this in the wrong order? What was it that caused the crying? I mean, they are Grade 1 students: these are big emotions for them.

What I did in the moment was I turned the lesson basically into a talk: "You know, you just need to call me over when you're feeling confused. Let's go step by step. What is 10?" I wish I had actually written some of this stuff down because we were able to get 10 together. The student knew what 10 was. If I took 2 out, she was not seeing that the 2 and the 8 together made the 10. In that moment, I was thinking, *Well, I guess she's never had to do this in her life*.

I'm still living through this because I have not actually taught addition since. I stopped there and I just focused on counting after that to really get the students to understand 5s and 10's. And then, again, the concept of 10 comes up. So, I have not taught addition again and I really need to work through how I'm going to teach it. And this was October (6–7 months ago). So, this

moment really got to me. It did this year because I am finding that what we would think is simple is actually very abstract for young children. And you really do get to see, *My gosh, this is how humans made sense of their world*. And it's not that they all just got it. For me, the teachable moment, I guess in that time, was about me asking the student to let me know when they feel pushed a bit too far. And then for me to see, *how many smaller steps do I need to take?* Or even letting the student be overwhelmed for a bit.

When I think of teachable moments in general, I think one thing is how much conceptual knowledge and historical knowledge do you have about what you are teaching, and use those teachable moments as a way to really make it work to the students' benefit. I'm thinking of the conceptual knowledge, for example, of a circle. When you are teaching a circle in Grade 7, how much do you know? I think what I'm saying is, it would be interesting to see the outcomes of teachable moments, like, if a teacher has a lot more conceptual knowledge on the topic and how much the teacher enjoys teaching it themselves. Meaning: for it to be a teachable moment, like I find the circle to be so beautiful and fascinating, so I think I would actually really enjoy teaching through the confusion of it. I think there are certain times where you can really take whatever is happening in the classroom—whether it be the confusion of a student or if it's yourself making new sense of something—and explaining it with excitement.

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Ms. Carter's experience of teaching the concept of the number 10 to her Grade 1 students reveals the intricate and dynamic interplay of empathy, challenge, and self-reflection that defines the lived reality of teaching mathematics. Through the hermeneutic lens, her practice unfolds as a dialogical engagement with her students' diverse ways of knowing, shaped by their unique backgrounds and individual capacities for learning.

As she endeavoured to unveil the significance of 10—a foundational yet abstract notion—Ms. Carter found herself navigating a spectrum of understanding. Some students approached the concept with ease, while others faced profound struggles, revealing the multifaceted nature of mathematical comprehension in early learners. Each moment with her students became an interpretive act, requiring her to attune to the subtle cues embedded in their responses, hesitations, and successes.

To bridge the gap between the abstract and the tangible, Ms. Carter employed a variety of pedagogical approaches, including counting exercises and hands-on activities with blocks. These strategies, though thoughtful and intentional, often revealed the limits of her assumptions about her students' readiness to engage with abstract concepts. The process of teaching, then, became a reflective journey, where each struggle and success illuminated new layers of understanding—not only about her students but also about the nature of her own teaching practices.

Adaptation emerged as a central motif in Ms. Carter's lived experience. Each adjustment to her instructional approach was an interpretive response to her students' needs, reflecting the dynamic and evolving nature of teaching. In this way, her journey was marked by a deep commitment to her students' growth, underscored by a willingness to question, revisit, and refine her practices in the face of the unexpected. Through this hermeneutic engagement, Ms. Carter's teaching transcended the act of delivering content, becoming an ongoing, relational encounter with the complexities of learning and teaching mathematics.: she recalled her intent to teach the significance of the number 10 and the struggles she faced due to the varied proficiency levels of her students. Her recollections expressed a balance between following her teaching plan and adjusting it based on students' reactions: "This is me still learning how to introduce while I'm still going through making my long-range plan for what to teach first, second, etc."



When teaching, Ms. Carter encountered teachable moments, or instances when students' reactions or insights provided unplanned learning opportunities. The profound distress of a student who could not grasp the idea of making the number 10 offered Ms. Carter such a moment. This intense emotional response served as a window into the deeper layers of a child's learning experience, revealing the weight of comprehension struggles, potential fears of comparison, and the daunting task of grappling with the unfamiliar. In this instance, she opted for a gentle, conversational approach to comfort and guide the distressed student, suggesting a delicate balance teachers must strike between challenging students and not pushing them beyond their emotional and cognitive thresholds. For Ms. Carter, these moments are filled with both challenges and revelations. They are surprising, as evidenced by her initial surprise at the unexpected anxiety and confusion from the students. However, these instances also allowed her a deeper insight into the learners' conceptual challenges. She mentioned, for instance, "I realized in that moment that I really did not know how difficult it is to understand and how abstract it is to understand a number for little children." Noticing a teachable moment for Ms. Carter seems to come from a blend of intuition, observation, and reflection. She was sensitive to the emotional state of her students, shown when she observed a student crying and immediately wondered about the cause, considering both the comparison to peers and the potential overwhelming nature of the task.

Ms. Carter's introspective recounting of this experience indicates her astute self-awareness. The event made her question her teaching sequence, pace, and even the foundational concepts she introduced. The distress of her student became a moment of profound reflection, prompting Ms. Carter to momentarily set aside addition to reinforce counting and the concept of 10. For her, these teachable moments are also deeply personal learning experiences. They require understanding both the topic at hand and the intricate cognitive landscapes of young learners.

The historical and conceptual depths of a subject, like the nature of circles, enhance the richness of teaching. Ms. Carter believes that a teacher's passion and deep knowledge about a topic can transform confusion into a springboard for exploration, thus harnessing the power and potential of teachable moments to benefit students.

Ms. Carter seized teachable moments by pivoting her approach. In the face of a challenging situation, she engaged in dialogue with the student, trying to break down the problem. She recalled that she had told the student, "You know, you just need to call me over when you're feeling confused. Let's go step by step. What is 10?" She also adapted her curriculum based on her observations, forgoing addition for a while to focus on counting. Additionally, she viewed these moments as opportunities for herself to learn and adapt, indicating a growth mindset.

When reflecting on her experience, Ms. Carter touched on the importance of possessing deep conceptual and historical knowledge of the topic at hand. The more profound the teacher's understanding, the better they can navigate and exploit these moments of confusion or curiosity. This perspective is evident when she said, "I'm thinking of the conceptual knowledge, for example, of a circle. When you are teaching a circle in Grade 7, how much do you know?" Ms. Carter's experience underscores the intricate dance teachers perform, constantly adjusting their steps to the rhythm of their students' needs and reactions. The hermeneutic phenomenological approach provides a lens through which we can appreciate the depth, complexity, and profoundness of such lived experiences in the classroom.

### **Ms. Davis**

Ms. Davis is a retired teacher with qualifications in science, physical education, and special education. Her passion for math led her to pursue additional math courses, facilitating her entry into the teaching profession at a time when opportunities for female math teachers were

expanding. As a math teacher, she aimed to be a role model, not only for her students but also for her female colleagues. She believed in making math engaging through innovative teaching methods. Over the years, she refined her approach by responding to her students' interests and inquiries, integrating everyday contexts into her lessons to demonstrate that math is everywhere. Teaching, for her, was about understanding and nurturing her students as complete individuals

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### **Recalling the Moment With Ms. Davis**

Okay, so the moment took some time. It was not right away that I was able to recognize or create a moment. I have many I can recall; however, I'm going to tell you one that really came to the top of the triangle of my teaching career. When I had my two children and they were growing up, my husband and I had to look at their future education, which also included postsecondary education. So, we had a discussion with our children about the cost and what they were going to contribute towards their future education. We said that we would pay and our children would have to contribute as well. So, while I'm going through that process with my kids and they're in middle school, financial literacy had not come into play in the curriculum yet at all. And of course, I was teaching math and science at the time, so I decided as a culminating task to do an assignment called "Where to Live." That little, small idea just ballooned. I took a real-world mathematics activity, and I turned it over to my classroom. So, I looked at what was happening with the real numbers. For me, the real world has always been my common denominator for teaching mathematics. Anytime I taught anything to do with numbers—the stock market, going to university, whatever—it had to be applicable to the real world. Because I personally was going through that with my own daughters, I put that over to my own students.

And feedback from my students, feedback from the parents, was amazing. It just started with a simple idea that I wondered about while going thorough it with my own daughters, and it

blossomed. It was incredible! I had a professor at Nipissing University who wanted a copy of that culminating task—like, I mean, it was amazing. You could have done the entire Grade 8 curriculum in that one assignment ‘cause there was so much, so much meat and the infamous hook – like I got them interested, and now they’re now these kids who are 13 and are asking their parents, “Hey, do you have any money set aside for me for the university? Oh. You do? Oh. What’s that all about? The government gives you money?” It just opened up dialogue. So, it was something that I knew they had interest in. It was money. They all love money. They are all about to start working part-time.

I told them, “You’re not living with your parents forever.” Well, some of them do. But the idea was, you know, I used to always say there’s, you know, three things you can do with money. You can save it, you can spend it, and you can give it away. And what percentage that is, is up to you. So, let’s talk about the saving part. So, when you get your first part-time job, some of that has to be saved and then of course, we looked at paychecks. “Oh, what do you mean unemployment insurance? What are these taxes?” And then it just bloomed. And I always really listened. Like, I always listen more than I spoke and I listen to my kids and whatever they talked about—the cost of hockey sticks, the girls’ makeup, whatever. I just listened and I threw that in and Bingo, gotcha.

As a retired math teacher, in terms of teachable moments, I would like to offer some advice. For any teacher I think it’s enough to say, “Always listen more than you speak.” Uh, try to find everybody’s story. And to respond, and not react. That will set a comfortable stage. You want a safe place, always. Oh, you want to make sure that students are open to talking, listening, speaking—not only to me as a teacher but to one another. So, I really think that it’s important to make that environment as comfortable as possible. And then the numbers will flow and then the

curriculum will flow: everything will flow and be flexible. Like, change on a dime based on what you hear. Like, I used to love snow days at school. We would have so much fun on snow days, not just “Oh, you have to babysit.” I’m thinking, “Okay, what can we do that’s different?” You know? “Let’s go outside. Let’s do math and snow.”

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Ms. Davis’s commitment to connect math with the real world characterizes her lived experiences and her moment-to-moment teaching of mathematics, as she stated that, “For me, the real world has always been my common denominator for teaching mathematics.” Ms. Davis’s approach to teaching is grounded in her genuine curiosity and personal experiences, as seen when she said, “Because I personally was going through that with my own daughters, I put that over to my own students.”

Experiencing teachable moments, for Ms. Davis, involves recognizing the students’ interests and finding ways to engage them in the subject matter. She recalled, for instance, “It just started with a simple idea that I wondered about while going thorough it with my own daughters, and it blossomed. It was incredible!” This demonstrated her ability to recognize potential teachable moments and capitalize on them to create effective learning experiences.

For Ms. Davis, noticing teachable moments seems to be an intuitive process that comes from her ability to actively listen to her students and be receptive to their needs. As she mentioned,

And I always really listened. Like, I always listen more than I spoke and I listen to my kids and whatever they talked about—the cost of hockey sticks, the girls’ makeup, whatever. I just listened and I threw that in and Bingo, gotcha.

In terms of taking up teachable moments, Ms. Davis demonstrated flexibility and

creativity in her teaching methods. She was able to weave real-life situations and examples into her curriculum, creating engaging and impactful learning experiences for her students. For instance, she developed the “Where to Live” assignment, which allowed her students to explore financial literacy and its relevance to their own lives. This not only made the subject matter more relatable, but also opened up a dialogue between the students and their parents about their future education and financial planning.

Overall, Ms. Davis’s ability to connect with her students, recognize teachable moments, and adapt her methods to create engaging and meaningful learning experiences characterizes her teaching approach. Her story serves as an inspiration for other educators to listen actively, be flexible, and find ways to connect the curriculum with real-world situations.

As a retired teacher, Ms. Davis’s story reveals what it was like for her to experience a teachable moment while teaching mathematics. Her story reveals that her most significant teachable moment happened in her classroom for her students when she was thinking about mathematics in a real-life context, which came to surface when she was talking to her own children about saving money for their future education.

We see that it was in the moment when she was talking to her own children about saving money for their postsecondary education that she realized that her students may also benefit from this real-life math application. Ms. Davis’s story reveals the nature of a teachable moment as something that blossomed from her curiosity about what her students may need to know about real-world applications of mathematics:

So, while I’m going through that process with my kids and they’re in middle school, financial literacy had not come into play in the curriculum yet at all. And of course, I was teaching math and science at the time, so I decided as a culminating task to do an

assignment called “Where to Live.”

For Ms. Davis, the teachable moments happened for her students when she connected real concepts to the curriculum expectation of percentages:

I told them, “You’re not living with your parents forever.” Well, some of them do. But the idea was, you know, I used to always say there’s, you know, three things you can do with money. You can save it, you can spend it, and you can give it away. And what percentage that is, is up to you.

The way Ms. Davis experienced teachable moment reveals her awareness of the need to connect math to the real-world by listening to her students’ interest and using that to “hook” them into mathematics.

### **Ms. Edwards**

Ms. Edwards, a middle school mathematics teacher, has been teaching for approximately 20 years and is passionate about working with middle school students, particularly those in Grades 7 and 8. For Ms. Edwards, being a mathematics teacher means understanding her students’ needs and meeting them where they are. She aims to create a positive learning environment and ensure that her students do not view math as a difficult subject. Ms. Edwards’s personal experiences as a student have motivated her to become a mathematics teacher who helps students develop a love for learning math and truly enjoy the subject.

When teaching mathematics, Ms. Edwards’s main focus is on building her students’ confidence in their math skills. While she teaches the necessary mathematical processes and problem-solving skills, she believes that boosting students’ confidence is essential for helping them become successful math learners. By motivating and encouraging her students, Ms. Edwards creates a supportive learning environment where students feel capable of mastering math concepts.

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### **Recalling the Moment With Ms. Edwards**

It was a recent experience, when I was teaching fractions to my Grade 8 class. There was this one student who is not very confident in math and gets support from the support staff in the school. We were working on a recipe project, where students had to find a recipe, figure out the servings for one person, for 24 people, etc. So, they had to determine the ingredients needed for different quantities like serving one person or 24 people using the same recipe.

Initially, this particular student was showing no interest and appeared to check-out. I had a conversation and told her, “You have a choice here: you can either try or you can leave it. But whatever you choose will not impact you and your future learning.” Surprisingly, she chose to keep trying and learning. I could tell that she was struggling with fractions, I guess because she never had to apply fractions to real life. So, I had to use manipulatives and go back to the basics just to get her started. She was frustrated, and there were many tears and moments of giving up; however, despite it all, she continued to work on the assignment. It was as if she was determined to learn.

She picked a recipe that her grandma used to make, and that connection helped her engage with the project. With tons of help from me, she went through the process of understanding fractions and completed the project. What struck me the most during this experience was her perseverance and determination to learn and get good marks.

When she started asking for help, it made me feel happy and relieved, knowing she would carry this attitude into high school. This experience taught me that making personal connections, and real-life connections, is important for learning math concepts. I realized that when students can connect their learning to real-life experiences, it becomes more meaningful



for them. I hope that more of my students will have similar moments: where they recognize the importance of seeking help and taking control of their learning. These teachable moments are crucial for us as educators to self-reflect and help our students have richer learning experiences in the math classroom.

As a teacher, I wish more students would go through similar experiences and realize the importance of seeking help. I believe that when math teachers start noticing teachable moments and reflecting on them, students have richer experiences and feel better in math classes. I think it's important to not only notice these moments, but also, to take the time to reflect on them and analyze what worked, what did not work, and how we can improve our teaching practices. As teachers, we should continuously strive to create a positive learning environment for our students, particularly in challenging subjects like math.

And when it comes to teachable moments, it's important to remember that they can happen at any time and can involve any student. So, we should always be ready to adapt our teaching strategies to capitalize on these moments, and help our students not only grasp mathematical concepts but also develop a positive attitude towards learning. I think that if more math teachers focused on these teachable moments, we would see a significant improvement in students' overall attitude towards math and their willingness to seek help when needed. In the end, our goal as educators should be to inspire a lifelong love of learning in our students, and that starts with recognizing and nurturing these teachable moments.

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Ms. Edwards vividly recalled the profound journey of teaching fractions to her Grade 8 class, particularly centering on one student who lacked self-confidence in mathematics. The experience opened up a vast landscape of emotions, challenges, and ultimately, triumph.

Integrating real-life scenarios into math problems, Ms. Edwards presented the students with a recipe project. However, for one particular student, the numbers and fractions seemed daunting, almost alien, making the math classroom a space of discomfort and withdrawal. Yet, through a heart-to-heart dialogue, Ms. Edwards instilled a sense of agency in her, emphasizing that the choice to try or retreat was solely hers. The student's choice to persevere in the face of adversity showcases the immense power of human will.

In this journey, the emotional connection to her grandmother's recipe served as an anchor. Although she wrestled with the challenges, frequently on the brink of surrendering, she was driven by a relentless determination to understand. This revealed to Ms. Edwards the transformative potential of intertwining personal stories with academic content. She came to a profound realization that mathematics, often perceived as abstract, can come alive when tethered to one's lived experiences. This epiphany underscored the importance of teachers being observant and receptive to students' unique stories, adapting their methods to ensure each student finds resonance in the content.

Ms. Edwards's experience also underscored the transformative power of teachable moments. Observing her student's eventual enthusiasm in seeking help, she felt a surge of hope and joy, envisioning her carrying this newfound resilience into her future academic pursuits. Such moments of realization are not just crucial milestones for students but are equally, if not more, significant for educators. They serve as reflective mirrors, allowing teachers to introspect, recalibrate their methods, and continuously seek innovative ways to make learning more relatable and engaging. In these fleeting yet impactful moments, Ms. Edwards discerned the true essence of teaching: to nurture a persistent curiosity and instill a sense of empowerment in students. Recognizing and harnessing these moments of epiphany can be the catalysts for

positive transformation, both in the realm of mathematics and beyond.

Ms. Edwards's moment-to-moment teaching of mathematics is filled with deep attentiveness, discernment, and emotional investment. When she described how, "Initially, this particular student was showing no interest and appeared to check-out," it painted a picture of her heightened awareness of students' demeanor and engagement levels. Her description that "I could tell that she was struggling with fractions, I guess because she never had to apply fractions to real life" further emphasizes the intertwining of mathematical concepts with real-life contexts. Ms. Edwards's lived experience is one of oscillation between observing, guiding, and deeply reflecting on her teaching methods, especially when met with challenges.

For Ms. Edwards, teachable moments are a bridge connecting the abstract concepts of mathematics to the tangible realities of students' lives. As she stated, "This experience taught me that making personal connections, and real-life connections, is important for learning math concepts," it demonstrates that these moments are not merely about understanding math, but also about fostering meaningful relationships and evoking intrinsic motivation. Ms. Edwards's experience with teachable moments was twofold: teachable moments are opportunities for growth for both the student and herself.

Ms. Edwards was acutely observant and responsive; for instance, Her statement, "When she started asking for help, it made me feel happy and relieved" exhibited her intuitive sense in detecting these pivotal moments. Noticing a teachable moment for Ms. Edwards was akin to identifying an opportunity—a fleeting window where she could make a genuine difference in a student's life, both academically and emotionally.

Teachable moments are embraced by Ms. Edwards with immense passion and commitment. When she stated, "So, I had to use manipulatives and go back to the basics just to

get her started” it underscored her readiness to adapt her teaching methods to the student’s unique needs. Furthermore, she stated, “These teachable moments are crucial for us as educators to self-reflect and help our students have richer learning experiences in the math classroom.” This perspective exemplified her proactive approach to transforming such moments into deep learning experiences, not just for the student, but for her own professional growth.

Drawing from the rich narrative of Ms. Edwards, it became evident that teaching, for her, is not merely a profession, but a journey. A journey filled with challenges, emotions, revelations, and teachable moments that, when acknowledged and nurtured, have the potential to transform lives.

### **Ms. Foster**

Ms. Foster’s journey towards becoming a mathematics teacher was deeply rooted in her lifelong passion for mathematics and her upbringing, significantly influenced by her mother, a mathematics teacher and professor. During her high school days, Ms. Foster was actively engaged in mathematics education, tutoring her peers and assisting a teacher in basic level mathematics. She initially began her university education in actuarial science, but she discovered her true love laid in teaching mathematics, prompting her to switch to a pure mathematics program. After her 4-year degree, she completed a one-year teacher education program at Queen’s University, enhancing her qualifications by specializing in mathematics. Interestingly, beyond mathematics, she is also qualified to teach physics.

When it comes to teaching mathematics, Ms. Foster believes that she has a significant responsibility to share the joy, beauty, and thrill of mathematics with her students. She prioritizes creating a classroom environment where all students feel confident and motivated to learn and appreciate mathematics, striving to understand their interests and abilities. Her teaching

philosophy involves creating conditions that allow students to experiment with mathematics, to make mistakes, learn from them, and discuss them openly without fear of shame or judgment. For Ms. Foster, teaching mathematics isn't merely about passing on information, but it's about creating engaging and thought-provoking moments in the classroom. This involves a deep understanding of the subject matter as well as students' needs. During these moments, students are urged to engage with mathematics, to think, problem solve, and draw connections. A crucial aspect of Ms. Foster's teaching philosophy involves adaptability and flexibility, enabling her teaching plans to adjust based on real-time needs and observations.

Even with meticulous planning and structure, Ms. Foster sees teaching as a fluid process that evolves according to the changing needs of her students. She admits that her initial teaching strategies were more rigid, but over time, she has learned to appreciate the importance of flexibility in teaching, responding to students' needs as they come up and modifying her teaching methods accordingly.

In essence, Ms. Foster personifies a student-centered approach to teaching mathematics, creating a nurturing and stimulating environment that empowers her students to explore, interact with, and enjoy the subject.

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### **Recalling the Moment With Ms. Foster**

It was a defining moment, both for my students and me, that has stuck with me for some time. This moment of learning unfolded in a Grade 9 mathematics classroom, right after I had returned from a year-long break. I had covered for a consultant during his leave, a year that was packed with professional learning and self-reflection about how I taught mathematics.

I was eager to go back to the classroom. So, I decided to begin the year by exploring

patterns in mathematics, something I believe to be a fundamental part of the subject. During my year off, I had come to realize that as much as I thought I was fostering an open and collaborative learning environment, there was always room for more growth and openness.

One day, I presented a growing pattern to my students and asked them to think about how they perceived it to be growing. I had some anticipations of the responses I might receive, with my ultimate goal being to encourage the students to create a pattern rule.

I noticed some students brainstorming ideas and asked a few to share their perspectives. The first two students described seeing the pattern grow in ways that I had anticipated. However, a third student came up and said he did not see the pattern growing the same way. I encouraged him to explain his perspective.

Despite his multiple attempts to describe his viewpoint, I struggled to understand his perception of the pattern. His explanation did not seem to resonate with me or anyone else in the classroom. But, despite this, the student was adamant. He approached the front of the classroom and began to draw his interpretation of the pattern's growth. And suddenly, it made perfect sense.

His perception was something I had never anticipated. He saw the pattern growing diagonally, a concept that I, along with most students, usually perceive as vertical or horizontal growth. It was as if I had a mental block that kept me from understanding his point of view until he demonstrated it clearly.

This student's persistence led to a significant shift in the classroom dynamics. We had a deep conversation about how people can perceive the same thing differently. I learned that just because I didn't anticipate a student's perspective does not mean it isn't valid or even brilliant mathematical thinking. In fact, this student's unconventional viewpoint provided a new way to algebraically generalize the pattern and furthered our discussion.

This instance made me reevaluate my role as a teacher. I questioned whether I would have allowed this student to share his unique perspective if he hadn't been confident and persistent. This was an awakening moment for me, making me realize that I needed to pay closer attention to my students' ideas and celebrate different ways of thinking, regardless of whether they were hesitant or unconventional.

After that experience, that particular class became a group of risk-takers who were highly engaged in problem-solving. They saw the value in viewing problems from different perspectives and celebrated unconventional approaches. It was that student's persistence that paved the way for this shift, not anything I had particularly done.

As teachers, we need to be mindful of not dismissing ideas that are unconventional or which differ from our own thinking. Instead, we should embrace these new viewpoints because they can potentially lead to exceptional mathematical thinking. After all, there's a possibility that our students could be better mathematicians than us.

That student's unique approach and the subsequent discussions were transformational for me. It made me question whether I was truly prepared for the range of interpretations students might present. More importantly, it made me reflect on how I responded to such situations and the significant impact of those decisions on the learning trajectory. It taught me the importance of patience and openness in the face of unfamiliar ideas.

Looking back, what led me to allow the student to continue was his passion, enthusiasm, and belief in his own thinking. Although it was uncomfortable at first and I was unsure of whether his approach would lead anywhere, I decided to take the plunge, which turned out to be a groundbreaking experience for all of us in the class. And I believe it's this ability to take chances and truly listen to our students that can unlock new opportunities for learning and understanding.

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Ms. Foster's story revealed a rich tapestry of self-realization, a deep appreciation for diverse perspectives, and a marked transformation in her approach to teaching mathematics. The statement, "I was eager to go back to the classroom. So, I decided to begin the year by exploring patterns in mathematics, something I believe to be a fundamental part of the subject," highlights her initial enthusiasm. However, the lived experience for Ms. Foster goes deeper than merely teaching mathematics: it is about a relentless quest for personal and professional growth. For instance, she noted, "During my year off, I had come to realize that as much as I thought I was fostering an open and collaborative learning environment, there was always room for more growth and openness."

Ms. Foster's moment-to-moment teaching of mathematics was filled with anticipation, curiosity, and discovery. She sought to provoke thought and generate discourse among her students, creating a learning environment that fostered engagement and the sharing of different perspectives. She mentioned, for example, that "One day, I presented a growing pattern to my students and asked them to think about how they perceived it to be growing."

The student's unique interpretation of the pattern and his persistence in explaining it constitutes a teachable moment for Ms. Foster. Her experience in grappling with the unfamiliar perspective is enlightening: "His perception was something I had never anticipated. ... It was as if I had a mental block that kept me from understanding his point of view until he demonstrated it clearly." This tells us that teachable moments, for Ms. Foster, are not just about imparting knowledge, but are also about learning from her students and expanding her own understanding. Her interaction with the student reshapes her approach towards teaching and learning, as she reflected, "This instance made me reevaluate my role as a teacher ... I needed to pay closer



attention to my students' ideas and celebrate different ways of thinking, regardless of whether they were hesitant or unconventional.”

Ms. Foster engages with the teachable moment, not by imparting a ready answer but by allowing the student to navigate his unique perception, which further leads to profound classroom discussions. This is a clear indication of her adaptive teaching strategy that utilized teachable moments to facilitate a dynamic and inclusive learning environment: “I questioned whether I would have allowed this student to share his unique perspective if he hadn't been confident and persistent.”

In conclusion, Ms. Foster's teaching experience in mathematics is richly nuanced, shifting from an anticipatory approach to one that embraces diversity of thought and nurtures growth in unanticipated directions. Her ability to recognize and adapt to teachable moments speaks volumes about her commitment to fostering an environment that values and encourages different perspectives.

### **Emergent Themes**

Eight themes emerged from the lived experiences shared by the participants, illuminating the essence of what it is like to encounter teachable moments in mathematics teaching. These themes are not merely descriptive; they represent the deeper, interpretive meanings that arise when teachers engage with the fluid and dynamic nature of teaching. Each theme is reflective of a facet of the phenomenon as it unfolded in the participants' stories, revealing the interplay between intention, awareness, and response in the classroom. The following sections delve into each theme, drawing upon the rich narratives of the participants to offer a textured understanding of these pivotal moments. Through these stories, the phenomenon of teachable moments is revealed in its complexity, offering glimpses into the heart of what it means to teach mathematics.

## Noticing Students' Gaps in Mathematics Understanding

This first theme is comprised of three elements: learning opportunities, students' comprehension gaps, and the challenging of teachers' assumption and expectation.

In this theme, a *teachable moment* is referred to as a specific instance when a unique, often unforeseen opportunity arises that can be used as a learning experience for both the teacher or the student. Instead of a planned lesson from a curriculum, it's a spontaneous moment where a teacher can offer an opportunity for students to learn about; for example, a mathematics concept. Recognizing when a student or a group of students doesn't fully understand a concept is crucial in this theme. From the participants' stories and hermeneutic interpretations, this gap, when identified, seems to become an immediate opportunity for teaching, where a teacher can revisit, rephrase, provide examples, or use different teaching methodologies to bridge the gap.

The stories and their hermeneutic interpretation reveal that participants indicated that teachers carry their own sets of assumptions and expectations into their classrooms. These could be about how quickly students will grasp a concept, the prior knowledge they bring, or how a particular lesson might be received. When these assumptions are challenged—when something unexpected occurs or students react differently than anticipated—it's an opportunity for self-reflection and growth for the teacher. For instance, when Ms. Carter assumed that all students knew the foundational concept of the number 10—but then realized that many do not—this challenged her assumptions that she held as a teacher. She then adapted her teaching style by attending to students. In other participants' cases, they revisited certain topics (Ms. Adam, for example, revisiting place value) or even sought feedback from students on how they learned best.

The interplay between recognizing a student's gap in understanding and having one's assumptions challenged can create rich learning opportunities. For the educator, it emphasizes

the importance of being adaptable, responsive, and attuned to students' needs. For students, it can make their learning experience more personalized, relevant, and engaging. Recognizing teachable moments, especially in the context of understanding gaps and challenging assumptions, can greatly enhance the learning experience. It promotes adaptability, responsiveness, and continuous growth for both educators and students.

All the participating teachers, including Ms. Adam, Ms. Baker, Ms. Carter, Ms. Davis, Ms. Edwards, and Ms. Foster, encountered teachable moments upon realizing their students' misconceptions or gaps in understanding with mathematical concepts where their expectations and assumptions as teachers were challenged. These educators uniformly acknowledged their students' misunderstandings and took active steps to rectify them during their lessons.

Ms. Adam, for instance, discovered her students' difficulty in grasping the connection between percentages, fractions, and decimals, and their challenges with place values. She remarked, "So in my head, it was like in that moment, things are clicking for me as it's happening and I'm realizing, *wait, there's a gap here; wait, there's something.*"

In Ms. Baker's experience, her students were confused about placing commas in numbers and understanding the area formula for a parallelogram. She reflected, "I would say this was kind of like an "ah-ha!" moment, not only for them, but for me as well because it was a new learning experience for me, something I never really considered before."

Ms. Carter's students had difficulty comprehending the number 10 and the fundamentals of addition. She observed, "I saw other students who were still understanding how to get to 10, and some who did not understand the concept of more, the concept of addition." Meanwhile, Ms. Davis noticed a gap in financial literacy and introduced relevant concepts to her students to address it. She shared, "When I had my two children and they were growing up, my husband and

I had to look at their future education, which also included postsecondary education ... financial literacy had not come into play in the curriculum yet at all.” Likewise, Ms. Edwards noticed a student’s challenge in applying fractions to real-world situations, and stated, “I could tell that she was struggling with fractions, I guess because she never had to apply fractions to real life.”

Ms. Foster believed she was ready for any student interpretations of mathematical concepts, but was caught unaware when she realized that one of her student’s solutions was different from all the anticipate solutions she had in her mind. She mused, “It made me question whether I was genuinely ready for the range of interpretations students might offer.” On the other hand, Ms. Carter realized the complexity of concepts that adults might view as simple, noting, “what we would think is simple is actually very abstract for young children.”

Their stories have underlined the risks of presuming what students already know or comprehend. Ms. Foster was taken aback by a student’s unique perspective on a pattern, while Ms. Carter had presumed understanding the number 10 would be straightforward for youngsters. Ms. Foster shared, “His viewpoint was something I had never considered” in her situation, while Ms. Carter reflected, “I realized in that moment how challenging and abstract understanding a number can be for little ones” in her experience. Both Ms. Foster and Ms. Baker experienced times when students’ knowledge or understanding clashed with their anticipations, too, prompting them to address these misunderstandings. Ms. Foster commented, “His explanation did not seem to resonate with me or anyone else in the classroom,” whereas Ms. Baker confessed, “Every single one of my students was doing this, and I did not know why.”

### **Noticing Students’ Needs**

Participants underscored the potency of teachable moments deriving from noticing students’ needs. This theme involves introspective reflection on pedagogical techniques and a

genuine response to the dynamic needs and perceptions of students. The theme reflects the importance of not only investigating one's instructional strategies, but also being adaptable enough to tailor them based on real-time student feedback.

Reflecting on their experiences, participants from the study narrated tales of missed opportunities, sudden epiphanies, and the power of student-centric adaptability. Ms. Adam poignantly stated, "So, I think there are missed opportunities that you don't even get to go back to because you didn't think of it." She further delved into the idea of recognizing student misconceptions, remarking, "The next thing I did was ask, "can you tell me what place these numbers are in, on the place value chart?" so we started going through it like that."

This sentiment of adaptability in teaching was echoed by many, including Ms. Davis, who asserted the need to "be flexible. Like change on a dime based on what you hear," and Ms. Foster, who emphasized the importance of acknowledging diverse student perspectives, noted, "I learned that just because I didn't anticipate a student's perspective does not mean it isn't valid or even brilliant mathematical thinking."

Furthermore, participants like Ms. Baker and Ms. Carter, in their pedagogical tales, highlighted the transformative power of recalibrating their teaching methods in response to their learners' needs. Ms. Bacer illuminated, "So, I told them "I don't care for wrong answers. That's fine. It's the thinking behind it" because then it all made sense to them." Similarly, Ms. Carter shared, "What I did in the moment was I turned the lesson basically into a talk: 'You know, you just need to call me over when you're feeling confused. Let's go step by step. What is 10?'"

A spectrum of experiences presented by participants such as Ms. Carter and Ms. Foster emphasize the myriad interpretations of students and pedagogical shifts required of the educators. Ms. Foster's reflection on the unpredicted interpretations of students stood out: "His

perception was something I had never anticipated,” for instance, while Ms. Adam pondered, “So for me, I am thinking, *what do they mean they are separate?*”

The narratives of Ms. Foster and Ms. Davis highlight the value of diverse perspectives in education. Ms. Foster highlighted her introspective moments when she noted, “This instance made me reevaluate my role as a teacher. I questioned whether I would have allowed this student to share his unique perspective if he hadn’t been confident and persistent.” Ms. Davis, in parallel, showcased her flexibility, emphasizing the importance of integrating real-life experiences for better student engagement by bringing real life example much as financial literacy.

Ms. Adam’s narrative demonstrates the interconnected nature of teachable moments, highlighting the importance of reflective practice and the dynamic interplay between missed opportunities and responsive teaching. She expressed an awareness of the moments that might go unnoticed in the immediacy of teaching but recognized how such reflections can inform future decisions. Balancing this introspective stance, she illustrated adaptability by revisiting her instructional strategies, asking students to engage with the place value chart, and guiding them step by step. This blend of reflection and adaptability reveals the temporal and interpretive dimensions of teaching, emphasizing its profound impact on student understanding.

Ms. Foster’s experience illuminates the intersubjective nature of teachable moments, where the persistence of one student becomes a catalyst for mutual growth. This moment reveals the dynamic interplay of perspectives in the classroom, challenging the teacher to embrace a horizon of understanding that extends beyond her initial expectations. In recognizing the student’s unexpected approach, Foster not only adapts her teaching but also redefines her role as both a guide and a learner. This reciprocity underscores the relational essence of teaching, where meaning emerges through a shared journey of exploration.

A consistent theme among participants is the unpredictable and emergent nature of

teachable moments, which demand pedagogical adaptability deeply rooted in reflective practice. Ms. Baker's reflections on her own experiences as a learner inform her teaching approach, particularly her emphasis on valuing the reasoning behind student responses rather than focusing solely on correctness. This perspective nurtures a dialogical environment where students feel empowered to explore their thinking, fostering deeper engagement and understanding.

Ms. Carter's account brings to light the significance of attentiveness and timely intervention in teaching. By transforming a moment of confusion into a collaborative exploration, she demonstrated the importance of relational attunement, turning the lesson into a shared inquiry where students felt supported in addressing their gaps in understanding. This approach exemplifies how being present and responsive in the moment can create meaningful learning opportunities.

Similarly, Ms. Davis emphasized the need for flexibility and the ability to adapt teaching strategies based on real-time feedback. This perspective aligns with Ms. Edwards's understanding of the teacher's dual role as both guide and learner. By valuing student input and encouraging them to seek support, she highlighted the evolving dynamics of teacher-student relationships, which are built on mutual trust and responsiveness.

The participants' narratives collectively emphasize that teachable moments do not arise in isolation but are deeply embedded in a cycle of noticing, interpreting, and responding. These moments emerge through a confluence of reflective practice, pedagogical recalibration, and sensitivity to the ever-changing needs of students. Whether it involves addressing misconceptions, adapting instructional techniques, or embracing the inherent unpredictability of the classroom, these experiences reveal the multifaceted and interpretive nature of effective teaching. Each moment becomes an opportunity to engage with the complexity of learning, fostering growth for both teachers and students.

## **Dialoging and Discussing With and Among Students**

In this theme, the participants' lived experiences of teachable moments revealed the profound significance of fostering collaboration and dialogue with their students. These moments illuminated the transformative potential of creating spaces where students could take the lead in exploring, constructing, and articulating their understanding. Within these narratives, the teachers recognized the intrinsic value of student-led inquiry, mutual engagement, and the co-construction of knowledge.

Through their reflections, the participants described their intentional efforts to nurture environments where students could collaborate and exchange perspectives, thereby deepening their grasp of the subject matter and cultivating an atmosphere conducive to shared learning. These educators also expressed a deep appreciation for the moments when students displayed engagement, resilience, and determination to persevere through initial challenges, underscoring the dynamic interplay between effort and discovery in the learning process.

Ms. Adam captured this essence in her account, stating, "We have conversations with them all the time." She elaborated on a pivotal moment of student realization, as her learners began to grasp the interconnections among percentages, fractions, and decimals. "They actually start seeing the place values," she reflected, emphasizing the power of dialogue in fostering such epiphanies. Similarly, Ms. Baker highlighted the importance of allowing time and space for collaborative exploration, recounting, "I gave them a couple minutes to kind of discuss in their little groups," which facilitated a shared journey of discovery.

The participants' stories also underscored their recognition of students' tenacity and resolve as integral to the unfolding of teachable moments. Ms. Edwards celebrated a student's perseverance amidst challenges, sharing, "What struck me the most during this experience was her perseverance and determination to learn and get good marks." This commitment to pushing



through difficulties exemplifies the active role students take in shaping their understanding. Ms. Baker's narrative further illuminated this theme as she described a moment of insight: "So sure enough, I go up and I just move one triangle over to the other side ... after a while, they figured it out." The teacher's patience and the students' collective effort converged to create a moment of shared understanding.

Ms. Foster's reflection revealed a complementary dimension: the teacher's role in being patient, receptive, and attuned to students' needs. She remarked, "It was that student's persistence that paved the way for this shift, not anything I had particularly done." Her narrative highlights the importance of stepping back and genuinely listening to students as they navigate new concepts. As she reflected, "And I believe it's this ability to take chances and truly listen to our students that can unlock new opportunities for learning and understanding."

Ms. Davis's account similarly emphasized the primacy of attentive listening in fostering meaningful connections and supporting student growth. She articulated, "I always listen more than I spoke ... always listen more than you speak," pointing to the relational and dialogical essence of teaching. This stance of listening as an act of pedagogical care resonates throughout the participants' experiences, reaffirming the centrality of authentic engagement in the co-construction of knowledge.

In synthesizing these narratives, it becomes evident that the essence of teachable moments lies not only in the content but in the relational and dialogical interactions that facilitate student-led discovery. Through patience, attentiveness, and openness, these teachers exemplify to honor the students' agency and embraces the shared journey of learning.

### **Noticing Students' Mistakes and Opportunities to Learn**

This particular theme refers to when a participant notices students making a mistake or things are not unfolding as planned, and making a choice that leads to a positive learning

environment. This choice includes a fine balance between giving too little information or giving too much information to steer students' learning. Here, the participants reflected on the obstacles student face, their attitudes to overcome the obstacles, and the importance of recognizing and acknowledging this as an achievement in students.

All participating teachers underscored the imperative of attentively listening to their students, thereby fostering a secure and receptive positive learning environment. Evidently, from their recounted experiences, the creation of positive learning environment wherein students can confidently make errors and seek clarifications emerged as crucial. As exemplified in Ms. Adam's narrative, she actively advocated for viewing errors not as setbacks but rather, as avenues for learning, accentuating the abundance of these teachable moments. She stated, "As teachers, we work with these kids 6 hours a day. We have conversations with them all the time." Complementing this viewpoint, Ms. Davis stated, "Always listen more than you speak ... You want a safe place, always." Concurrently, Ms. Baker's account illuminated her pedagogical approach which reassured students about the acceptability of incorrect responses. Instead, she emphasized delving into the cognitive processes underlying their solutions rather than a mere fixation on their accuracy:

I definitely wanted them to see these shapes can be decomposed and can be moved around. I didn't want to shut down their ideas because had I just given them the formula, then I'm not having them become critical thinkers, which is what I wanted them to be. I want them to problem-solve. So, I told them "I don't care for wrong answers. That's fine. It's the thinking behind it" because then it all made sense to them. And then they're going back and the little groups are going, "Oh, we could have just done this all along." We did. And now they're discussing their solutions and where their little miscalculations

happened—which wouldn't have happened if I just said “Here, today we're doing area for a parallelogram. Here's my formula.”

In their narratives, both Ms. Baker and Ms. Edwards highlighted the importance of students facing obstacles, students' attitudes toward the obstacles, and the importance of recognizing and acknowledging students' achievement when overcoming the obstacles. Illuminated in Ms. Baker's reflection, she stated, “Just me giving them the formula would be good, but then I'm doing same as my teachers did. I'm just having them mimic the process and the steps.” She further added, “Cherishing those “ah-ha!” moments, I think they're very important in the classroom because it gets the kids excited, you know, when you're celebrating their little successes.” On the other hand, Ms. Edwards's poignant tale revealed, “She was frustrated, and there were many tears and moments of giving up; however, despite it all, she continued to work on the assignment. It was as if she was determined to learn.” Ms. Edwards continued, “When she started asking for help, it made me feel happy and relieved.”

Both Ms. Forest and Ms. Adam accentuated the significance of students possessing the self-assurance to articulate their insights. This necessitates the role of teachers in nurturing such confidence in their students. Ms. Forest reflected that, “Looking back, what led me to allow the student to continue was his passion, enthusiasm, and belief in his own thinking.” Additionally, Ms. Adam raised a poignant query: “Is it basically just a moment in time where there's an opportunity to change the thinking, or is it that a kid made a mistake and now we're trying to fix it?”

Both Ms. Edwards and Ms. Forest highlight the importance of recognizing and acknowledging their students' achievements by engendering a positive learning disposition and sculpting an inclusive learning space. Ms. Edwards stated, “After that experience, that particular

class became a group of risk-takers who were highly engaged in problem-solving.”

Complementing this, Ms. Forest stated, “I think that if more math teachers focused on these teachable moments, we would see a significant improvement in students’ overall attitude towards math and their willingness to seek help when needed.”

### **Questioning and Broadening Teachers’ Understanding of Mathematics Content**

Participants’ narratives of their experiences with teachable moments underscored the significance of possessing an in-depth and profound conceptual comprehension of the subject matter they endeavour to teach. This perspective is not merely a surface realization, but is deeply entrenched in their pedagogical journey. The participants’ narrative accounts shed light on their episodic moments of epiphany that not only catalyze a transformation in their pedagogical strategies, but also prompt a recalibration in their overarching approach to the subject matter.

Ms. Carter, exemplifying this viewpoint, elucidated the inherent aesthetics and intricacies of a circle, highlighting the need for educators to delve beyond superficial knowledge. She poignantly posed a rhetorical query: “When you are teaching a circle in Grade 7, how much do you know?” This question is emblematic of the continual introspection educators must undertake to ensure the depth of their knowledge mirrors their teaching intent. Ms. Carter questioned her adult understanding of the concept of the number 10 and students’ understanding of it—this, in turn, created room for her to broaden her understanding as a teacher of mathematics content. Similarly, Ms. Foster questioned her understanding on how the algebraic pattern she presented to the class was growing diagonally, a position put forward by one of her students. Ms. Foster offered a testament to the transformative potential of student-driven discourse and innovative approaches. Reflecting on a specific encounter in the moment, she articulated, “[t]hat student’s unique approach and the subsequent discussions were transformational for me.” By

“transformational,” Ms. Foster highlighted how the exchange reshaped her perspective on teaching and learning. It allowed her to see the depth of her students’ creative reasoning and pushed her to rethink how she facilitates mathematical inquiry. These discussions not only validated the value of student-driven approaches but also reinforced her commitment to cultivating a classroom environment where diverse interpretations are celebrated, ultimately enriching both her professional growth and her students’ learning experiences. Her statement underscores the dynamism inherent in the classroom environment, where both teachers and students alike contribute to mutual growth and learning.

In a parallel vein, Ms. Baker accentuated the value of fostering a flexible and explorative learning environment. She elucidated, “I definitely wanted them to see these shapes can be decomposed and can be moved around. ... So, I told them “I don’t care for wrong answers. That’s fine. It’s the thinking behind it.” This perspective champions the notion that the learning process is as much about exploration and understanding as it is about arriving at the correct conclusion.

### **Bringing Real-World Applications in Teaching**

Participants’ stories highlight the integration of real-life experiences with mathematical concepts to bolster comprehension. This was evident in the reflections of several participants’ stories when they were asked to recall their teachable moments.

In Ms. Adam’s account, she elucidated her methodology wherein percentages, fractions, and decimals are expounded upon in conjunction with place values, effectively establishing a tangible context. Moreover, Ms. Baker provided a compelling narrative where she stated, “[w]e went on a little walking trip to the shopping center for some financial literacy.” From Ms. Edwards’s recounting, too, it becomes evident that a deepened student engagement with fractions

transpired when they were contextualized with a cherished familial recipe. This is affirmed in the quotation: “She picked a recipe that her grandma used to make, and that connection helped her engage with the project.” Ms. Foster’s narrative underscored the salience of a multifaceted approach to problem-solving. She emphasized, “They saw the value in viewing problems from different perspectives and celebrated unconventional approaches.”

In Ms. Davis’s story, she employed tangible scenarios—such as financial systems, tertiary education expenses, and occupational contexts—to elucidate mathematical and financial literacy concepts. Her perspective is encapsulated in the statement: “Anytime I taught anything to do with numbers—the stock market, going to university, whatever—it had to be applicable to the real world.”

The overarching consensus among the participants appeared, then, to be the enhanced student engagement and meaningfulness they attributed to lessons that were interwoven with real-life scenarios. This is further supported by the remarks of Ms. Foster: “this student’s unconventional viewpoint provided a new way to algebraically generalize the pattern and furthered our discussion.” Additionally, another reflection highlights, “This experience taught me that making personal connections, and real-life connections, is important for learning math concepts.”

### **Practicing Self-Reflection and Continuous Self-Improvement**

Throughout the narratives presented by the participants, there was a recurrent emphasis on the indispensable role of self-reflection within the pedagogical domain, particularly concerning seizing teachable moments. This emphasis serves as an indication to the evolving nature of effective teaching practices that are grounded in introspection and responsive adaptation. Ms. Adam and Ms. Baker underscore the imperative of revisiting certain concepts to

fortify comprehension and fix gaps in understanding. Ms. Adam acknowledged the inevitability of overlooked opportunities, accentuating the criticality of subsequent reflection: “So, I think there are missed opportunities that you don’t even get to go back to because you didn’t think of it.” In her narrative, Ms. Adam articulated that any such overlooked opportunity necessitated revisiting the topic with students to ensure comprehensive understanding. Contrastingly, Ms. Baker’s narrative revealed her pedagogical approach which emphasized a profound comprehension of the foundational logic behind mathematical formulas. She championed the ethos of problem-solving and collaborative discourse among students, rather than mere rote learning.

Ms. Edwards underscored the centrality of teachable moments as moments for teachers to engage in introspection: “[t]hese teachable moments are crucial for us as educators to self-reflect and help our students have richer learning experiences in the math classroom.” Furthermore, the narratives from the participants illuminated the significance of educators discerning these teachable moments and recalibrating their methodologies to enhance the learning trajectory. As evidenced in Ms. Baker’s recounting: “For me, when I think of the topic of teachable moments, I—as someone who didn’t have such a positive experience learning math—I think it is a very important topic.” She later elaborated on her collaborative endeavours with an instructional coach to foster a conducive learning environment. Meanwhile, Ms. Edwards’s reflection offered a glimpse into the nexus between personal and real-world connections in facilitating the comprehension of mathematical concepts: “This experience taught me that making personal connections, and real-life connections, is important for learning math concepts.” There are poignant instances of self-questioning and pedagogical reevaluation, too, as depicted by Ms. Foster and Ms. Carter. While the former contemplates the inadvertent dismissal of non-traditional notions, the latter deliberates on the optimal sequencing of concept introduction in her teaching module.

Reflective practice is instrumental in shaping the participants' pedagogical orientation and self-conception as teachers. This introspection often left them with an array of queries, signifying a dynamic, ceaseless process of self-examination. Several participants articulated the pedagogical journey as one characterized by continual learning, adaptation, and introspection. Both Ms. Edwards and Ms. Foster highlighted the prominence of reflective practices for teachers. They contend that teachable moments exert a dual influence: they are pivotal for students' learning experiences and concurrently proffer invaluable insights for the teachers themselves.

Ms. Foster's and Ms. Baker's stories show a retrospective analysis of their personal growth trajectories as teachers. While cognizant of their limitations, they aspire towards growth in their pedagogical endeavours. Ms. Foster's introspection, for instance, encapsulated the ethos of humility in teaching: "After all, there's a possibility that our students could be better mathematicians than us." Concurrently, Ms. Baker's narrative underscored the multifaceted perspectives essential for understanding mathematical education, emphasizing both the students' and teachers' viewpoints.

### **Noticing the Emotional Aspect of Learning Mathematics**

This theme points to the intricate interplay between emotion and the process of learning. The narratives provided by the participants underscore the profound emotional intensity that often accompanies students' learning journeys, particularly when they encounter challenges in comprehending novel ideas.

In Ms. Foster's story, the relentless determination of a student not only transformed the classroom's mood, but also catalyzed a paradigm shift that celebrated diverse perspectives. This shift subsequently cultivated an environment conducive to taking risks and engaging in proactive problem-solving. In reflecting upon this experience, Ms. Foster articulated, "I learned that just



because I didn't anticipate a student's perspective does not mean it isn't valid or even brilliant mathematical thinking."

Furthermore, Ms. Carter's narrative provided a poignant glimpse into the profound emotional distress a student can experience when grappling with complex concepts. This distress was so profound in the instance she described that it manifested in the student's visible emotion, culminating in tears. Ms. Carter poignantly observed, "I saw a student crying because she did not understand why she did not understand it."

### **The Dual Positions Shaping Teachable Moments in Mathematics**

In exploring teachable moments within mathematics teaching, two interpretive positions emerged, each weaving a nuanced understanding of classroom interactions: one that centers on students' immediate needs and the other on the teacher's evolving journey of self-discovery. The student-centered position is a responsive, intuitive stance, where teachers tune in to the undercurrents of their students' experiences, aiming to create a space that adapts as learning unfolds. This sensitivity is embodied in themes like *Noticing Students' Gaps in Mathematics Understanding*, where moments of realization surface as teachers detect comprehension gaps, revealing unique opportunities to bridge learning in real-time. Similarly, *Noticing Students' Needs* captures the adaptability required to respond to unspoken cues, as teachers adjust their methods to meet students exactly where they are. When teachers foster *Dialoging and Discussing With and Among Students*, they cultivate an atmosphere where understanding deepens through collaborative, shared exploration, letting students' voices lead the discourse. This attentiveness extends to *Noticing Students' Mistakes and Opportunities to Learn*, a theme that highlights how errors become fertile ground for growth, transforming the classroom into a safe space for experimentation and authentic engagement. Moreover, in *Noticing the Emotional*

*Aspect of Learning Mathematics*, teachers acknowledge the layered emotions students experience, embracing the highs and lows of their intellectual and emotional journeys through challenging concepts.

The teacher-centered position, in contrast, reflects an introspective stance, emphasizing the teacher's journey toward deeper understanding and self-growth. This position invites teachers to view teachable moments as catalysts for their own learning, encouraging a continuous dance between their self-reflection and pedagogical practice. The essence of this process unfolds in the lived experience of epiphany—those sudden, transformative moments when the familiar becomes unfamiliar and a teacher's understanding of their subject, their students, or their own being is irrevocably reoriented. These epiphanic moments emerge amidst the complexity of teaching, where tensions and challenges become the crucible for perspective shifts. In such moments, the teacher encounters a new horizon of meaning, where abstract concepts and their tangible realities coalesce, revealing connections previously obscured. This revelation ignites a profound renewal of purpose, awakening curiosity and deepening the teacher's engagement with their practice.

Interwoven with these epiphanies is the grounding force of humility—a stance of openness that acknowledges the finitude of one's knowledge and the inexhaustibility of learning. Humility, as a lived attitude, invites teachers into a relational encounter with their students and the world, where vulnerability becomes a site of growth and dialogue. It is within this space of humility that teachers recognize their students as partners in the co-creation of meaning, where the act of teaching transcends mere instruction to become an ongoing, dynamic interplay of understanding.

Through the interplay of epiphany and humility, teachers are drawn into a deeper, more authentic engagement with their vocation. This dynamic fosters an evolving sense of self, where

the identity of the educator is not fixed but continuously shaped by the interplay of insight, reflection, and relationality. In this way, the journey of teaching becomes a hermeneutic endeavour—a perpetual unfolding of meaning and being. *Questioning and Broadening Teachers' Understanding of Mathematics Content* speaks to this introspective curiosity, as teachers confront the depth of their knowledge, finding that students' insights often challenge their assumptions and push them to think differently. *Bringing Real-World Applications in Teaching* reminds us that relevance and meaningfulness are vital; by integrating students' lived realities into mathematics, teachers ground abstract ideas in tangible contexts, sparking engagement. Through *Practicing Self-Reflection and Continuous Self-Improvement*, teachers embrace an ongoing process of adaptation and self-examination, recalibrating their methods and beliefs in response to every teachable moment.

These two positions—one student-centered, the other teacher-centered—intertwine in a delicate balance, revealing the depth of commitment both students and teachers bring to the learning process. In moments where students' needs collide with teachers' reflections, a powerful synergy unfolds, inviting teachers to act as both guides and learners. This duality, where immediate responsiveness meets self-reflective growth, shapes a dynamic classroom environment that is rich in discovery, adaptability, and shared meaning-making, resonating long after the lesson ends.

### **Summary of the Results**

In this chapter, I explored the lived experiences of six mathematics educators, each who encountered teachable moments that invited them into a deeper understanding of their students, their subject, and themselves. Through a hermeneutic phenomenological lens, I presented findings that revealed the essence of these moments, capturing the ways teachers interpret,

respond to, and learn from the unexpected opportunities that emerge in their classrooms. Guided by both crafted stories and thematic reflections, this chapter became an interpretive journey into the heart of mathematics teaching.

Each crafted story is a window into the personal and professional worlds of these educators, illustrating how teachable moments arose within the flow of everyday classroom interactions. Ms. Adam's narrative revealed a moment of realization as she perceived gaps in her students' understanding of decimals and fractions. This epiphany demonstrated her attunement to the subtle signals of her students' struggles and a humility to adjust her teaching methods in real time. Her spontaneous response to these gaps allowed her to guide her students more deeply into the content, while simultaneously deepening her awareness of their needs. Ms. Baker's story depicted a teachable moment rooted in surprise and curiosity, as her students' unfamiliar use of commas challenged her assumptions and broadened her understanding of numerical conventions. This revelation underscored how transformative moments can arise when educators remain open to questioning their preconceptions. Ms. Carter's story exposed the emotional dimensions of learning, as she experienced a young student's struggle with the number 10, an encounter that prompted her to reimagine how abstract concepts can be made accessible. This transformative experience reflected her humility in recognizing the emotional barriers to learning and her attunement to the needs of her students.

Ms. Davis's narrative revealed the transformative power of connecting mathematics to real-world contexts, as she invited students to explore financial literacy through their own family dynamics, mirroring her experiences with her own children. In Ms. Edwards's story, a student's choice to work with a grandmother's recipe brings math into personal and meaningful territory, as abstract fractions become tangible, instilling determination in a previously reluctant learner.

Here, revelation and attunement were intertwined, as the teacher recognized the importance of connecting abstract concepts to the lived experiences of students. Finally, Ms. Foster's story showed the potential of different perspectives to enrich learning, as a student's unconventional view of a pattern challenged her to embrace new ways of thinking and foster a classroom of mutual discovery. This moment of humility and transformation highlighted the reciprocal nature of learning, where the teacher's perspective evolved alongside that of her students.

From these individual experiences, eight emergent themes arose, capturing shared dimensions of teachable moments and revealing a deeply reflective and interpretive aspect of teaching. The essence of these themes lies in the transformative epiphanies experienced by educators, their attunement to the nuances of their classrooms, and the humility required to continuously grow in their practice. *Noticing Students' Gaps in Mathematics Understanding* highlighted the teacher's role as an attuned observer, sensitive to the nuances of student comprehension. These gaps, rather than being barriers, became invitations for growth, where the teacher's response was both intentional and intuitive, and fostered a space for connection and exploration. *Noticing Students' Needs* underscored the relational nature of teaching, as educators interpreted and responded to each student's individual journey, creating an inclusive environment where all voices were valued.

Themes like *Dialoging and Discussing With and Among Students* and *Noticing Students' Mistakes and Opportunities to Learn* illustrated the dialogical and collaborative essence of these moments, where teachers and students shared an interpretive space that transformed mistakes into rich opportunities for understanding. Through conversation and reflection, both teacher and student participated in the co-construction of knowledge, deepening their grasp of concepts and fostering a learning environment rooted in trust and openness. These revelations underscored the

importance of humility and the transformative potential of seeing mistakes as opportunities for shared growth.

Self-reflection emerged as central in the theme *Practicing Self-Reflection and Continuous Self-Improvement*, as these educators engaged with teachable moments as opportunities for their own growth. *Questioning and Broadening Teachers' Understanding of Mathematics Content* further demonstrated how teachable moments are reciprocal, inviting educators to expand their own understanding alongside their students. Epiphanies in this context became catalysts for professional and personal transformation, highlighting the dynamic interplay of learning and teaching. This reflective process revealed the dynamic and transformative nature of teaching, where both student and teacher evolve through shared engagement with the content.

Themes such as *Bringing Real-World Applications Into Teaching* and *Noticing the Emotional Aspect of Learning Mathematics* reminded us of the relational and affective layers of mathematics education. In connecting math to students' lived experiences, these teachers invited students to see math as meaningful and relevant, linking academic content to their personal worlds. This attunement to students' experiences and emotions exemplified the transformative potential of empathy and responsiveness in teaching. This connection, grounded in empathy and responsiveness, turned learning into an embodied experience where concepts resonated with students' lives and identities.

Together, these crafted stories and emergent themes revealed the hermeneutic cycle in action, where teaching was both an interpretive and relational act that unfolded in real-time. Through this lens, teachable moments were shown to be experiences of shared meaning-making, where teachers and students co-created understanding, extending beyond content mastery to transform both the teacher's and student's perspectives. The humility to embrace these moments,

the attunement to notice them, and the epiphanies that arise through reflection collectively illuminate the transformative essence of mathematics teaching. This chapter thus invited us to appreciate teachable moments as profound acts of mutual discovery that reveal the heart of mathematics teaching: an ongoing, dynamic relationship between knowing and becoming.

## CHAPTER 5: DISCUSSION, CONCLUSION, AND IMPLICATIONS

The purpose of this research was to investigate the lived experiences K–12 mathematics teachers had with teachable moments. In this study, I began by understanding teachable moment as follows: the term *teachable moment* refers to an opportunity that arises when a connection has been made to advance learning, recognize learning, and/or recognize the gap in learning by a learner and/or a teacher. More specifically, the term *moment* is distinctly defined as an expected or unexpected occurrence that allows learners and/or teachers to deepen their understanding of when such a connection is made. The guiding research question was: what are the lived experiences of K–12 teachers in their moment-to-moment teaching of mathematics? More, specifically: what is it like for K–12 teachers teaching mathematics to experience teachable moments? How is it like for these teachers to notice teachable moments? In what ways do these teachers take up teachable moments?

Chapter 1 focused on an introduction of the research, outlining the study's purpose, scope, and limitations. Chapter 2 presented a review of the literature on teacher effectiveness, highlighting how teachers' formal training might be limited in preparing them for the real-time decisions that are needed to recognize and respond to teachable moments in the classroom. Chapter 3 then detailed the study's methodology, rooted in hermeneutic phenomenology, which used qualitative methods to reveal teachers' lived experiences with teachable moments. Chapter 4 presented the findings of the study, and revealed two positions from which teachers live these teachable moments: attunement to students and teacher reflective self-exploration. In this chapter, I present the discussion of the results, conclusions, and implications of the study. I conclude the chapter by providing my reflection of self-exploration as a teacher and researcher.



## Discussion of the Results

In this section, I discuss the findings from Chapter 4 by addressing the research questions. The findings suggest two distinct interpretive stances through which K–12 mathematics teachers live their teachable moments in their practice: attunement to students and reflective self-exploration. The two interpretive stances manifest through eight themes, each embodying a unique way that teachers live their teachable moments. Each theme reveals a specific interpretive orientation, offering insights into how teachers open themselves to the unexpected, responding in ways that reflect both their pedagogical understandings and the unique circumstances of each classroom interaction. Eight themes emerged from participants' reflections on their lived experiences of teachable moments in mathematics teaching. These themes include:

1. Noticing students' gaps in mathematics understanding
2. Noticing students' needs
3. Dialoging and discussing with and among students
4. Noticing students' mistakes and opportunities to learn
5. Questioning and broadening teachers' understanding of mathematics content
6. Bringing real-world applications into teaching
7. Practicing self-reflection and continuous self-improvement
8. Noticing the emotional aspect of learning mathematics

This chapter engages in a hermeneutic exploration of the themes above, seeking to illuminate the lived experiences of K–12 mathematics teachers as they encountered and responded to teachable moments. Through a dialogical interpretation of teachers' narratives, situated alongside relevant literature, this discussion reveals the ways in which teachers perceive,

make meaning of, and act within moments of potential learning. This interpretive process is grounded in the research questions, bringing teachers' voices into resonance with the broader discourse of mathematics teacher education research and practice. It highlights the intricate interplay between teachers' attunement to the present moment and the pedagogical possibilities that emerge, reflecting a continuous unfolding of understanding in the educational encounter.

### **How Is It Like for Teachers to Notice Teachable Moments?**

For teachers, the act of noticing teachable moments is a finely tuned skill that extends beyond mere observation, embedding deep reflection and responsiveness into daily classroom interactions. Mason's (2002) concept of the *discipline of noticing* can offer a lens through which teachers engage in this heightened attunement to emerging learning possibilities, *emphasizing that noticing is a dynamic, interpretive, and relational act.*

The theme of *Noticing Students' Gaps in Mathematics Understanding* demonstrated how teachers leveraged this disciplined noticing to identify immediate insights about students' understanding, enabling spontaneous adjustments that enrich learning. For example, Ms. Carter noticed that her students were grappling with the concept of the number 10, a critical building block in early mathematics. This awareness draws upon her past teaching experiences and anticipates how addressing this gap will influence students' future understanding. Recognizing this gap, she adapted her approach, using tangible examples to solidify their understanding before advancing. This dynamic response illustrates Mason's (2002) notion that noticing requires a cultivated awareness – a disciplined interpretive sensitivity that enables teachers to navigate the layered complexities of the classroom (Blömeke et al., 2022). Within this heightened state of professional mindfulness, teachers like Ms. Carter can engage in a responsive, dialogical act—attuning to subtle shifts in student engagement and embodying a reflective, adaptive stance that

reveals teachable moments as they naturally arise and evolve (Fry & Hillman, 2018; Mason, 2002).

Teachable moments carry particular weight in mathematics, where abstract concepts often present mathematical understanding challenges. The theme of *Bringing Real World Applications in Teaching* is crucial in these instances, as it allows teachers to ground abstract math in familiar scenarios that make it more relatable and memorable. Teachers who are skilled in noticing can transform abstract moments into relevant, personal learning experiences (Amador et al., 2021; Muir, 2008; Pacifici & Garrison, 2004; Rowland & Zazkis, 2013), further enhanced by the relational ontology of co-creating meaning, where teachers and students collaboratively shape understanding. For instance, Ms. Davis capitalized on a real-world application by integrating a budgeting exercise into her lesson on percentages. This approach helped students grasp the importance of these math concepts by connecting them to planning expenses—an activity with clear, everyday relevance. Such applications demonstrate Mason’s (2002) *noticing*, as teachers tailor their approaches to meet students’ needs in ways that resonate with their real-world experiences (Dreher et al., 2021; van Manen, 2016). This approach also aligns with Jacobs et al.’s (2010) concept of *professional noticing*, where teachers observe, interpret, and dynamically adapt their responses to students’ thinking, thereby fostering a more robust understanding (Sherin et al., 2011).

The theme of *Dialoguing and Discussing With and Among Students* supports this interpretive noticing process by encouraging open communication, which helps teachers uncover students’ thought processes and recognize pivotal learning moments. Teachers use these discussions to gather insights about students’ understanding, allowing them to intervene meaningfully when needed. Ms. Baker, for instance, used small-group discussions about

fractions to allow students to share their perspectives on part-whole relationships. Observing a misconception about improper fractions, she took the opportunity to clarify, reinforcing students' understanding through peer interaction. This interactive process aligns with Smith and Stein's (2011) framework for *orchestrating productive discussions*, in which structured conversations enable teachers to draw out students' insights and constructively address misunderstandings (van Es & Sherin, 2021).

Creating a safe space where mistakes are welcomed as learning opportunities further enhances a teacher's ability to notice and respond, while also addressing the emotional resonance of noticing, where empathy transforms frustration into growth opportunities. The theme of *Noticing Students' Mistakes and Opportunities to Learn* highlights the role of errors as windows into students' thinking, revealing their reasoning and misconceptions. For instance, Ms. Adam observed her students incorrectly applying the area formula for a parallelogram and used this moment to guide the entire class through a diagnostic process. By framing the mistake as a step toward learning, she encouraged students to experiment, emphasizing that errors are natural and valuable for understanding (Boaler, 2015). This approach, noted by Hoth et al. (2022), shows that seeing mistakes diagnostically helps teachers link student errors to targeted instructional strategies that foster confidence and deeper engagement (Banse et al., 2021; Carter et al., 1988).

The theme of *Noticing Students' Needs* is also essential in seizing teachable moments, as it acknowledges that students may approach problems differently, each pathway offering its own insights. Teachers who recognize and encourage diverse problem-solving strategies can create a classroom environment where students feel confident exploring math in their own ways. Ms. Foster, for example, noticed a student interpreting a patterning problem with a diagonal solution rather than the expected linear method. Instead of correcting him, she encouraged him to explain

his approach, sparking a class-wide exploration of alternative patterns and validating that there is often more than one way to think about math. Dreher and Kuntze (2015) found that teachers who embrace multiple representations build a more engaging and supportive environment, encouraging students to explore a variety of approaches.

The theme of *Bringing Real-World Applications into Teaching* further strengthens teachable moments by linking mathematical concepts to familiar, everyday experiences. Teachers who embed real-world applications, such as cooking or budgeting, help students grasp abstract concepts by linking them to tangible experiences. Ms. Baker, for instance, initiated a cooking project that required students to apply fractions in adjusting recipes. This activity turned an abstract concept into a hands-on experience, illustrating the practicality of fractions in daily life. Researchers highlight that these real-world applications deepen students' understanding and engagement, allowing them to see the value of mathematics beyond the classroom (Blömeke & Kaiser, 2017; Sherin & Star, 2011).

Emotions also play a crucial role in how teachers notice and respond to teachable moments. The theme of *Noticing the Emotional Aspect of Learning Mathematics* recognizing the emotional aspects of learning underscores the value of being attuned to students' emotional responses—such as frustration or curiosity—as indicators of their engagement. Teachers who observe these cues can adjust their strategies to provide emotional support, fostering a climate that encourages resilience (Boaler, 2015). For example, Ms. Foster recognized one student's visible frustration with an algebraic concept and acknowledged it as part of the learning process. She reframed the challenge as an opportunity for growth, motivating the student to persevere and approach the problem with renewed determination. Noticing is described as both cognitive and affective, enabling teachers to create an emotionally attuned space that supports resilience and

confidence in students (Goodwin, 1994; Kosko et al., 2021). Mason (2015) highlights that responding in the moment requires an interpretive sensitivity to both the intellectual and emotional dimensions of student engagement. This dual awareness enables teachers to adapt their approaches in ways that address not only students' understanding but also their emotional well-being.

Finally, the theme of *Practicing Self-Reflection and Continuous Improvement* is foundational to effective noticing, as it encourages teachers to evaluate and refine their instructional practices continually. Reflection allows teachers to adapt strategies based on experiences and remain responsive to their students' evolving needs. Ms. Adam, for instance, reflected on a missed opportunity to address a student's question about fractions, leading her to prioritize student inquiries in future lessons. This approach fostered a classroom culture of inquiry, where student voices guided the learning process. This reflective process, as highlighted by Blömeke et al. (2015), emphasizes that reflective noticing helps teachers develop adaptive strategies that support a cycle of continuous growth and improvement (Kersting et al., 2012; Muir, 2008).

In summary, noticing teachable moments is a deeply interpretive and responsive act characterized by an evolving interplay of interpretation and understanding, where the teacher and student engage in a shared hermeneutic journey that transforms both the act of teaching and the process of learning. Through attuned engagement, teachers create inclusive environments, connect learning to real-world contexts, validate diverse cognitive approaches, and embrace mistakes as learning opportunities. These eight themes illustrate how noticing not only enhances instructional quality, but transforms everyday classroom interactions into powerful learning experiences. By honing their noticing capacity for interpretive awareness—the teacher's ability

to see beyond surface-level observations and engage deeply with the interplay of meaning-making, relationships, and teaching-learning moments in the classroom—teachers foster a vibrant educational environment that supports meaningful, lasting growth in students, underscoring the transformative impact of thoughtful, responsive instruction in mathematics education (Yang et al., 2021).

### **In What Ways Do These Teachers Take Up Teachable Moments?**

Teachers take up teachable moments as they unfold within the shared lived experiences of the classroom, responding in ways that embody attentiveness, reflection, and intentionality. These moments are not planned or fixed, but arise unpredictably, requiring teachers to navigate the dynamic interplay of their own assumptions, their students' understandings, and the evolving context of the lesson. To act after noticing a teachable moment is to engage with the present in a way that honors both the complexity of the student-teacher relationship and the unfolding potential for meaningful learning (Askew et al., 1997; van Manen, 2016).

Noticing is an act of awareness, while taking up a teachable moment transforms this awareness into purposeful engagement. After noticing a teachable moment, teachers move beyond observation into acts of recalibration and connection, adapting their teaching in response to what is revealed. In the *Noticing Students' Gaps in Mathematics Understanding* theme, this process was characterized by an openness to revisiting foundational concepts and meeting students where they were. For example, when Ms. Carter recognized that her students were struggling to grasp the concept of the number 10, she paused her lesson, engaging in questioning and using visual aids to reconstruct their understanding. Similarly, Ms. Adam noticed her students' difficulty with percentages, fractions, and decimals, and responded by crafting connections that bridged these concepts, allowing students to see their relationships more clearly.

Ms. Baker, instead of explaining the area formula for a parallelogram, guided her students through a hands-on discovery process, creating space for them to develop their own understanding. Such actions reflect Mason's (2002) discipline of noticing, where the teacher's interpretive sensitivity transforms observations into meaningful pedagogical responses. In the same vein, Jacobs et al. (2010) illuminate the intricate, lived experience of professional noticing, portraying it as a deeply interpretive act through which teachers attend to, make sense of, and respond to children's mathematical thinking. Their insights reveal how noticing is not merely a technical skill but a reflective and adaptive engagement with the unfolding dynamics of student understanding, resonating with Mason's emphasis on the transformative potential of noticing in teaching practice.

The act of reflection often follows the noticing of a teachable moment, as teachers engage in a hermeneutic dialogue with their own assumptions and practices. In the *Practicing Self-Reflection and Continuous Self-Improvement* theme, teachers confront the ways their expectations might shape or limit their responses to students. For instance, Ms. Foster entered the lesson with an expectation that her students would approach a pattern problem in familiar and predictable ways. However, she found herself immersed in the unexpected richness of their diverse interpretations, particularly struck by one student's perspective that defied her anticipations. This moment invited Ms. Foster into a space of reflection and openness, compelling her to reimagine her teaching approach. In embracing the unanticipated, she recognized the depth and complexity of her students' thinking, allowing their perspectives to shape and enrich the unfolding lesson.

Themes such as *Practicing Self-Reflection* and *Connecting to Real-World Contexts* illustrate how teachers move beyond noticing into acts of recalibration and contextual adaptation.



These themes reveal how educators like Ms. Foster and Ms. Davis transform their classroom practices by attuning to students' diverse approaches and real-life connections. For example, Ms. Davis incorporated financial literacy into her lessons, drawing on her personal experiences of saving for education to make mathematics relevant and engaging. Similarly, Ms. Foster's reflection on a student's unconventional perspective on patterns allowed her to recalibrate her teaching, creating a richer learning environment that valued multiple approaches. Such moments resonate with Mason's (1998) structure of attention, which illuminates the teacher's capacity to attune to the nuances of the unexpected, shifting their focus and reframing their understanding in response to emerging possibilities. This dynamic interplay of noticing and adaptation unfolds as a deeply reflective act, where challenges become invitations for growth. Dweck's (2006) growth mindset theory finds a natural alignment here, portraying both teachers and students as co-learners who embrace the fluidity of the learning process, viewing disruptions and adaptations as pathways to deeper understanding. Choy and Dindyal (2020) bring further depth to this perspective, situating teacher noticing as a living, essential practice in mathematics education, where reflective thinking becomes a way of being—allowing educators to engage fully with the evolving, interpretive nature of classroom dynamics.

Dialogical engagement is another interpretive action teachers take after noticing a teachable moment, as seen in the *Dialoging and Discussing With and Among Students* theme. Teachers create spaces where students can voice their thoughts, share their reasoning, and collectively construct understanding. For example, Ms. Adam facilitated small group discussions after noticing her students' confusion about place values, enabling them to clarify misconceptions through dialogue. Similarly, Ms. Baker encouraged her students to articulate their problem-solving processes, fostering a collaborative environment where ideas were

exchanged and refined. Ms. Foster embraced a student's unconventional interpretation of a growing pattern, inviting him to explain his perspective despite her initial difficulty understanding it. His persistence led to a shared exploration that deepened the entire class's understanding. Highlighting examples like Ms. Baker's parallelogram activity and Ms. Foster's pattern problem illustrates how fostering dialogue transforms these moments into shared spaces of growth. In these moments, the teacher's role shifts from authority figure to facilitator, creating a shared space for exploration. This action highlights how dialogical spaces foster the co-construction of knowledge (Burton, 2004; Friedrichsen et al., 2011; Smith & Stein, 2011).

After noticing a mistake, teachers often act to reframe it as an opportunity for growth, as described in the *Noticing Students' Mistakes and Opportunities to Learn* theme. Ms. Adam encouraged her students to engage with their errors, treating them as stepping stones toward understanding rather than obstacles. Similarly, Ms. Baker focused on students' reasoning processes, guiding them to analyze their thinking and discover alternative solutions. Ms. as supported a student who struggled with fractions by breaking the concept into smaller steps and creating a safe space for perseverance. "When she started asking for help, it made me feel happy and relieved," she noted, highlighting the emotional and intellectual impact of taking up the moment. Reframing mistakes, as seen in these examples, emphasizes resilience and fosters critical thinking, turning challenges into meaningful learning opportunities. This reframing creates a learning environment where mistakes are seen as integral to progress, fostering resilience and curiosity. These actions help transform errors into catalysts for learning (Fry & Hillman, 2018; Mason & Spence, 2000).

In the *Bringing Real-World Applications in Teaching* theme, teachers engage in the transformative act of making abstract mathematical concepts meaningful by grounding them in

students' lived experiences. Ms. Baker's budgeting activity, which included a visit to a shopping center, invited students to encounter mathematics as an essential tool for navigating real-life decisions. Similarly, Ms. Edwards's use of a family recipe to explore fractions revealed mathematics as part of the rhythms of everyday life, creating a bridge between the abstract and the tangible. Ms. Davis brought financial literacy into her lessons, inspired by her own family's discussions about saving for education. "It just started with a simple idea that I wondered about while going through it with my own daughters, and it blossomed," she recalled. These moments reflect Clarke and Hollingsworth's (2002) framework for authentic learning, where learning becomes situated in real-world contexts, deepening students' understanding and fostering a sense of purpose. Amador et al. (2021) emphasize the interpretive sensitivity required for teachers to notice and respond to opportunities where mathematical concepts can be connected to practical experiences. Their work highlights how such moments emerge through the teacher's attunement to students' needs and their ability to shape learning experiences that resonate with students' realities. In Ms. Baker's and Ms. Edwards's cases, this attunement allowed them to craft activities that not only demonstrated the relevance of mathematics but also drew students into an active dialogue with the world around them.

Olawoyin et al. (2023) extend this understanding by exploring how teachers, through pivotal teaching moments, create spaces for high-level cognitive engagement and meaningful discourse. These moments, as seen in Ms. Baker's and Ms. Edwards's lessons, transcend instructional techniques to become profound encounters where mathematics takes on personal and communal significance. By connecting mathematical concepts to the familiar, these teachers invited their students to see mathematics as not merely a discipline but a lived and embodied experience. These instances illustrate how teaching is an interpretive act—a dynamic interplay

between teacher, student, and context. Through their actions, teachers like Ms. Baker and Ms. Edwards unveil the presence of mathematics within the students' own lifeworlds, affirming its relevance while cultivating curiosity and connection. Mathematics, in this sense, is no longer abstract; it becomes a relational and human experience, woven into the narratives of students' everyday lives.

Teachers' responses to the emotional dimensions of teachable moments reflect a deep attunement to the lived experiences of their students, as explored in the *Noticing the Emotional Aspect of Learning Mathematics* theme. In recognizing and addressing emotions such as frustration or persistence, teachers enter into a relational space where learning is experienced as an embodied, affective, and cognitive process. For instance, Ms. Carter's reassurance of a frustrated student exemplifies how teachers navigate the emotional barriers that students encounter, transforming these moments into opportunities for growth. Similarly, Ms. Foster's celebration of a student's persistence underscores the interplay of emotion and motivation, inspiring the class as a whole to embrace the challenges of learning. Ms. Davis emphasized the importance of listening to her students, creating a supportive environment where dialogue could flourish. "Always listen more than you speak. ... You want a safe place, always," she explained. Damasio (1999) provides a lens for understanding these moments by framing emotion as integral to consciousness and meaning-making. From a hermeneutic perspective, this aligns with the idea that learning is not purely cognitive but deeply interwoven with the affective dimensions of human experience. Evans (2000) further illustrates how emotions are embodied in the experience of mathematical thinking, shaping students' engagement with content in ways that are both interpretive and dynamic. These affective responses are situated within the unique contexts of learners' lives, reflecting the hermeneutic notion that understanding emerges through the

interplay of individual and collective experience. May and Fray (2010) highlight how confidence, practice, and emotional responses mediate the process of learning mathematics, revealing the situated and relational nature of these experiences. Additionally, Mason and Spence (2000) emphasize the importance of knowing-to-act in the moment, which is essential in addressing the emotional dimensions of teachable moments. Teachers like Ms. Carter and Ms. Foster exemplify this principle by demonstrating an ability to act intuitively and responsively, drawing on their professional awareness to address students' emotional needs in real-time. This concept resonates with the hermeneutic perspective of teaching as an interpretive and adaptive practice, where the teacher's responsiveness is grounded in a deep understanding of both mathematical content and the relational dynamics of the classroom. Through their reflective and responsive actions, teachers demonstrate a sensitivity to the holistic nature of learning, recognizing that the emotional textures of teachable moments are essential to fostering meaningful understanding. These moments exemplify the essence of teaching as an interpretive, relational, and transformative practice, where knowing-to-act in the moment is pivotal in creating spaces for both cognitive and emotional growth.

In summary, the actions teachers take after noticing teachable moments are interpretive, reflective, and deeply relational. These actions—whether revisiting concepts, reflecting on assumptions, fostering dialogue, reframing mistakes, connecting to real-world contexts, or addressing emotions—transform the classroom into a shared space of growth and discovery. By adapting their strategies, fostering dialogue, connecting learning to real-life contexts, and reframing mistakes, teachers transform these moments into opportunities for mutual growth. Unlike noticing, which focuses on observation and recognition, taking up a moment requires intentional action, reflection, and responsiveness. Rooted in hermeneutic awareness, these

responses highlight the relational nature of teaching, where the teacher's intentionality creates opportunities for students to engage, persist, and thrive in their mathematical learning.

### **What Is It Like for K-12 Teachers Teaching Mathematics to Experience Teachable Moments?**

Experiencing teachable moments in K–12 mathematics is a deeply interpretive and evolving journey, marked by profound engagement with the cognitive and emotional landscapes of students. These moments, often unexpected, challenge teachers to attune to their students' unique needs, requiring a dynamic interplay of noticing, interpreting, and responding. The emerged theme of *Noticing Students' Gaps in Mathematics Understanding* underscores the relational and reflective nature of these moments, compelling teachers to recalibrate their teaching in real-time. These instances position educators as co-constructors of knowledge, illustrating teaching as a reflective, relational practice (Burton, 2004; Jacobs et al., 2010; Shulman, 1986). In such ways, teachers experience teachable moments by identifying gaps, reorienting their strategies, and building meaningful connections to meet students where they are in their learning journey.

A defining aspect of teachable moments is the discovery of *Noticing Students' Gaps in Mathematics Understanding*, prompting immediate adjustments to instructional strategies. For example, Ms. Carter realized that her students lacked a foundational understanding of the concept of 10, leading her to pause her planned lesson and revisit the topic with hands-on tools like number blocks. By breaking the concept into manageable steps, she ensured her students built the necessary foundation to progress. Such actions reflect the importance of noticing where students are in their comprehension and tailoring instruction accordingly (Askew et al., 1997; Ball & Bass, 2000; van Es & Sherin, 2002). These instances echo Gadamer's (1997) concept of a

*fusion of horizons*, highlighting how these moments transform both teachers' and students' perspectives. Particularly in mathematics, where foundational understanding serves as a scaffold for complex knowledge, recognizing and addressing these gaps is essential (Banse et al., 2021). Thus, teachers experience teachable moments by responding to these gaps with intentional, targeted interventions that prioritize foundational concepts.

Additionally, teachable moments reveal themselves as teachers engage with students' unique approaches to problem-solving, as exemplified by Ms. Foster's experience. This reflects the theme of *Noticing Students' Gaps in Mathematics Understanding*, emphasizing the interpretive interplay through which educators attune to and value students' diverse cognitive strategies. Such moments are revealed in the dialogical relationship between student expressions and teacher reflection, creating transformative opportunities to reframe assumptions and deepen shared understanding. In Ms. Foster's classroom, a student's unconventional diagonal solution to a pattern problem disrupted the habitual flow of teaching, inviting her to engage in interpretive reflection and facilitate a class discussion exploring this novel approach. This intentional openness not only deepened the students' understanding but also fostered a classroom culture of curiosity and creativity.

Such responses align with Mason's (2015) notion of responding in-the-moment, emphasizing the embodied act of noticing and interpreting diverse cognitive processes. Ben-Peretz (2011) illuminates the importance of teacher knowledge as not merely technical expertise but as a reflective capacity to discern and honor diverse student contributions. Ms. Foster's example demonstrates this hermeneutic sensitivity, as her openness to the student's unconventional solution enabled her to reframe preconceived assumptions and validate creative thinking, enriching the learning experience for all. Stockero et al. (2017) foreground the

complexity of noticing critical student thinking within the unfolding dynamics of classroom interactions, a concept that resonates with the hermeneutic act of attunement. In facilitating a class discussion around the student's approach, Ms. Foster exemplified how noticing as an interpretive act can transform a fleeting moment into an opportunity for shared meaning-making and deeper collective understanding.

Krauss et al. (2020) contribute to the discussion by conceptualizing teacher competence as a continuum of professional growth, where the capacity to notice and interpret students' diverse thought processes is integral. By engaging with the unconventional diagonal solution, Ms. Foster enacted professional responsiveness, fostering an inclusive environment that honored intellectual diversity and expanded the horizons of understanding within her classroom. Recognizing and celebrating students' individual approaches demonstrates that effective teaching is an interpretive and relational practice, extending beyond technical mastery to embracing diverse thought processes. Teachers thus experience teachable moments as interpretive opportunities, validating student contributions, fostering inclusivity, and encouraging creative problem-solving within the shared lifeworld of the classroom.

The theme of *Dialoguing and Discussing With and Among Students* highlights the collaborative nature of teachable moments. Teachers like Ms. Adam and Ms. Baker illustrated this theme by using small-group discussions to uncover misconceptions. Ms. Adam encouraged students to articulate their thinking on decimals and fractions, revealing misunderstandings about decimal placement, which she addressed using visual aids and peer feedback. Similarly, Ms. Baker's collaborative tasks on geometry allowed students to discuss relationships between shapes, enriching their conceptual understanding. These practices reflect Mason's (1998) *structure of attention* theory, which emphasizes how structured dialogue enhances students' focus and fosters co-construction of knowledge (Amador et al., 2021; Smith & Stein, 2011).



Through dialogue, teachers experience teachable moments as opportunities to deepen understanding collectively and collaboratively.

Active listening is another critical dimension, as seen in the theme of *Noticing Students' Needs*. For instance, Ms. Davis listened carefully when her students struggled to connect percentages with practical applications, leading her to contextualize the concept through relatable scenarios, such as calculating shopping discounts. This attentiveness aligns with Mason's (2002) discipline of noticing, emphasizing the importance of recognizing subtle cues that signal learning opportunities (Gorski, 2009; Sherin et al., 2011). Gorski (2009) highlights the role of teacher education in fostering cultural responsiveness, which reinforces the importance of listening to diverse student perspectives and adapting instructional strategies to meet their unique needs. Similarly, Sherin et al. (2011) emphasize that teacher noticing involves situating practice within a broader understanding of how students think and learn, making active listening a vital component in identifying teachable moments. By actively listening, teachers experience teachable moments as opportunities to align instruction with students' real-time needs and lived experiences.

Mistakes, too, are reframed as opportunities for growth, as seen in *Noticing Students' Mistakes and Opportunities to Learn*. Ms. Davis noticed her students hesitated to engage in problem-solving for fear of making errors. To address this, she celebrated mistakes as valuable learning tools, prompting students to examine the reasoning behind errors and build confidence. This practice aligns with Bandura's (1993) research on resilience and Mason and Spence's (2000) concept of knowing to act in the moment, highlighting how missteps can lead to constructive learning experiences (Hoth et al., 2022). In this sense, teachers experience teachable moments by reframing errors as valuable steps in the learning process, fostering a growth mindset.

The theme of *Bringing Real-World Applications Into Teaching* illuminates the profound interplay between abstract and practical understanding, where meaning is co-constructed through lived experiences. Ms. Baker's cooking project on fractions and Ms. Davis's financial literacy lessons exemplify how abstract mathematical ideas can transform into tangible, relatable insights, weaving together the concrete and the symbolic to create deeper connections for students. Mason's (1989) concept of delicate shifts of attention reveals these moments as hermeneutic openings—thresholds where abstract concepts and real-life contexts converge to foster transformative learning. This interpretive process empowers students to navigate seamlessly between practical problem-solving and abstract reasoning, enriching their comprehension through an evolving dialogue between part and whole. Further, Amador et al. (2021) highlight how technology and practice-based methodologies act as hermeneutic tools, mediating understanding by enabling teachers to observe, interpret, and respond dynamically to mathematical narratives in both real and simulated scenarios. This iterative engagement embodies the hermeneutic circle, where each interaction refines and deepens comprehension through recursive reflection.

In a complementary vein, Holden and Hicks (2007) emphasize the value of embedding mathematics within global contexts, fostering a dialogic understanding that connects students to broader, meaningful narratives. By integrating real-world applications, educators transcend conventional teaching methods, fostering transformative, interpretive encounters that position mathematics as a profound intellectual and human pursuit. These practices invite both teachers and students into a collaborative process of discovery, unveiling mathematics as a dynamic, relational, and lived experience that resonates beyond the classroom.

Themes such as *Noticing the Emotional Aspect of Learning Mathematics* and *Practicing Self-Reflection and Continuous Self-Improvement* illustrate the relational and interpretive nature

of teachable moments. Ms. Carter's response to a student's emotional struggle during a "friends of 10" activity highlights the importance of creating a safe learning environment by adapting her approach step-by-step, aligning with Damasio's (1999) emphasis on emotions in meaning-making. Ms. Adam's experience underscores the value of professional noticing in addressing gaps in understanding. When students failed to connect percentages, fractions, and decimals, she dynamically shifted to focus on place value, facilitating connections as outlined by Kosko et al. (2021). Her willingness to revisit missed opportunities further demonstrates the iterative and dialogical nature of teaching. Both teachers' practices reflect teaching as a relational and transformative process, integrating emotional attunement and adaptive strategies to foster meaningful learning (Damasio, 1999; Kosko et al., 2021).

In sum, teachable moments in K–12 mathematics are interpretive, reflective, and relational experiences. The eight emerged themes—ranging from addressing comprehension gaps to fostering dialogue and connecting to real-world contexts—reveal the transformative potential of these moments. By noticing, interpreting, and responding to teachable moments, teachers create inclusive, dynamic learning environments that inspire resilience, understanding, and a lifelong passion for mathematics (Rowland & Zazkis, 2013; van Manen, 2016). For K-12 mathematics teachers, teachable moments are lived experiences that highlight the art of teaching. These moments arise as interpretive encounters, where noticing and responding to students' needs transform ordinary classroom interactions into profound opportunities for growth. Rooted in the dynamic interplay of observation, reflection, and action, teachable moments require teachers to attune not only to cognitive gaps but also to the emotional undercurrents of their classrooms. Teachers like Ms. Adam, who recognized her students' struggles to connect percentages with fractions and decimals, exemplify how noticing is the first act of interpretation.

This relational process involves keen awareness of students' unique perspectives, opening a horizon of possibilities for learning. From here, taking up the moment becomes an intentional act of co-construction. For instance, Ms. Baker's encouragement to explore and rearrange shapes to grasp the logic of a parallelogram formula illustrates how such responses nurture both discovery and shared understanding. Reflection serves as the third essential layer. For Ms. Carter, pausing to ask why a student became emotional over the concept of the number 10 prompted her to reevaluate her teaching approach, deepening her sensitivity to the learning process. This reflective practice not only enriches immediate instruction but also inspires long-term professional growth, as teachers continuously adapt and refine their craft. Ultimately, teachable moments reveal the essence of teaching as a hermeneutic act—an interpretive, relational journey that transcends mere instruction. These moments invite teachers and students alike to explore the meanings embedded in learning, co-creating knowledge that is both personal and transformative. In these moments, the classroom becomes a space of mutual growth, where the human connection lies at the heart of education.

### **Conclusion**

This study began with a tension deeply rooted in my lived experiences as a teacher—moments when unanticipated insights and connections emerged in the classroom, calling into question the nature of these occurrences and their significance. These moments lingered, asking to be understood, compelling me to reflect on their essence and how they might shape teaching and learning. As I sought meaning, I turned to the work of Mason (2002), whose reflections on the unexpected illuminated the interplay of surprise and attentiveness in teaching. Yet, Mason's ideas, while enlightening, left an interpretive space—unanswered questions about how these moments are lived, carried forward, and sustained in the relational practice of pedagogy. It is

within this space of inquiry that this study finds its purpose, and significance to the body of research.

Through a hermeneutic phenomenological lens, I came to understand teachable moments not as fleeting or incidental occurrences, but as deeply relational opportunities—profound intersections of cognition, emotion, and human connection. These moments, as revealed through participants’ narratives, demand a heightened sensitivity and a deep attunement to the nuances of classroom life. They are lived experiences that redefine the act of teaching, transforming it into a relational practice of co-construction and shared meaning.

Mason’s (2015) assertion that “What matters even more than noticing an opportunity is how that opportunity is taken up” (p. 213) resonates as the heart of this inquiry. The participants described noticing as an interpretive act, requiring a capacity to see beyond the surface, to perceive the subtle shifts in classroom dynamics that signal potential for growth and understanding. Taking up these moments emerged as a dialogical and ethical engagement—an adaptive, human act where teachers meet their students in the space of possibility and co-create knowledge together. These are not technical maneuvers; they are deeply relational gestures that reflect the moral and interpretive dimensions of teaching.

In the act of noticing, reflecting, and adapting, teachers create learning conditions that transcend the transactional nature of mathematics education. Teachable moments become bridges—spanning gaps in understanding, validating diverse ways of thinking, and connecting abstract mathematical ideas to real-world contexts. These moments, when embraced, foster a sense of empowerment and belonging among students, enabling them to see themselves as capable, valued, and integral to the learning process. Mathematics, often perceived as impersonal or rigid, transforms into a living, humanizing experience that resonates far beyond the classroom.

What emerged through this inquiry is a profound recognition of teachable moments as sites of possibility where the ordinary becomes extraordinary. They invite teachers to step into the unknown with courage and responsiveness, deepening their engagement not only with their students but also with their own practice and identity as educators. These moments challenge us to embrace the unpredictability of teaching, to trust in the relational process, and to honor the transformative potential of education. In doing so, we create spaces for enduring and impactful learning, where students and teachers alike are empowered to grow, connect, and thrive.

### **Implications**

This study reimagines mathematics education not as the delivery of fixed content but as a relational, interpretive, and lived practice. Drawing on hermeneutic phenomenology—not as a method to follow but as a way of being—I attended closely to teachers’ lived experiences, staying present with the complexity of their everyday teaching moments. Rather than searching for final answers or universal truths, I approached these moments with openness—listening deeply, allowing meaning to unfold slowly, and honoring the uncertainty that comes with real teaching.

Hermeneutic phenomenology, as practiced in this study, is less about offering solutions and more about sitting—with stories, with questions, and with the layered nature of teaching as it happens in real time. This way of inquiry invited me to linger in the moments teachers described, to see not just what was said but how understanding was felt and formed in relationship. This orientation shaped how I engaged with the research questions and the narratives that emerged. In response to the first question—What are the lived experiences of K–12 teachers in their moment-to-moment teaching of mathematics? This study revealed teaching not as a mechanical act, but as

a deeply human and interpretive practice, where insight arises through presence, shifting classroom energy, and the ongoing back-and-forth between teacher and student.

This study calls on mathematics education practitioners, researchers, and policymakers to embrace the complexity and transformative potential of teachable moments. Teachable moments, as illuminated through the participants' stories, are not mere spontaneous opportunities, but require an intentional attunement to the unfolding dynamics of the classroom. For practitioners, this study underscores the critical need for cultivating an openness to the unexpected and an adaptive, responsive approach in teaching.

The implications here do not offer closure. They are gestures—toward more responsive, caring, and ethically grounded ways of teaching. They invite us to stay open, to pause, and to notice the subtle, meaningful shifts that occur in the everyday flow of classroom life. This study embraces a practical commitment—one that seeks to make meaning in ways that can transform teaching and learning. These implications are not step-by-step strategies. They are invitations to notice more deeply, to reflect more honestly, and to respond more humanely. They speak to teachers, teacher educators, policymakers, and researchers who are willing to be with the messiness and beauty of real classrooms, and who wish to engage with teaching not as a script, but as a living, breathing act of connection.

### **Implications for Teacher Education**

If we understand teaching as relational, interpretive, and always in motion, then teacher education must become a space where lived experience is not only welcomed but held with care. This study reveals that noticing and responding to teachable moments is not a technical task—it is a form of interpretive sensitivity. It is a way of being that requires teachers to be present, open, and attuned to the unfolding meanings of the moment.

Themes such as *Practicing Self-Reflection*, *Noticing Emotional Dimensions*, and *Bringing Real-World Applications into Teaching* illustrate that this kind of awareness does not arise from instruction alone—it emerges from lived engagement. These are not fixed competencies, but dispositions shaped through experience—through encountering the unexpected, staying with uncertainty, and being willing to reflect and re-story one’s teaching.

In teacher preparation, this study affirms the central role of experiential learning as a cornerstone for cultivating interpretive sensitivity. Programs must go beyond delivering theoretical content and instead immerse pre-service teachers in real or simulated teaching experiences where reflection on moment to moment teaching of mathematics can take root. Such experiences allow pre-service teachers to navigate the complexity of the classroom, engage relationally with students, and begin to make sense of their responses in the moment. In doing so, they learn not only what to teach, but how to listen—to their students, to themselves, and to what the moment is asking of them.

When teacher educators share their own moments of uncertainty—times they noticed something subtle, hesitated, or were changed by a student interaction—they model teaching as a hermeneutic act: interpretive, vulnerable, and open to transformation. These moments become invitations for pre-service teachers to reflect on their own stories, to dwell in their questions, and to begin crafting their own interpretive stance toward teaching.

Pedagogies of reflection—like lived journaling, inquiry through storytelling, and meaningful dialogue—offer pre-service teachers space to surface tacit knowing, attend to their inner responses, and interpret their experiences through multiple horizons. These approaches center story, emotion, and relational meaning-making—not as add-ons, but as vital aspects of learning to teach.



Mentorship, too, can be reimagined as a shared interpretive journey. When mentors model their own not-knowing, reflect aloud, and linger in the complexity of a moment, they show that becoming a teacher is not about achieving certainty—but about staying open, responsive, and reflective in the face of ambiguity.

\In a culture that often privileges speed, answers, and control, this study invites teacher education to embrace slowness, reflection, and the richness of lived experience. Dwelling in the complexity of the classroom allows pre-service teachers to become attuned to the layered, human dimensions of teaching—where growth is not linear, and meaning unfolds over time. Ultimately, teacher education must become a space of interpretive becoming—a space where pre-service teachers learn to respond not with scripts, but with presence, humility, and relational insight.

### **Implications for Policy**

If teaching is a lived and relational act—something that unfolds through presence, attentiveness, and care—then educational policy must begin from that place. Too often, policy frameworks are shaped by standardized, linear thinking that overlooks the unpredictable and deeply human nature of classroom life.

This study reveals that teachable moments are not planned—they emerge unexpectedly, in the flow of real-time relationships between teachers and students. These moments call on teachers to respond not with scripts, but with judgment, care, and ethical awareness. Teachers do not simply implement plans—they interpret what they see, feel, and hear in the moment. Their responses are grounded in experience and guided by a deep sense of responsibility to their students.

Themes such as *Noticing Students' Mistakes* and *Dialoguing with and Among Students* illustrate how learning often arises in moments of vulnerability and shared meaning-making—

not through control, but through openness. These moments are not measurable in neat categories. They require policy that trusts teachers as sense-makers, not just as deliverers of content.

Policy, then, can be reimagined as something that listens—something that recognizes the textured and emotional labor of teaching. Rather than narrowing the work to checkboxes and performance targets, policies should sustain environments where teachers can reflect, share stories, and make meaning together. This includes supporting professional development that centers classroom experiences and creates time for teachers to revisit, question, and interpret their everyday practices collectively.

Policymakers and educational leaders must also recognize the systemic supports required to nurture these interpretive and relational capacities. Integrating professional noticing into professional development frameworks is essential—not as add-ons, but as central practices in teacher growth. Structured opportunities for Pedagogies of reflection—such as lived journaling, inquiry through storytelling, and meaningful dialogue—offer teachers space to surface tacit knowledge, attend to their inner responses, and interpret their experiences across multiple horizons. These approaches center story, emotion, and relational meaning-making—not as add-ons, but as vital aspects of teaching. Peer observation, mentoring, and co-teaching create dialogical spaces where teachers learn with and from one another, cultivating a culture of shared growth. When policies create room for such practices, they affirm that understanding grows not just from theory, but from attentive engagement with the lived realities of classrooms.

Teachers in this study spoke of the teachable moment as a place of ethical responsibility—a place where they must choose how to respond, how to hold space, and how to guide students forward. Reducing their work to data points or compliance standards risks erasing the most powerful parts of teaching.

In this light, educational policy has the opportunity to shift. It can treat teachers not as technicians following prescriptions, but as co-constructors of educational meaning. It can make room for the emotional, relational, and intuitive dimensions of their work. Policy, like teaching, can become more responsive—bearing witness to the lived realities of classrooms and honoring the interpretive labor teachers carry every day.

### **Implications for Future Research**

Each of the three guiding research questions—on how teachers experience, notice, and take up teachable moments—open not only lines of inquiry but spaces of reflection. These are not questions that seek simple answers, but invitations to stay with the meaning-making that unfolds in the immediacy of classroom life. They point toward pedagogical, cultural, and epistemological horizons that are not fixed, but always in movement.

As a teacher-researcher, in this study, my understanding of learning is not detached or solely theoretical—it is lived, relational, and embodied. It is shaped through community wisdom, cultural heritage, and the generational transmission of ways of knowing. It is formed through daily acts of teaching and learning, where the classroom becomes a site of encounter—between self and other, past and present, question and possibility. Future research must take seriously how teachers' identities, experiences, and positionalities shape what they notice, how they interpret, and how they respond. Who we are shapes how we see. And in turn, how we see shapes what becomes possible in teaching. There is a need for research which offers counter-stories—ways of knowing and being that resist singular or universal truths.

Further research into the phenomenon of teachable moments holds significant potential to expand the understanding of this dynamic aspect of teaching. In the spirit of this hermeneutic phenomenological research study, further inquiry into the phenomenon of teachable moments

invites a deepened understanding of this dynamic and evolving aspect of teaching. Such research could illuminate the interplay between cultural, linguistic, and socioeconomic dimensions in shaping the conditions for the emergence and uptake of teachable moments, offering richer interpretations of how these experiences manifest and are enacted in diverse educational contexts. By engaging with the relational and contextual dimensions of teachable moments, such research has the potential to uncover the deeper meanings and transformative possibilities they hold within the shared lifeworld of the classroom.

We must remain open to the understanding that phenomenological and relational sensibilities are already deeply woven into many Indigenous worldviews—where knowledge is not transmitted, but lived through story, relationship, and the everyday. These ways of knowing do not sit apart from theory; they *are* theory in motion, in practice, in presence. Attending to them stretches and deepens what we understand it means to teach, to know, and to be in relation with others.

This study does not conclude with final answers. Instead, it offers an opening—a space to linger. To engage with hermeneutic phenomenology is to take up a way of being that listens deeply, dwells with complexity, and returns again and again to lived experience—not to reduce it, but to let it speak. It is a stance of curiosity, humility, and care.

Longitudinal studies exploring the unfolding of teachers' noticing and reflective capacities over time could provide profound insights into the temporal arc of professional growth, revealing how these capacities evolve and contribute to the lived experience of teaching, as well as their influence on student learning trajectories. Future inquiry might also explore how sudden insights—or moments of clarity—shape teachers' evolving sense of self. It can follow how teachable moments unfold across diverse educational landscapes—whether urban or rural,

culturally rich or trauma-informed—and trace the specific tensions and possibilities that emerge in each.

Moreover, examining the relationship between teachable moments and broader educational imperatives—such as equity and inclusion—could reveal the ways in which these moments serve as conduits for fostering more just and responsive educational practices. In expanding this horizon of understanding, future studies may enrich the pedagogical significance of teachable moments, unveiling their capacity to shape not only the immediate dynamics of learning but also the broader purpose of education in cultivating equity, engagement, and human connection.

Interpretive research that lingers with the ordinary—a pause, a gesture, a silence—can reveal the relational and ethical heart of teaching. Noticing, interpreting, and responding are not just strategies; they are practices of being-with. They invite us to recognize that teaching is not only what we do, but how we are—with students, with knowledge, and with the unfolding moment.

### **Personal Epilogue: A Reflection on Teachable Moments in Mathematics Education**

As I embarked on this journey into the hermeneutic phenomenology of teachable moments, I was guided by a simple yet profound question: what does it truly mean to teach? This inquiry was not born of abstraction but rooted in my own lived experience—one that has lingered in my memory as both a source of inspiration and a touchstone for understanding the transformative nature of education.

It was Halloween during my first year of teaching, and I had decided to dress as Cleopatra, weaving a tale that sought to unite history and mathematics. I stood before my students, narrating the evolution of the circle, thinking it would spark curiosity and help bridge

the gap between the abstract and the tangible. What unfolded, however, surpassed all my expectations. The story of a line transforming into a circle spiraled into an expansive conversation—one that touched on Christopher Columbus’s voyages, the nature of discovery, and even the philosophical musings of karma.

In that moment, I found myself at a crossroads: Should I steer the discussion back to geometric properties, or should I embrace the organic trajectory of my students’ curiosity? It was disorienting, yet exhilarating. The boundaries of my planned lesson dissolved, revealing a deeper truth: the curriculum is not a cage, but a starting point. For me, the word “revelation” evokes something far deeper than a mere realization—it feels like a curtain being drawn back, revealing the essence of what teaching truly is. I didn’t just stumble upon a new insight; it was as though a light broke through, illuminating the relational and transformative power of education. In that moment, I understood that teaching is not about standing at the front of a room dispensing knowledge; it’s about stepping into the current of learning alongside my students. This revelation humbled me, yet it also filled me with a quiet sense of empowerment. I realized that the true artistry of teaching isn’t in rigidly following a plan but in being open to the unexpected, where uncharted moments spark the most profound learning.

Looking back, I realize this moment was not just a pedagogical highlight—it was deeply mathematical. Mathematics, I came to see, is not confined to formulas or numbers: it is a way of thinking, connecting, and reasoning. That day, my students and I engaged in a form of mathematical thinking that transcended the conventional. It was this experience—this profound interplay of spontaneity, curiosity, and connection—that planted the seed for this research.

Through the lens of hermeneutic phenomenology, this study became my way of making sense not only of that moment but also of countless others shared by fellow educators. Through casual yet reflective conversations with my teacher friends, I discovered that they, too, had

similar experiences as new teachers, navigating the surprises, challenges, and revelations that shape the early years of teaching. This evolved into a hermeneutic exploration of what it means to teach and learn through teachable moments. As I listened to the stories of teacher participants, themes emerged that resonated with my own experiences: *Noticing Students' Gaps in Mathematics Understanding*, *Dialoguing and Discussion With and Among Students*, and *Bridging Real-World Applications Into Teaching*. These themes were not abstract concepts: they were living, breathing experiences, filled with the humanity and vulnerability of educators navigating the unpredictable terrain of the classroom.

As I wove together the narratives shared by participants, I began to recognize the profound interplay of cognitive and emotional engagement in teachable moments. Each story revealed how emotions—frustration, curiosity, or excitement—serve as indicators of learning, calling for the teacher's attunement and responsiveness. I came to understand that noticing is not merely observing; it is a deliberate and active process of interpreting and responding to the evolving dynamics of the classroom. This practice, steeped in humility, demands that teachers embrace vulnerability, acknowledging that we are co-learners alongside our student

Teaching, I have learned, is a practice that rests on the delicate balance of control and openness. It is through the humility of admitting what we do not know and the courage to follow the unexpected that we foster trust and curiosity. Each teachable moment reminds us that the classroom is a space where meaning is co-constructed—a relational process that transforms both teacher and learner. Schön's (1983) reflection-in-action offered a lens through which to understand the iterative nature of teaching—the way we adapt, respond, and co-construct knowledge in real-time. These moments require more than expertise; they demand presence, openness, and a willingness to embrace the unknown.

I've come to see teachable moments as threads woven into the larger fabric of education. They connect the abstract with the tangible, the personal with the collective, creating a rich tapestry of meaning. These moments empower my students, inviting them to step into their roles as active participants in their own learning, while also reminding me of the deeply relational nature of teaching. It's in these connections—between ideas, between people—that the true essence of education comes alive.

Teaching, I have come to realize, is not a transactional act but a relational and creative one. It is an invitation—to explore, to connect, to wonder. It is not simply an act of imparting knowledge but a profoundly human endeavour, one that requires us to remain open to the mysteries and surprises that unfold in the act of learning together.

In the end, this study is not just about teachable moments: it is about the evolution of my own identity as an educator. It has illuminated a path toward teaching that is reflective, inclusive, and deeply attuned to the unpredictable beauty of learning. These moments remind me of why I teach: not simply to impart knowledge but to co-create it, to inspire curiosity, and to learn alongside my students. Through this research, I hope to have captured the essence of these transformative moments, offering a lens through which others might recognize and harness their power. It is in these moments that we glimpse the true heart of teaching: to connect, to inspire, and to be inspired.



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## Appendix A

### Mathematics Teachers' Lived Experiences of Teachable Moments

#### Introduction

As you may know, my name is Amanjot Toor and I am doctoral candidate at Brock University. The title of my study is *Mathematic Teachers' Lived Experiences of Teachable Moments*. Thank you so much for volunteering to participate in the interview for my study. During this interview, I will be asking you open-ended questions. Please provide examples and as much details as possible. I also will be following up with some questions and prompting you to give examples, details, and clarification when needed. Please feel free to ask me for clarifications if and when you do not understand the question.

(Suggested prompts: "Tell me more"; "Can you explain that to me?"; "Can you give me an example of that/what you mean?" etc.)

#### Interview Questions

1. Please tell me about how you came to teach mathematics at your grade level and what background teacher training or education you have received to teach mathematics?
2. What does it mean for you to be a mathematics teacher?
3. What does it mean for you to teach mathematics?
4. Please recall from your teaching experiences a particular moment or moments when you noticed something unexpected or a surprise. I would like you to try as much as possible to describe the details of that moment as you experienced it. Try not to speculate, imagine or guess; just stick to your personal experience; just tell it as you experienced it. In other words, just describe it as it happened or as you lived through it. Please include as much concrete details as possible.
  - a. Where were you when this moment happened?
  - b. What did you see?
  - c. How did you feel?
  - d. What struck you during the moment or about the moment?
  - e. What was, for you the key issues or points about the moment?
  - f. What did you do about the moment?
5. This study is about *Mathematic Teachers' Lived Experiences of Teachable Moments*. Is there anything that I have not asked you but it would be useful for me to know?

## Appendix B

### Letter of Invitation

March 2023

Title of Study: Mathematics Teachers' Lived Experiences of Teachable Moments

Principal Investigator: Joyce Mgombelo (PhD), Associate Professor, Mathematics Education, Faculty of Education, Brock University; jmgombelo@brocku.ca | T 905 688 5550 x5117

Student Principal Investigator: Amanjot Toor, Doctoral Candidate, Faculty of Education, Brock University; aman.toor@brocku.ca; Tel. (905) 580-3301

Dear \_\_\_\_\_

I, Amanjot Toor, a PhD Candidate in the Joint PhD program, Brock University, invite you to participate in a research project entitled Mathematics Teachers' Lived Experiences of Teachable Moments.

The purpose of my research study is to explore mathematics teachers' lived experiences of teachable moments. At this stage, the term teachable moment is defined as opportunities that arise when connection has been made to advance learning, recognize learning or recognize the gap in learning by an educator. The study will focus on lived experiences of moment to moment teaching of mathematics for K to 12 mathematics teachers. Should you choose to take part in this research, you will be asked to participate in a semi-structured interview which will be conducted virtually (Microsoft TEAMS) and will consist of questions about your personal lived experiences of teachable moments. As a participant, your workplace location is not important, as I am only interested in your personal lived experiences of the central phenomena of this study, which is teachable moments. The questions will be about your experience of teaching mathematics. Specifically, you will be asked to recall your experience of moment-to-moment teaching of mathematics. The interview will take approximately 60 minutes in total of your time.

If you are interested in participating in this research, please e-mail by [DATE] at aman.toor@brocku.ca and provide me with the following information: your gender, number of years in teaching mathematics, and grades you have taught. Using the information you provide, six teachers will be selected, ensuring balance of years of teaching mathematics, as well as ensuring a fair process that will include a diverse group.

The findings of this study will benefit mathematics educators and teachers by shedding light on the characteristics of teachable moments in mathematics education. Additionally, the reflective and recalling nature of interview questions may bring participants to become aware about their pedagogical practices.

If you have any pertinent questions about your rights as a research participant, please contact the Brock University Research Ethics Officer (905 688-5550 ext. 3035, reb@brocku.ca)

If you have any questions, please feel free to contact me (see above for contact information).

Thank you,

This study has been reviewed and received ethics clearance through Brock University's Research Ethics Board [Ethics file #].

## Appendix C

### Informed Consent Letter – Individual Interviews

**Project Title:** Mathematics Teachers' Lived Experiences of Teachable Moments.

**Principal Investigator (PI):** Joyce Mgombelo (PhD), Associate Professor, Mathematics Education, Faculty of Education, Brock University.  
[jmgombelo@brocku.ca](mailto:jmgombelo@brocku.ca) | T 905 688 5550 x 5117.

**Principal Student Investigator (PSI):** Amanjot Toor, Doctoral Candidate, Faculty of Education, Brock University; aman.toor@brocku.ca; Tel. (905) 580-3301

#### INVITATION

You are invited to participate in a study that involves research. The purpose of this research project is to explore mathematics teachers' lived experiences of teachable moments. At this stage, the term teachable moment is defined as opportunities that arise when connection has been made to advance learning, recognize learning or recognize the gap in learning by a learner and/ or an educator.

#### WHAT'S INVOLVED

As a participant, you will be asked to participate in a semi-structured one-on-one audio-recorded interview that will last approximately 60 minutes. The interview will be conducted virtually (Microsoft TEAMS) and will consist of questions about your personal lived experience of teaching mathematics. Specifically, you will be asked to recall your experience of moment-to-moment teaching of mathematics.

The researcher will collect field notes to record her experiences and thinking during the interview. The audio-recorded interviews will later be transcribed. Furthermore, within two weeks after an interview, each participant will be asked to review an exact transcript of their interview for verification purposes (member check). All participants will be given a corresponding two weeks to respond with any inconsistencies. After two weeks it will be assumed that transcribed data is correct.

#### POTENTIAL BENEFITS AND RISKS

There is no direct benefit to the participants from their involvement in the study. The reflective and recalling nature of interview questions may bring participants to become aware about their pedagogical practices. During the interview, participants may feel embarrassed, judged, distressed, or become emotional due to the reflective opportunities on their mathematical content and pedagogical knowledge. The findings of this study will benefit mathematics educators and teachers by shedding light on the characteristics of teachable moments in mathematics education. There are no risks for participants in this study.

#### CONFIDENTIALITY

All information collected in this study will be treated confidentially. Participants are guaranteed any personal information that can identify them, will be kept private. Personal identifiers such as name and contact information will only be known to the Principal Investigator and the Principal Student Investigator, and only the said persons will have access to data. Each data, including transcript and audio-recorded interview will be stored using pseudonyms. Furthermore, only pseudonyms will be used in reporting. That is, while gender, year of teaching experience and background education of participant may be reported, only pseudonyms will be used for names, locations, and institutions in reporting. All data about the research will be stored in the Principal Student Investigator's password-protected computer in password-protected files.

There is no penalty for withdrawing. In case, if a participant withdraws from the study, participants will be asked if they would like their data to be included or destroyed. Any information that participants choose to be destroyed will be destroyed and not be used in the study.

All paper documents relating to this study will be kept in a locked file cabinet in the Principal Student Investigator's home. All electronic files, including consent forms and data, will be saved in the Principal Student Investigator's password-protected computer in password-protected files. After the transcription is completed, the audio recordings will be destroyed. All data will be kept for one year allowing time for dissemination and publication. At that time, paper documents will be destroyed by shredding, and electronic files, including emails, computer files, and audiotapes, will be deleted.

### **VOLUNTARY PARTICIPATION**

Participation in this study is voluntary. You can withdraw your participation from the study at any time. Furthermore, you can decline answering any of the questions if you wish without withdrawing from the study.

### **PUBLICATION OF RESULTS**

Results of this study may be published in professional journals and presented at conferences. Feedback about this study will be available through the Principal Student Investigator whom could be contacted by email at [aman.toor@brocku.ca](mailto:aman.toor@brocku.ca). The feedback will be made available after the publication of the findings.

### **CONTACT INFORMATION AND ETHICS CLEARANCE**

If you have any questions about this study or require further information, please contact Amanjot Toor or Dr. Joyce Mgombelo using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University [file # 22-266 – MGOMBELO]. If you have any comments or concerns about your rights as a research participant, please contact the Office of Research Ethics at (905) 688-5550 Ext. 3035, [reb@brocku.ca](mailto:reb@brocku.ca).

Thank you for your assistance in this project. Please keep a copy of this form for your records.

### **CONSENT FORM**

I agree to participate in this study described above. I have made this decision based on the information I have read in the Information-Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

Name: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_



## Appendix D

### Certificate of Ethics Clearance



Brock University  
Office of Research Ethics  
Tel: 905-688-5550 ext. 3035  
Email: reb@brocku.ca

Social Science Research Ethics Board

#### Certificate of Ethics Clearance for Human Participant Research

DATE: 4/17/2023  
 PRINCIPAL INVESTIGATOR: MGOMBELO, Joyce - Educational Studies  
 FILE: 22-266 - MGOMBELO  
 TYPE: Ph. D.  
 TITLE: Lived Experience of Mathematic Teachers with Teachable  
 Moments OR The Experience of Knowing in Mathematics Teaching in Moment to Moment Bases

#### ETHICS CLEARANCE GRANTED

Type of Clearance: NEW

Expiry Date: 4/1/2024

The Brock University Social Science Research Ethics Board has reviewed the above named research proposal and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement. Clearance granted from **4/17/2023 to 4/1/2024**.

The Tri-Council Policy Statement requires that ongoing research be monitored by, at a minimum, an annual report. Should your project extend beyond the expiry date, you are required to submit a Renewal form before 4/1/2024. Continued clearance is contingent on timely submission of reports.

To comply with the Tri-Council Policy Statement, you must also submit a final report upon completion of your project. All report forms can be found on the Office of Research Ethics web page at:  
<https://brocku.ca/research-at-brock/office-of-research-services/research-ethics-office/#application-forms>.

In addition, throughout your research, you must report promptly to the REB:

- Changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
- All adverse and/or unanticipated experiences or events that may have real or potential unfavourable implications for participants;
- New information that may adversely affect the safety of the participants or the conduct of the study;
- Any changes in your source of funding or new funding to a previously unfunded project.

We wish you success with your research.

Approved:

Nicole Luke, Chair  
Social Science Research Ethics Board

**Note:** Brock University is accountable for the research carried out in its own jurisdiction or under its auspices and may refuse certain research even though the REB has found it ethically acceptable.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of research at that site.