Saint Francis Xavier University

BEGINNING MATHEMATICS TEACHERS' PERCEPTIONS OF PREPAREDNESS FOR AN OECS TEACHER EDUCATION PROGRAM

By

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A Dissertation Submitted to
The St. Francis Xavier University Faculty of Education

In Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Educational Studies

Antigonish, Nova Scotia

Acknowledgment

I extend my heartfelt thanks to Almighty God for sustaining me and preserving my health throughout the challenging process of writing this dissertation. My gratitude extends to my husband, Gilbert, whose unwavering love and endurance were indispensable during the doctoral program and dissertation process. I also appreciate the love, patience, and understanding of our children, Jodi and Gerard. The encouragement and sacrifices made by my family played a vital role in the successful completion of this dissertation.

I am deeply thankful to Dr. Jennifer Mitton, my dissertation advisor, for her continuous guidance, encouragement, and expertise throughout the entire program, especially during the challenging task of writing this dissertation. Dr. Mitton's passion for learning and dedication to research have been a constant source of inspiration, enabling me to achieve what once seemed impossible. I am grateful for her mentorship, which significantly contributed to the improvement of my research skills. Without her consistent feedback, care, and support, the completion of this dissertation would not have been possible.

Acknowledgment is due to my committee members, Dr. Evan Throop-Robinson and Dr. Gregory MacKinnon, for their thought-provoking feedback and critical insights. Dr. Throop-Robinson's emphasis on pertinent issues in mathematics education has been particularly valuable, while Dr. MacKinnon's encouragement, sacrifice, and commitment to excellence in research are deeply appreciated.

I would also like to recognize and express my gratitude to the teacher participants, the Ministry of Education in St. Vincent and the Grenadines, and the schools for consenting to participate in this research. Their willingness to contribute has significantly enriched the body of knowledge, and I value their role in helping me grow professionally during this research process.

I want to express my special appreciation to Dr. Jeff Orr, who was the first person to encourage me to pursue PhD studies and supported me throughout the entire process. Additionally, I am grateful for the financial assistance provided by the Racial Justice Leadership Grant from the Frank McKenna Centre for Leadership and Mindbloom Education Consultancy. Their support played a crucial role in successfully completing my doctoral degree program.

I am grateful to Mr. Nigel Scott, the Director of the Community College, and Dr. Marise Butler, the Dean of the Division of Teacher Education, for granting me the study leave necessary to complete this dissertation. Lastly, I appreciate the encouragement and support received from all my colleagues in education throughout this challenging dissertation journey.

Abstract

The primary objective of this qualitative case study was to investigate the perceptions of elementary Beginning Mathematics Teachers (BMTs) regarding an OECS teacher education program. This exploration specifically focused on the impact of the program on their mathematics pedagogy and teaching practices, with an emphasis on their preparedness to teach in the practical context of Saint Vincent and the Grenadines. The study employed theoretical frameworks such as pedagogical content knowledge, signature pedagogies, and problem-based learning to interpret and understand the beliefs and practices of BMTs.

Concentrating on the personal experiences of voluntarily participating Beginning Teachers (BTs) who completed the Division of Teacher Education program in St. Vincent and the Grenadines, the study utilized 18 semi-structured interviews, 27 classroom observations, 21 artifacts, and 27 BT reflections to gauge participants' perceptions based on their lived experiences. Through coding and analysis, the data were examined to comprehend participants' experiences.

The study revealed that although beginning teachers (BTs) generally viewed their Teacher Education Program positively, they faced unanticipated challenges such as insufficient preparation for issues like resource scarcity, large class sizes, diverse student abilities, limited technology integration opportunities, and inevitable classroom management problems. Despite a 10-week teaching practicum, participants unanimously advocated for more microteaching activities integrated into all coursework to enhance their teaching skills.

The recommendations for a more effective transition of BTs to full-time classroom teachers involve incorporating an internship period along with a mandatory induction program as they enter the teaching profession.

Table of Contents

List of Abbreviations

Abbreviations	Definitions
AMTE	AMTE
BMTs	Beginning Mathematics Teachers
BTs	Beginning Teachers
CSEC	Caribbean Secondary Education Certificate
ERIC	Education Resources Information Centre
GTE	General Teaching Efficacy
JBTE	Eastern Caribbean Joint Board Teacher Education
JBTE/MAT	Eastern Caribbean Joint Board Teacher Education/Mathematics
JBTE/TP	Eastern Caribbean Joint Board Teacher Education/Teaching Practice
MKT	Mathematic Knowledge for Teaching
MCK	Mathematics Content Knowledge
MPK	Mathematics Pedagogical Knowledge
MOE	Ministry of Education
NCSM	National Council of Supervisors of Mathematics
NCTM	National Council of Teachers of Mathematics
OECS	Organization of the Eastern Caribbean States
PCK	Pedagogical Content Knowledge
PSTs	Preservice Teachers
PTE	Personal Teaching Efficacy
PTSE	Preservice Teacher Education
SoTL	Scholarship of Teaching and Learning
SSE	Sense of Self-Efficacy
STEM	Science, Technology, Engineering, and Mathematics
StFX	St. Francis Xavier University
SVG	St. Vincent and the Grenadines

Chapter 1: Introduction

Identity and Positionality

Through personal experiences and diverse career opportunities, I have developed a strong commitment to improving the quality of education by supporting teachers. As a high school student from a low-income family, I struggled with learning mathematics until I experienced good teaching. Hence, I feel compelled to conduct a research study that will allow me to investigate elementary teacher pedagogy and its relationship to teaching mathematics. I am opting for teaching philosophies that promote equal opportunities and social justice (Gates, 2009; Panthi et al., 2018; Stinson et al., 2012; Vale et al., 2016) due to my growing understanding of issues of power and privilege informing the lack of achievement in mathematics amongst learners in St. Vincent and the Grenadines (hereafter SVG). I have been a teacher for over 30 years and have taught at all levels. I am a mathematics lecturer at the SVG Community College - Division of Teacher Education. My position involves preparing preservice teachers to teach mathematics effectively at the early childhood, elementary, and high school levels.

My Role as Practitioner/Researcher

History preceded us. I was one of three children born into a working-class family in a small rural village called Fair Hall in SVG. My father had migrated from St. Vincent to a nearby island in search of better job opportunities by the time I was two months old, so I grew up without my father. Eventually, he moved on with his life and started a new family, as did my mother who left school at around grade 8 to become a seamstress.

My mother was a single parent with two children when I began my formal educational journey. I attended a primary school in the rural community where I lived. Many students back then would not have gone above the primary school level, and many dropped out even before graduating. My aunt was a teacher who inspired me to do my best despite the environment. Additionally, some of my teachers took an interest in me and caused me to believe that I had what it took to do well in school. In the primary exit exams, I obtained a pass and was able to attend the top girls' secondary school in the country, the St. Vincent Girls High School. It was a significant achievement for my family, school, and community that I was the first person in my family to attend the country's most prestigious girls' school. Everyone celebrated, and I felt exceptional.

My time at high school is remembered with mixed emotions: from friendships forged to classes that I could not wait to be over because of poor-quality teaching. My education was not only in the form of being taught in a classroom. I was made a class prefect and put in charge of one of the most challenging classes. Here, I learned leadership and responsibility. From as early as I can remember, I heard that mathematics was difficult, but I fell in love with it for some reason. I enjoyed my primary school mathematics experience because it was engaging and fun. My lower secondary experience of just the "chalk and talk" way of mathematics instruction made me think I had no hope of passing mathematics. Still, when I got to grade 10, I was blessed with a passionate mathematics teacher who helped turn my entire mathematics experience around. Today, I believe everyone can learn mathematics if exposed to quality teaching. Another thing that caused me to persevere in mathematics is that I knew the only way to change my family's socioeconomic status was to do well in school.

Early Career Context

I did reasonably well on the high school exit exams, and after completing Advanced Subjects, I began my teaching career at 18 years old. I taught at a coed rural high school. In those first years, I experienced all the ups and downs that most early career teachers encounter. However, I slowly established myself within the school as I worked on improving my mathematics teaching. I saw how students who initially thought that they could not learn became excited about learning. I saw many boys who were labelled as troublemakers and "will amount to nothing good" change their attitudes toward school and were able to graduate. To this day, some of these boys, who are now adults, will often call or visit to update me on their accomplishments as adults. They credit the impact of my teaching skills, which resulted in an attitude adjustment, and thus, they could benefit from becoming educated.

I became the first member of my family to obtain an undergraduate degree. By this time, I was married and had started a family. During my undergraduate studies, I was introduced to the idea of pedagogy. I had entered the teacher education program believing that teaching was only a matter of telling or showing others how to do something. There was much more to it! I was intrigued that there might be different approaches to teaching that should be implemented depending on the context – there was no single right way, an echo of fallibilism. During the practicums, I became more aware of the complexity of the classroom and learned that my best lessons were those that were approached as a problem to solve. I also understood that documenting what worked and what did not and reflecting on that made a difference in the success of follow-up lessons. It seems that those in higher education thought I had some potential, so I was transferred to the Division of Teacher Education at our lone community college. While being a lecturer, I realized I needed further training to prepare an effective preservice teacher to teach mathematics better. I then applied for and was granted a Fulbright Scholarship to attend NC State University in Raleigh, North Carolina, USA.

Theoretical Context

Completing doctoral studies was not a goal I thought I would have accomplished at this stage in my life because I felt I could not afford it. My salary is very minimal; I have two children who are both in university, and I have to assist them financially. However, I met Dr. Orr during one of his consultancy visits to SVG, and he was my motivating factor when applying to the doctoral program. He made me believe that completing doctoral studies was possible and that it was vital that I do. I applied and eventually enrolled in this doctoral program, and I have not regretted it. So far, I have had tremendous learning experiences.

Despite coming from a single-parent home where resources were extremely scarce, I have seen how quality teaching has changed my socioeconomic position. Throughout my life journey, I have learned that quality teaching will result in a good education. As I journeyed through the writing of this dissertation, I became more enlightened, which resulted in the constant refinement of my research topic and a shifting between research paradigms. I started this journey as a constructivist (Piaget, 1970), moved to a pragmatist (James, 1975), and after reflecting on my ideologies and beliefs, I stand firm as a constructivist. As a constructivist, I believe that each learner should actively participate in the learning process, and educators act as both facilitators and guides, carefully planning and organizing learning experiences while offering support and resources to their students. Being a constructivist was important in my research since I explored the perceptions of beginning mathematics teachers (BMTs) about their preparedness to teach mathematics after completing their teacher education program. Participants were involved in constructing their understanding of teaching mathematics through professional collaboration and continuous monitoring of their practice, which led them to seek out collaborators or critical friends.

From an ontological perspective, I believe reality is experienced and constructed socially (Merriam & Tisdell, 2016). Therefore, the focus of my research was not the subject of teacher preparedness or BMTs but the relationship between both. Hence, to explore BMTs' perception of their preparedness to teach, I focused on teacher participants' experiences in the classroom. My epistemological view is that knowledge can be subjective and objective (Johnson & Onwuegbuzie, 2004). I believe that effective mathematics teaching must be facilitated by active engagement with hands-on, practical, contextual problem-solving and poised for teachers to form their relationship with what they are learning through their sense-making. My axiological position is that values are integral to our social life (Merriam & Tisdell, 2016). My goal was to help BMTs develop the value of meaningful mathematics learning in the classroom.

History Paints a Complex Context for the Study

My homeland, SVG, is a former British colony. History confirms that our only national hero, Carib Chief Joseph Chatoyer, was ambushed and brutally murdered as the British sought to remove Garifuna citizens from their homes. Colonial society in SVG consisted of an elite white minority that owned the means of production, a small East Indian community, while most of the population were enslaved Africans. Thus, after the abolition of slavery, miscegenation occurred between these classes, producing a racial hierarchy based on the percentage of "whiteness" of citizens (Tate & Law, 2015a). This phenomenon is known as "colorism," as discrimination was based on skin complexion rather than race.

When introducing formal education, the colonists ensured that the standards aligned with the needs of their mother countries. Since independence, most of the Caribbean states have not improved their education system, which has caused a disparity between Vincentians of higher income who can afford private schools and tutors and those in lower-income classes. The descendants of colonists predominantly have positions of privilege, wealth, and status in Caribbean society due to the legacy of colorism (Tate & Law, 2015b). Thus, people of lighter skin tones often have better educational outcomes than their darker counterparts, who are descendants of slaves (Kelly, 2020; Longman-Mills et al., 2019; Thompson & McDonald, 2016). Additionally, the education system in my country does not promote innovation and entrepreneurship, which negatively affects significant economic growth (Chaney et al., 2012).

Mathematics Education Driven by Foreign Interests

The issues identified above are related to Vincentian history and create challenges for us in the teaching and learning of mathematics. The mathematics curricula designed by experts and implemented by the government at all grade levels are not aligned with our culture. We teach foreign mathematics curricula, content imposed upon the teachers and students of SVG, which does not consider the particular needs of SVG students, the diversity and values of our society, or the norms of the Caribbean culture.

The government of SVG has emphasized an urgent need to increase the number of learners who are sufficiently proficient in mathematics – that is, who have successfully passed the Caribbean Secondary Education Certificate (CSEC) examination. This limited pool of mathematically proficient graduates entering the workforce each year hinders the nation's economic growth, particularly in an emerging resource-based economy. Consequently, improving mathematics learning outcomes necessitates a concurrent improvement in teaching and assessment practices.

Barrows (1996) advocated integrating various teaching and assessment methods to enhance the effectiveness of mathematics instruction. This observation remains relevant today, as research by Kim et al. (2019) and DeJaeghere et al. (2021) suggests that utilizing diverse teaching and assessment strategies fosters deeper learning. Scholars emphasize that teacher education programs should prioritize principles of effective pedagogy to equip preservice teachers with the skills necessary to develop these practices. Such a focus is crucial for driving reform in mathematics education.

Where to Begin Preparing Novice Teachers

BMTs in SVG face the persistent challenge of engaging learners in mathematics learning while attempting to address educational gaps. Many scholars advocate for training teachers to become catalysts for change within the education system. (Pettersson & Molstad, 2016). Teacher preparation programs significantly contribute to this process by equipping educators to actively participate in shaping educational systems and practices, moving beyond simply implementing standardized approaches. For example, Harmer (2001) emphasized that teaching means creating conditions for students to learn from themselves. To do so, however, means a teacher is knowledgeable and competent in teaching the content. Leacock (2020) found another challenge for many BMTs: they know the best practices for teaching mathematics. Still, their limited content knowledge interferes with their ability to implement these practices successfully. As a result, they struggle to translate theoretical knowledge into practical classroom strategies.

Student Attitudes Towards Mathematics

Research in SVG suggests a concerning trend: disliking math is becoming socially acceptable, even among successful students. This trend aligns with national exam results (Ministry of Education, National Reconciliation, 2018-2019), revealing significant math achievement gaps across socioeconomic groups. Studies elsewhere (Boaler, 2011; Leonard et al., 2020; Noyes, 2009) confirm a strong link between social class and math achievement. In SVG, this translates to higher failure rates in math for students from lower-income families. Unequal access to quality math education, often linked to socioeconomic background (Ministry of Education, National Reconciliation, 2018–19), disadvantages students and limits their career opportunities. Therefore, reforming math education in SVG can improve student attitudes toward math, promote educational equity, and ultimately create a level playing field for future careers.

Significance of the Research

Equipping future educators with the tools to teach diverse classrooms is a core objective of preservice teacher education programs (PSTEs) in the Eastern Caribbean (Damoah & Omodan, 2023). Better-trained teachers will help address some low-achieving mathematics students' equity issues by improving mathematical instruction for all (Arthur et al., 2017). However, even with better teaching methods, if students fail to perceive the relevance of math in their daily lives, their academic performance may not improve regardless of instructional improvements.

This study advocates for a better understanding of the conditions and supports that nurture the development of quality teaching. Darling-Hammond (2000) argued that effective teaching involves delivering high-quality instruction tailored to meet students' varied learning styles and aligning with subject matter requirements and specific learning objectives for the context. The above description explains that the quality of teaching is strongly connected with a teacher's skill in preparing lessons as actualizations of their ability to meet diverse learners' needs. Hence, the quality of training provided through preservice teacher education (PSTE) programs potentially impacts teachers' practice, effectiveness, and career commitment (Muzaffar et al., 2011). Well-designed teacher training programs can significantly improve classroom teaching and learning outcomes. According to Darling-Hammond et al. (2019), these programs focus on personalized teaching methods, connecting learning to real-world issues and creating inclusive environments. Research suggests a strong link between student achievement, teacher quality, and the effectiveness of preservice teacher education (PSTE) programs (Nye et al., 2004; Rivkin et al., 2005; Verspoor, 1989). Therefore, investing in developing and maintaining high-quality PSTE programs is crucial for initiatives to improve teaching and learning for all students (Shaked, 2023). The World Bank Annual Report (World Bank Group, 2017) and its examination of the Organization of the Eastern Caribbean States (OECS) underscore how economic instability and recurring natural disasters in OECS nations have diminished financial support for education.

Consequently, there is a lack of adequate funding and a shortage of adequately trained teachers, significantly impacting the quality of education in these countries. Hence, the countries of the OECS have recognized that the solution to the social and economic development crisis must come through improvements in the quality of education provided to citizens (Alexander & Corbin, 2017). This study is essential to help teacher educators understand the experiences of Vincentian BMTs, particularly in light of the limited funding for education in the region, and to help them rigorously prepare and improve the quality of education for the next generation of teachers with the realities of Vincentian schools in mind.

Purpose of the Study

The impetus for this study is to examine BMTs' perceptions of their preparedness for and transition to full-time teaching. This study is important since improvements in student learning depend on substantial, large-scale changes in how teachers are prepared and supported to teach (Ball & Forzani, 2009; Darling-Hammond, 2000; Manasia et al., 2020; Zhukova, 2018). This research is the first of its kind in the Eastern Caribbean, and it will provide the stakeholders with information about the currency of the JBTE Primary program that is being offered in the OECS. The following research questions will guide this study:

- What are beginning Vincentian elementary teachers' perceptions about their overall preparedness to teach mathematics?
- When considering their preparedness, what do beginning Vincentian elementary teachers identify as key factors influencing their early career mathematics regarding their content knowledge?
- When considering their preparedness, what do beginning Vincentian elementary teachers identify as key factors influencing their early career mathematics regarding pedagogical knowledge?
- What do beginning Vincentian elementary teachers identify as schooling context constraints that shape how they teach mathematics?
- What do beginning Vincentian elementary teachers identify as personal constraints shaping their teaching mathematics?

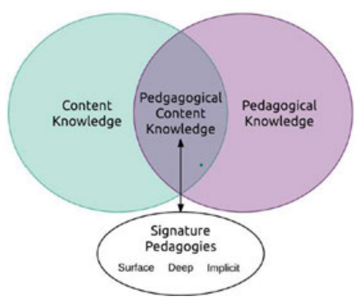
Theoretical Framework

One way to inform my understanding of BMTs' early career experiences is to use theory to evaluate my beliefs, thus challenging my knowledge of the research context and my practices (Sandretto, 2009). I used multiple theoretical perspectives to help and challenge assumptions when analyzing and organizing my understanding of the phenomenon under investigation and my thinking. This framework enabled me to determine how to interpret and understand BMTs' beliefs and practices. In what follows, I discuss the theories of pedagogical content knowledge (PCK) (Shulman, 1987), signature pedagogies (Shulman, 2005), and problem-based learning (PBL) (Barrows, 1996) in connection to BMTs' experiences.

Pedagogical Content Knowledge

Figure 1

Intersection of Content & Pedagogy in Signature Pedagogies



Note. This diagram was retrieved from Smith & Kanuka (2018). It illustrates the intersection of disciplinary content and pedagogical knowledge relating to the elements of signature pedagogies as outlined in Shulman (1986, 2005).

This research investigates the relationship between teachers' mathematics knowledge and teaching methods, explicitly focusing on PCK as a framework. Shulman's (1987) concept of PCK argues that effective teachers possess subject matter expertise and the skill to transform that knowledge into engaging and successful pedagogical practices (see Figure 1). Shulman (1986) distinguishes between content knowledge, the domain of academics, and pedagogical knowledge, the realm of teaching skills. PCK, according to Shulman (1987), goes beyond mere subject knowledge by focusing on how to present that knowledge in a way students can understand (p. 9). He emphasizes teaching as transforming content into a teachable form (Shulman, 1987, p. 15). Shulman (1986) argues that effective teachers can identify the most appropriate representations, analogies, and explanations to make complex concepts understandable (p. 9). Ultimately, Shulman (1987) suggests that teacher expertise lies in adapting subject matter knowledge to their students' specific needs and backgrounds, (p. 15). This alignment between content and pedagogy is central to the role of mathematics teachers, who must try to implore a learning environment that fosters understanding for all students.

Elements of Pedagogy Content Knowledge

Building on Shulman's (1987) foundational work, Magnusson et al. (1999) proposed a comprehensive model for PCK with five key elements. The first element focuses on instructional strategies, exploring how teachers transform content knowledge into engaging lessons with illustrations, examples, and effective teaching methods. The second element centres around student understanding, acknowledging students' learning process and potential challenges with specific content. Assessment knowledge, the third element, equips teachers with tools to evaluate student learning and gauge their comprehension. The fourth element addresses curriculum knowledge, encompassing the prescribed curriculum and the pedagogical knowledge needed to implement and plan effective instruction. Finally, the fifth element delves into teachers' orientations toward teaching, including their beliefs about the subject matter and how best to teach it.

From a mathematics education perspective, Ball et al. (2005) offer a broader definition of PCK, encompassing the teacher's role in fostering students' understanding of mathematics. Similarly, Ma (1999) describes PCK in mathematics as a teacher's ability to unpack mathematical concepts and present them in ways that facilitate successful learning. Stevens (2005) further emphasizes the importance of teachers' thorough understanding of the mathematics they teach, which allows them to flexibly approach and explain concepts in multiple ways to enhance student conceptualization. It aligns with the notion that BMTs should be proficient in presenting mathematics using multiple representations to accommodate diverse learning styles and promote student understanding. Mavhunga and Rollnick (2016) briefly summarize PCK in mathematics as the integration of content knowledge (mathematics) and pedagogical knowledge (how to teach it). PCK combines mathematical knowledge with the methods necessary to teach it effectively. They highlight PCK as a specialized type of knowledge essential for teachers to achieve successful student learning in mathematics. A background of many relevant experiences has created a broad base of PCK for mathematics teachers to draw from in their professional roles. A mathematics teacher with strong PCK can address their students' misconceptions and anticipate their needs (Kadarisma et al., 2019). Pedagogical ability is not obtained suddenly but through continuous and systematic learning efforts, both in the preservice teacher education period and the teaching profession (Kadarisma et al., 2019). Several things influence this pedagogical ability: among them, the talents, interests, and potential of every individual concerned (Kadarisma et al., 2019; Moh'd et al., 2022; Van Driel et al., 1998). Furthermore, the literature shows that content and pedagogical content knowledge are essential for promoting student-teacher achievement (Ball et al., 2005; Steele, 2013).

Sources of Pedagogical Content Knowledge

Several researchers have identified four key sources that contribute to a teacher's development of PCK (Evens et al., 2015; Henze & Van Driel, 2015; Henze et al., 2008; Kind, 2009; Van Driel & Berry, 2010). These sources include the following:

- Formal PCK courses, designed to enhance teachers' PCK during preservice training or professional development programs.

- Apprenticeship of observation, where teachers' experiences as students influence their current teaching approaches.
- Collaboration with colleagues, involving learning from and sharing experiences with other educators.
- Teacher reflection on their classroom practices.

By grounding my research in the PCK framework, I identified key areas for exploration during data collection, ultimately shaping the design of my methodology. Furthermore, PCK theory will be valuable for organizing and interpreting the study's findings.

Signature Pedagogies

My research is further informed by Shulman's (2005) concept of signature pedagogies (see Figure 1). Shulman defines signature pedagogies as "the forms of teaching that structure the fundamental ways future professionals are prepared for their new careers" (p. 52). These pedagogies typically involve training novices in three key areas: thinking critically, performing skillfully, and acting ethically within the profession. Shulman identifies three dimensions constituting a signature pedagogy: surface structure, deep structure, and implicit structure.

- Surface structure refers to the observable teaching methods employed, such as lectures, student-led discussions, small group activities, case studies, or role-plays.
- Deep structure delves into the underlying assumptions about the most effective ways for teachers to transmit knowledge. It is linked to the pedagogical approach or paradigm (e.g., constructivism) that guides a teacher's classroom actions.

In addition, implicit structures encompass the underlying reasons behind teachers' actions, including prevailing beliefs, attitudes, values, and dispositions, all intertwined with their professional identity. Implicit structures reflect underlying professional morals on how students representing a profession should think, act, and perform ethically with integrity. Examples of implicit structures can be found in professional competencies, codes of ethics, or best practices documents. For something to be considered a signature pedagogy, it must contain elements of both broad and specific features. Overall, signature pedagogies help professionals within a discipline to define (a) what counts as important knowledge, (b) how knowledge transpires through acts of teaching and learning, (c) how knowledge is sequenced, and (d) how knowledge is evaluated and accepted (Shulman, 2005).

According to Gurung et al. (2009), through investigations into teaching and learning practices (scholarship of teaching and learning or SoTL), researchers have identified specific pedagogical approaches in mathematics that have become recognized as signature pedagogies. These include (a) posing problems of interest to students, (b) generating solutions collaboratively, (c) requiring conceptual reasoning, and (d) encouraging multiple approaches and solutions.

Problem-Based Learning

Constructivism, a well-established learning theory, emphasizes that students learn best by actively constructing knowledge (Piaget, 1970). It can involve both individual sense-making (radical constructivism) (Von Glasersfeld, 1984) and social interaction with peers and teachers (social constructivism) (Vygotsky, 1978). Instead of teacher-centred, deductive approaches, rich learning contexts encourage students to integrate new concepts with their existing knowledge (Posner et al., 1987). Traditional math pedagogy in SVG often relies on rote memorization, which doesn’t foster deep understanding or positive attitudes toward the subject. Constructivist approaches, like problem-based learning (PBL), can address this by offering differentiated instruction with accessible entry points and diverse learning outcomes, potentially increasing student success in math (Shah, 2019).

PBL, a popular constructivist strategy, originated in medical education during the 1950s (Hung & Jonassen, 2008; Moust et al., 2021; Savery & Duffy, 1995). Dissatisfied with traditional lecture-based learning and rote memorization, pioneers like Barrows (1996) advocated for PBL to develop problem-solving skills crucial for lifelong learning in healthcare (Albanese & Mitchell, 1993). PBL has since been adopted in various fields to promote critical thinking and problem-solving in realistic contexts (Moust et al., 2021).

PBL actively engages students with meaningful problems (Moust et al., 2021). Students collaboratively solve problems, develop mental models for learning, and cultivate self-directed learning habits through reflection and practice (Hmelo-Silver, 2004; Schmidt & Moust, 2000). PBL's core philosophy positions learning as a "constructive, self-directed, collaborative and contextual" activity (Dolmans et al., 2005, p.39).

Social constructivism (Jonassen, 1991; Vygotsky, 1978) and situated learning (Hung, 2002; Lave et al., 1991) are the theoretical foundations of PBL. From a constructivist perspective, the instructor acts as a guide and facilitator rather than a sole provider of knowledge (Snowman et al., 2012). PBL fosters a culture of feedback and reflection, allowing students to examine their learning process and group dynamics (Hendry et al., 1999). Students are active participants who co-construct knowledge through social interaction (Savery & Duffy, 1995; Yilmaz, 2008). PBL fosters meaning-making and the development of personal interpretations based on experiences and interactions (Gezim & Xhomara, 2020). By bridging theory and practice, PBL helps students transition from theoretical knowledge to practical problem-solving applications.

Integrating PBL into teacher education equips future teachers to impact their students' learning experiences beyond the classroom positively (Thomas et al., 2013). Shetty (2010) suggests using PBL to train future teachers to learn from their experiences and create or adapt to new ones, fostering experiential learning and reflective practice. PBL can also bridge the theory-practice gap in teacher education, promoting a more holistic learning experience (Farahmand, 2018; Filipenko & Naslund, 2016).

In PBL, the “situation” or context is often presented as an ill-structured problem that learners grapple with, mirroring real-world problem-solving scenarios. Teacher educators can model this approach by thinking aloud during lesson preparation, as learners derive meaning from their work contexts (Hmelo-Silver & DeSimone, 2013). Abstract theories presented without context hold little meaning for learners. Conversely, knowledge “situated” in specific contexts is more meaningful, integrated, transferable, and better retained (Brown et al., 1989; Lave et al., 1991; Motteram, 2013). Teacher education programs, recognizing the need to prepare preservice teachers for the practicalities of classroom life, are increasingly incorporating PBL experiences (Borhan, 2012). Peterson and Treagust (1998) propose that PBL experiences in teacher education allow preservice teachers to develop essential skills and acquire knowledge, from curriculum content to understanding how children learn.

In Summary

To this end, the study uses three theories – PCK, signature pedagogies, and PBL – as a theoretical framework to explore the main research questions based on several assumptions. Since this research is about BMTS, using PCK helped me identify whether BMTs could orchestrate teaching and learning opportunities centred on specific ways of knowing and doing within mathematics. PCK is deeply rooted in a teacher’s everyday work. Furthermore, this research includes signature pedagogies theory to explore those established and shared conceptions of the teaching of mathematics by focusing on the common but complex purposes of the subject, which governs how the content should be taught. Because this research involves a detailed examination of BMTs’ behaviours and activities as they teach mathematics, PBL theory is essential to help me focus on the relationships and interactions in the teaching and learning of mathematics within the authentic setting of the classroom.

Chapter 2, the literature review, provides context for this research, informs the methodology, and ensures that professional standards are met for this research.

Chapter 2: Literature Review

This study explores BMTs' perception of their preparedness to teach mathematics after completing the Organization of the Eastern Caribbean State (OECS) teacher education program on elementary teachers' mathematics classroom practices. The following literature review summarizes the research literature surrounding the challenges of beginning mathematics teachers (BMTs). I also examine empirical studies focused on teacher beliefs, including preservice mathematics teachers' beliefs and their experiences in teacher education programs. Finally, I discuss the relationship between self-efficacy and mathematics teaching (see Figure 2). Although I have found comprehensive support and discussion in my literature search about the issues related to beginning teachers (BTs), I have encountered limited literature regarding the influence of teacher education programs on elementary teachers' mathematics classroom practices in the OECS and the wider Caribbean region.

Literature Search Strategy

I used published articles from peer-reviewed journals, scholarly articles, and books on current empirical studies concerning the research questions from the St. Francis Xavier library database and the database on Google Scholar. The databases I employed include EBSCO Host, ProQuest Central, Education Research Complete, Education Resources Information Center (ERIC), and Education from SAGE publications. Common keywords and phrases that I frequently used are the following: teacher beliefs, self-efficacy, and beginning mathematics teachers.

As part of this review, I determined that any published empirical study on teacher education programs' impact on elementary teachers' mathematics classroom practices was eligible for inclusion. As such studies were limited, the following literature review includes sources organized into categories that align with the proposed study (Hart, 2019). Examining factors like mathematics teacher beliefs, preservice teacher experiences in education programs, self-efficacy, instructional practices, and the challenges beginning math teachers face can provide valuable insights into improving mathematics education. Finally, I determined that saturation of the literature had been reached by repetition and the lack of new additional information that contributed to the review.

Exclusion/Inclusion Criteria

Research can be disseminated through publication in academic journals or on the websites of educational or research institutions. This research may encompass qualitative or quantitative methodologies and employ various theoretical frameworks and analytical methods. This review was restricted to articles published in the past five years; however, a few articles outside the required time frame deemed useful to provide a historical context were incorporated into the review. Articles were further excluded based on the criteria identified below:

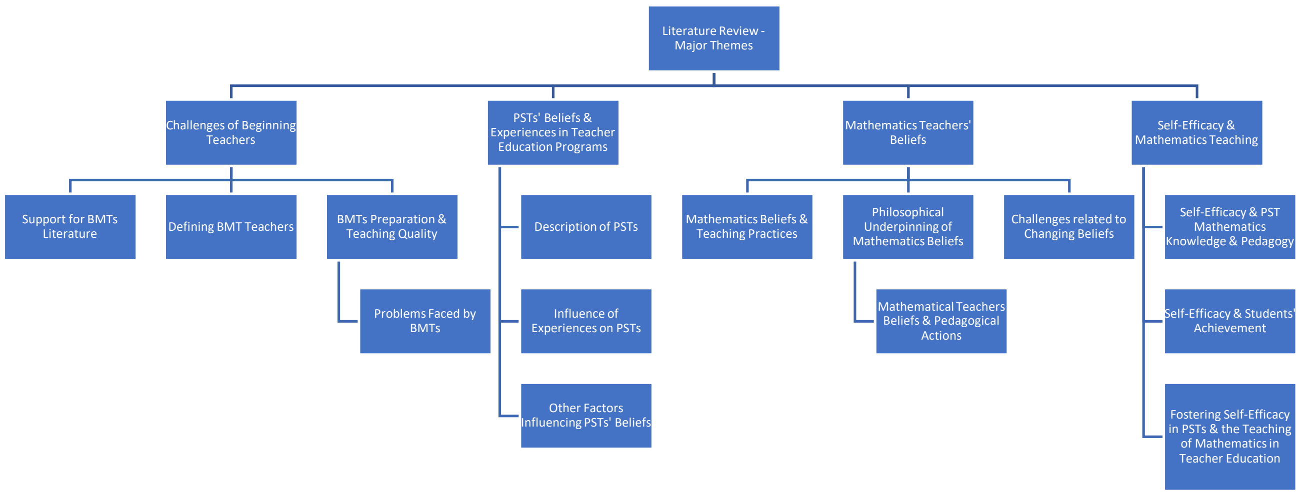
- Articles not written in the English language.
- Studies that were not conducted in educational institutions.
- Studies that were opinions and not empirically based.

I excluded articles by first reading abstracts while using the guidelines previously identified. The screening phase reduced the number of studies considered; only 412 of 4230 studies passed the initial screening of article abstracts. Then, articles were excluded if they did not apply to the Caribbean cultural context. This resulted in a substantial narrowing of the study pool. Only 222 articles passed this stage and were read fully. Finally, a total of 43 empirical studies were included in this review.

In what follows, I begin with a discussion of the challenges facing BTs, followed by examining teacher beliefs and the impact of beliefs on mathematics teaching and learning practices. Next, I explore preservice teachers’ beliefs and experiences in teacher education programs. A discussion of the role of self-efficacy in teaching mathematics follows this. Each discussion begins with a general discourse on BTs, followed by a more focused conversation on beginning mathematics teachers (BMTs).

Figure 2

Showing the Major Theme and Subtopics of the Literature Review



Challenges of Beginning Teachers

Defining Beginning Teachers

BTs may be defined as individuals teaching for three years or less (Markle, 2020; Spooner-Lane, 2017; Stein & Stein, 2016; Strom & Martin, 2016; Woest, 2018). Internationally, the percentage of BTs who leave the profession varies between 30% and 50% each year (Harmsen et al., 2018; Schleicher, 2018). Therefore, it is essential to understand why this is happening as the social cost of teacher turnover is a significant concern (Carver-Thomas & Darling-Hammond, 2017; Darling-Hammond, 2010; Darling-Hammond et al., 2019). Understanding the issues BTs face and how they might be supported during the initial years of teaching (Hobson, 2009; Hobson & Maxwell, 2017) is a proactive measure for maintaining those new to the profession (Woest, 2018). Like many life changes, the shift from being a student to becoming a teacher presents challenges (Markle, 2020; Ovens et al., 2016; Worden, 2019). Goodwin and Miller (2012) and Fernet et al. (2016) found that while new teachers bring energy, enthusiasm, and commitment to their classrooms, some are faced with what Fernet et al. describe as "daunting challenges." These challenges include work overload and creating a climate that fosters student attentiveness and is conducive to learning.

Researchers have described this phase with a variety of terms: "transition shock" (Corcoran, 1981, p.19), "reality shock," "the survival phase" (Huberman, 1989, p. 57), and "shattered dreams" (Friedman, 2000, p. 598). Kumazawa (2013) has added that another challenge faced by BTs is the "dilemma from the extensive range of duties" (p. 50) because they are expected to take on various other duties besides teaching such as supervising athletic and social activities and attending a variety of meetings after regular working hours. According to Carver-Thomas (2018), 40% of BMTs are underprepared, and most are likely to teach in high-needs schools comprising mostly historically marginalized populations of students.

Despite teacher education programs providing instruction and practical experience in classroom settings, BMTs may not fully understand all the issues involved with teaching until they enter the profession (Perryman & Calvert, 2020; Towers, 2013). As a result, BMTs often experience a "reality shock" (Huberman,1989, p. 57) upon entering the teaching profession. Veenman (1984) first popularized the term "reality shock" to identify the experiences of new teachers. It can be inferred from Markle's work (2020) that this refers to the collapse of the missionary ideals developed during teacher training due to the confrontation with the harsh and rude reality of everyday classroom life.

According to Whiteford et al. (2021), the reality shock of entering the classroom leads many BTs to realize that the day-to-day realities of surviving in the classroom overshadow ideals. Botha and Rens (2018) explored the nature and scope of reality shock of 100 South African BTs. The findings revealed that the "reality shock" came in the form of various school dynamics, including heavy workloads and the poverty experienced by some of their learners. Also, despite the length of time BTs spent during field experience, they all experienced varying degrees of reality shock. Similarly, Perryman and Calvert (2020) explored what originally motivated teachers to teach and why they left or considered leaving. They found that despite BTs' awareness of workload before entering the profession, BTs thought they could cope, but the reality was different, and they struggled to adapt. These findings are very similar to many BMTs. Voss and Kunter (2020) assessed 163 mathematics teachers and found that these BMTs also experience reality shock, mainly due to emotional exhaustion.

Although limited research has been done in the Caribbean, Lam (2007) noted that some Caribbean BMTs cited challenges that included a lack of time for lesson planning, the exam-oriented system, the size of classes, unmotivated students, and dense curricula as influencing their abilities to apply knowledge and skills gained in their teacher education programs. Hence, most BMTs in this study became dependent on chalkboard work, excessive dictation, and drills to ease classroom management issues and mitigate these challenges. Furthermore, Leacock (2020) found that many BMTs in the Eastern Caribbean grapple with understanding what actions to take but lack the confidence to implement them. They find it difficult to turn theoretical knowledge into practical application confidently. Leacock found that participants' weak content knowledge interfered with their ability to implement pedagogical knowledge gained during their teacher education programs successfully.

Beginning Mathematics Teachers' preparation and teaching quality

Research suggests that, regardless of the type or quality of the initial teacher training program, BMTs will likely enter the most vulnerable stage of their teaching career once they enter full-time teaching (Gainsburg, 2012; Moir et al., 2009; Podolsky et al., 2016; Towers, 2013). Paniagua and Sánchez-Martí (2018) concluded that having a good quality preservice education for teachers is not enough to meet the numerous challenges that teachers face throughout their careers; initial teacher training lays the foundation, but experience builds other skills required in the actual classroom (Lizette Neng & Cheo, 2022; Shin et al., 2021;). In contrast, Hulme and Wood (2022) argued that high-quality teacher preparation has the potential to sustain new teachers across diverse employment contexts and the many challenges of the beginning teaching phase. BMTs, scholars agree, need to learn how to solve problems, establish professional routines, and deepen emerging skills to become effective teachers in the classroom (Gainsburg, 2012; Kiru, 2020; Moir et al., 2009; Towers, 2013). Hence, meaningful and relevant support provided to BMTs can contribute to developing teacher competence and enhance well-being and commitment in the teaching profession (Hobson & Maxwell, 2017; Schepens et al., 2009; Towers, 2013). Examples of such support include ongoing professional development (Bautista & Ortega-Ruiz, 2015), induction programs (Paniagua & Sánchez-Martí, 2018), and mentoring (Spooner-Lane, 2017). Matsumoto-Royo and Ramírez-Montoya (2021) purported the need for a practice-based teacher education program that can fulfill the urgency for those BTs to carry out quality teaching from the moment they enter the profession. They further claimed that practice-based teaching will allow BTs to learn about teaching methods and teach them to put them into practice (Kaplan et al., 2021). Berry et al. (2017) and McKitrick-Rojas (2022) emphasized that teachers view the Professionalism Principle of the National Council of Teachers of Mathematics (NCTM) as crucial. This principle acknowledges that teachers must continuously engage in learning and cultivate a culture of professional collaboration driven by a sense of interdependence and collective responsibility.

Support for Beginning Mathematics Teachers

While this professionalism principle is true, there must also be structural support for BMTs. For example, Yuliana (2020) proposed induction programs that can take the form of mentoring or coaching, collaboration or networking opportunities, teaching observations (both observations of others' teaching and observation and feedback related to one's teaching), reductions in teaching load and extra planning time, workshops/seminars, orientations, or provision of other resources or supports (e.g., curricular materials) (Ingersoll, 2012; Kang & Berliner, 2012). Yuliana (2020) also claimed that induction programs facilitate the transition period of BTs before they start the teaching task, increase the teacher's effectiveness through classroom management training and effective teaching techniques, and promote the school district's culture. While some programs can be more formal, induction programs may entail or include informal elements that can include simply pairing a new teacher with an experienced teacher to consult as a resource, but without the provision of materials, training, or meeting times (Isenberg et al., 2009; Patrick et al., 2010).

Problems Faced by Beginning Mathematics Teachers

BMTs typically face numerous challenges during their transition into a school's culture, some of which they may feel unprepared to handle (Correa et al., 2015; Towers, 2013). These common challenges include excessive workload, classroom management difficulties, and inadequate support from school leaders (Dias-Lacy & Guirguis, 2017; Richards et al., 2013; Schuck et al., 2018). Veenman (1984) conducted 83 studies in different countries concerning the perceived problems of BTs. Based on these studies, it was concluded that the main problems faced by BTs include classroom discipline, handling individual differences, motivating students, evaluating students' work, dealing with parents, insufficient teaching material, and classroom organization. Similarly, Kozikoglu (2017) examined studies focused on the challenges of BTs and concluded that BTs' challenges are classified into four categories: instructional, relational, adaptation challenges, and challenges in the physical infrastructure and facilities of the school. These challenges outlined above are also common to BMTs.

In summary, BMTs are next-generation mathematics teachers, and their success in the profession potentially determines the next generation's success. Therefore, a comprehensive professional development program, scholars argue, should be provided for BMTs to enhance their professional experiences and reduce turnover (Dias-Lacy & Guirguis, 2017; Schuck et al., 2018). Research has shown that if BMTs are provided with meaningful and relevant support, this can contribute to their development into competent mathematics teachers. Finally, a high-quality teacher education program that empowers candidates to teach for deeper learning in personalized ways, apply learning to real-world problems, and foster productive learning communities to promote equity and social justice (Darling-Hammond et al., 2019) can significantly impact BMTs. Such a program has the potential to sustain new teachers across diverse employment contexts and the many challenges of the early career phase (Hulme & Wood, 2022).

Mathematics Teachers' Beliefs

Since teacher education may powerfully influence current and prospective teachers' beliefs (Tatto et al., 2008), I think discussing mathematics teachers' philosophical beliefs is necessary. Scholars have extensively researched teachers' beliefs over several decades. Amongst this body of work, scholars agree that teachers' philosophical beliefs about teaching and learning are related to their teaching practices (Fives & Buehl, 2016; Pajares, 1992). Skott (2015) conceptualized teacher beliefs as "individual, subjectively true, value-laden mental constructs that are the relatively stable results of substantial social experiences and that have a significant impact on one's interpretations of and contributions to classroom practice" (p. 19). Similar to Skott, Khader (2012) and Rashidi and Moghadam (2015) identified that teachers' beliefs play a central role in guiding their teaching behaviour as they constitute a set of ideas rooted in the psychological and mental content of the teacher. Common to both views is the idea that beliefs are teachers' thoughts and feelings about their position and role in the teaching environment (Cross, 2009; Howard, 2014). These beliefs, argued Pajares (1992), are well-developed before individuals embark on a teacher-education program due to almost two decades of previous experience in education as students. Because of such vast experiences, teachers' beliefs will likely be somewhat entrenched and implicit (Ferguson, 2020; Pajares, 1992). Fives et al. (2019) suggested that BTs' beliefs lead to behaviours that influence teaching practices. In other words, BTs' beliefs are considered pivotal to pedagogy. Because of this, the beliefs of BTs are essential to consider, as they shape how BTs may perceive new ideas and how they are implemented, if at all.

Mathematics Teachers' Beliefs and Teaching Practices

Recent empirical studies have highlighted the connection between a teacher's philosophy of education and their teaching methods. (Canbay & Beceren, 2012; Erkmen, 2014; Feixas & Euler, 2013; Gilakjani, 2012). Gilakjani (2012) acknowledged that teachers' beliefs are essential in forming some of the foundations for their teaching practices because, in a new ill-structured teaching dilemma, BTS will rely on intuition, which is nested in their foundational beliefs about best practices. For example, these beliefs determine which instructional mathematical content is selected, the format of lesson plans, interactions with students, and strategies used to assess mathematical learning outcomes. Canbay and Beceren (2012) concluded that BMTs orient their mathematics classroom practice based on their beliefs. They found that teachers with similar educational backgrounds may view and approach teaching differently. They added that teachers' conceptions of teaching are not shaped by the institution where they work.

Feixas and Euler (2013) agreed that teaching approaches manifest teachers' conceptions, techniques, and ideas. For example, a teacher must communicate to students the definitions, formulas, and rules they need to understand and show them how to apply this knowledge to solve math problems. Other teachers prioritize rote memorization and applying that knowledge to basic problems. Drills and factual memorization are essential to ensure students have a strong foundation in the material. Still, other teachers might believe that providing students with appropriate challenges, encouraging perseverance in solving problems, and supporting productive struggle in learning mathematics is best and plan their classroom around that idea. Feixas and Euler (2013) argued that BMTs' beliefs about learning could influence the entire learning process.

Ernest (1989) found that teachers with similar knowledge of mathematics may adopt varied instructional approaches due to their divergent beliefs regarding the principle of mathematics and its pedagogy. For instance, teachers' perspectives on preferred teaching methodologies and their beliefs about the learning process in mathematics shape their notions of optimal classroom practices (Yang et al., 2021). These beliefs influence their perceptions of the cognitive and behavioural aspects involved in learning mathematics and their understanding of suitable and ideal learning activities in mathematics education. BMTs are more likely to follow prescribed approaches to teaching as they have yet to build a philosophy rooted in practice. Lack of confidence inherently limits BMTs from exercising flexibility to be effective teachers. (Chan & Elliott, 2004; Ernest, 1989).

Scholars have conceptualized various models to understand better the relationship between teacher beliefs and mathematics teaching and learning. For example, Ernest (1989) identified three beliefs BMTs might have about teaching mathematics. First is the dynamic, problem-driven view of mathematics. Mathematics is viewed as a continually expanding field of human inquiry, not a finished product. Secondly, the Platonist view posits mathematics as a fixed and interconnected set of knowledge with underlying principles that are eternally true. Thirdly, the instrumentalist view is that mathematics is an isolated skill that can be learned and practiced without focus on interconnections (Ernest, 1989).

Ernest (1989) further asserted that teachers' perceptions of the nature of mathematics significantly impact their instructional methods. For instance, an instrumentalist perspective on mathematics tends to align with a teaching approach centred around direct transmission and strict adherence to prescribed materials or curricula. This viewpoint may also emphasize compliant student behaviour and the mastery of skills-based learning. Similarly, other philosophical views of mathematics may correspond to distinct instructional models. For example, viewing mathematics as a unified body of knowledge in the Platonic tradition may lead to a teaching role centred on explanation, with learning perceived as the passive reception of knowledge. However, the student's role in constructing understanding may be acknowledged. Additionally, the perspective of mathematics as problem-solving may entail a teaching style where the teacher serves as a facilitator, fostering autonomous problem-posing and solving among students (Divrik et al., 2020; Ernest, 1989; Safrudiannur, 2020).

Ernest (1989) also discussed whether mathematics is something we find or create. He said some people see mathematics as absolute and unchanging as if it's out there waiting to be discovered by mathematicians through intuition and proof. But others think mathematics is always evolving, like a work in progress that we keep refining and adding to. In this view, new math ideas come about through invention or as side effects of inventing new things rather than just being found. Rowlands and Davies (2006) summarized that mathematics is invented and discovered simultaneously. They argued that the goals and operations that mathematics serves are found, but the ideas themselves are created. Operations always exist, but without someone inventing the idea, it would not be possible to discover the exact nature of the problem.

Philosophical Underpinning of Mathematics Beliefs

Törner (2002) outlined a hierarchical framework for mathematical beliefs, wherein overarching beliefs about teaching and learning (global beliefs), beliefs specific to certain areas of mathematics (domain-specific beliefs), and beliefs concerning the nature and organization of mathematical content (subject-matter beliefs) interact through both top-down and bottom-up influences. Alternatively, Clark et al. (2014) proposed that their professional socialization and personal experiences significantly shape teachers' perspectives on mathematics instruction during their education. Minarni et al. (2018) confirmed Clark et. al.'s (2014) argument, asserting that mathematics teachers' beliefs are shaped over time through accumulated knowledge and experiences.

Voss et al. (2013) presented a theory akin to Ernest's regarding mathematics teachers' beliefs and instructional practices. Voss et al. distinguished between two types of beliefs held by mathematics educators: constructivist epistemological beliefs and transmissive epistemological beliefs. A teacher may adhere to transmissive epistemological beliefs, viewing mathematical knowledge as a static set of facts and procedures. From this perspective, teaching and learning mathematics involve a unidirectional process of information transmission from teacher to student, emphasizing repetition, automatization, and passive learning. Alternatively, a teacher may embrace constructivist epistemological beliefs, considering mathematics as a dynamic process and its knowledge as the outcome of subjective processes of knowledge construction. According to Voss et al., in this view, mathematical learning is ideally perceived as a process of comprehension facilitated by active engagement with mathematical problems and tasks, leading to conceptual understanding. Within this framework, the teacher assumes the role of a facilitator, responsible for creating learning environments that foster active and independent student engagement with the content and providing support and guidance in their learning processes. The beliefs held by mathematics teachers (BMTs) regarding mathematics directly influence their instructional approaches and curriculum decisions (Xie & Cai, 2021).

In summary, studies on beliefs held by BMTs have explored various aspects, including beliefs regarding students, self, motivation, and subject knowledge (Gill & Fives, 2014; Tatto et al., 2020). It's important to note that while scholars recognize a close relationship between teachers' beliefs and their knowledge, beliefs are considered distinct because they are seen as more emotional, episodic, and not necessarily bound by requirements of truth and justification (Buehl & Beck, 2016; Towers, 2013). A teacher's personal views on education act like a filter, shaping how they understand and apply teaching methods and information. Parkinson and Maggioni (2017) proposed connections between teachers' epistemic beliefs, beliefs about teaching and learning, and their actual practices. However, not all scholars agree with this perspective, suggesting that teachers may hold contrary beliefs about knowledge, teaching, and learning (Fives & Buehl, 2008). While consensus is lacking regarding teachers' beliefs' impact on teaching, there is general agreement that beliefs can shape pedagogy and decision-making processes. Therefore, investigating the actions, teaching knowledge, and beliefs of BMTs is crucial for understanding the factors guiding their practice (Davis & Simmt, 2006).

Mathematics Teachers' Beliefs and Pedagogical Actions.

Despite the lack of consensus, some literature shows how teachers' beliefs affect their actions in the classroom (Aksoy, 2015; Shouldice, 2019; Song & Zhou, 2020; Towers, 2013). Aksoy's (2015) research on classroom management and teacher beliefs shows both consistencies and inconsistencies between what teacher participants expressed as their beliefs and what was observed while they taught. In contrast, some studies concluded that there was little to no correlation between teachers' beliefs and actions. Jones and Gullo (1999), in their study of 13 first-grade teachers, found that there was little to no relationship between teachers' beliefs and their practices.

Similarly, Hedrick et al. (2004) reported that teachers did not put into practice strategies that they believed were important to students' success. Poole-Christian (2009) observed and conducted interviews with teachers and found their practices conflicted with their beliefs. Finally, Borg et al. (2018) concluded that the relationship between teachers' beliefs and practices could be significantly shaped by the following: how this relationship is conceptualized, how beliefs are defined, and the design and conduct of these studies, particularly the choice of research methods.

The beliefs of BMTs may not always match what they actually do in the classroom, and this can be because of the specific teaching situations and the environment in which they work. Towers and Proulx (2013) found that the actions of mathematics teachers "fit" their particular context. They explained that what teachers and students do in mathematics class is adapt to each other, and it's through making practical decisions that a teacher figures out how to act. Towers and Proulx (2013) also pointed out that mathematics teachers might change what they do in class based on ensuring all students are paying attention. For example, they may select a specific problem to solve or decide to redirect attention if they think it's necessary. They concluded that in a dynamic math classroom, there can be many different ways for a teacher to act, and these actions might not always line up with what the teacher personally believes. Whereas the study highlighted above may cause one to question the effect of teachers' beliefs on their classroom practices, other studies provide support. For example, Zakaria and Maat's (2012) findings revealed no differences between BMTs and more experienced teachers in mathematics beliefs. There was a moderately significant correlation between their mathematics beliefs and teaching practices. Additionally, Muhtarom et al.'s (2020) research, which focused on the relationship between BMTs' beliefs and mathematics teaching practices in the classroom, revealed that BMTs' beliefs about mathematics were consistent with the beliefs of their mathematics teaching practices.

The intricate dynamics of classroom settings can introduce various factors that may cause discrepancies between the teaching practices of BMTs and their beliefs. Charalambous and Hill (2012) highlighted that curriculum materials and Mathematical Knowledge for Teaching (MKT) (Ball & Bass, 2002; Thurtell, 2019) are pivotal instructional resources influencing classroom dynamics. They further noted that MKT enhances the quality of dialogue between teachers and students, the use of mathematical language during instruction, students' explanations, and the teacher's ability to summarize and connect mathematical concepts for students.

Furthermore, research indicates that BMTs' pedagogical beliefs may resist change despite concerted efforts to alter them (Towers, 2013; Yerrick et al., 1997). For example, Yerrick et al. (1997) implemented a two-week summer institute to transform the beliefs of science, technology, engineering, and mathematics (STEM) instructors regarding the nature of scientific content and student roles in the classroom. Despite this effort, only a minority of experienced teachers shifted from teacher-centred to student-centred beliefs after participating in the professional development program. The new information presented during the institute merely supplemented the teachers' existing knowledge and was interpreted to align with their pre-existing belief structures.

Challenges Related to Changing Beliefs

Attempting to modify mathematics teachers' beliefs can present significant challenges, as Cross (2009) highlighted. His research investigated the persistence of teachers' beliefs despite efforts to integrate reform-oriented classroom materials and instructional methods. While Fives and Buehl (2016) reaffirmed that teachers' beliefs serve as a lens through which they interpret and implement new curriculum standards, Cross's findings indicated that although teachers were open to adopting new practices, these were filtered through their existing belief systems, resulting in minimal overall change. Conversely, Alfaro Víquez and Joutsenlahti (2021) discovered that the complex dynamics of the classroom environment might steer mathematics teachers toward traditional teaching methods.

Despite the insights gained from mainstream teacher education and educational research, transferring this knowledge to actual classroom practice is not always straightforward (Goffree et al.,1999; Kennedy, 1997; Wilson & Goldenberg, 1998). Nevertheless, Towers (2013) found that novice teachers adhered to the beliefs and practices instilled during their initial teacher preparation program. Despite external pressures to embrace inquiry-based methods, novice teachers relied on pragmatic, action-oriented approaches consistent with their training.

In summary, empirical evidence suggests that teachers' beliefs about teaching and learning are influenced by their prior student experiences rather than formal teacher education. Additionally, mathematics teachers' beliefs may vary across different aspects of practice, such as knowledge, teaching, and learning. Lastly, these beliefs may be deeply ingrained and resistant to change.

Preservice Teachers' Beliefs and Experiences in Teacher Education Programs

Description of Preservice Teachers

Preservice teachers (PSTs) are individuals enrolled in initial teacher education programs at either the undergraduate or postgraduate level (Barmore, 2016; Ryan et al., 2017). These PSTs spend extensive time in classrooms not as teachers, but as students. Research has extensively documented that during their years as students, PSTs develop strong beliefs regarding various aspects of teaching and learning, including teacher behaviour, roles, effective teaching methods, and classroom environment (Borg, 2004; Mattheoudakis, 2007; Peacock, 2001). These prior learning experiences of PSTs have been likened to an "apprenticeship of observation" (Lortie, 1975). As noted by Lortie (1975), the years spent as students entail extensive observation periods, effectively serving as an apprenticeship in teaching. Students engage in prolonged, face-to-face interactions with experienced teachers during this time. Consistent with Lortie's (1975) perspective, numerous studies have demonstrated that early educational experiences significantly shape the beliefs acquired by mathematics teachers (Borg, 2004; Cancino et al., 2020; Högqvist, 2017; Lunsmann et al., 2019; Moodie, 2016).

The Influence of Experiences on Preservice Teachers' Beliefs

Erkmen (2010) further proposed that during the apprenticeship of observation, students are inclined to develop both favourable and unfavourable impressions, or "anti- and pro-role models," of teachers, potentially shaping the type of educator they aspire to become (p. 23). Additionally, researchers have highlighted that these beliefs significantly influence how PSTs perceive, interpret, and integrate new materials introduced in their teacher education programs, and they may prove resistant to change (Bråten & Ferguson, 2015; Buehl & Fives, 2016; Ferguson & Lunn Brownlee, 2018; Gainsburg, 2012; Sosu & Gray, 2012). Johnson (1999) argued that the memories PSTs have from their time as students are powerful because they serve as "indelible imprints on most teachers' lives and minds" (p. 23). Some scholars have suggested that PSTs' beliefs can hinder the impact of teacher education programs (Nespor, 1987). Moreover, Pajares (1992) characterized prospective teachers (PSTs) as "insiders" within their field, having already established their own beliefs about teaching before undergoing formal higher education training. This perspective could elucidate why the beliefs held by PSTs regarding various aspects of teaching often endure throughout their teacher preparation and may persist unchanged in their professional practice (Cansiz & Cansiz, 2019).

Examining the beliefs and experiences of PSTs in their teacher education programs is crucial as it directly impacts their future roles as BMTs. PSTs regularly assess and evaluate students, pedagogical methods, and their abilities as teachers, and these assessments likely shape their beliefs. Scholars have described PSTs' beliefs as distinct notions influenced by their experiences in learning and teaching, which in turn impact their conduct and instructional approaches in the mathematics classroom (Ford, 1994; Khader, 2012). These beliefs are also characterized as the opinions and perspectives of PSTs regarding teaching and learning (Haney et al., 1996; Khader, 2012). It's widely acknowledged that PSTs enter teacher training programs with firmly entrenched beliefs about education, often reflecting their preferences and dislikes from prior educational encounters (Debreli, 2016; Kagan, 1992; Tatto, 1998; Xu, 2012).

Additionally, race, class, and gender are interconnected factors that significantly shape the perspectives and beliefs of both PSTs and practicing BMTs (Cochran-Smith, 2020; Cochran-Smith et al., 2016; Markle, 2020; Richit et al., 2021; Ticknor et al., 2020). Therefore, examining PSTs' beliefs solely through their school experiences as students is inadequate; we must also consider their prior experiences and beliefs regarding race, class, and gender. To effectively address inequality, we must recognize that it is rooted in and constantly reinforced by deeply ingrained social systems that disadvantage certain groups (Cochran-Smith et al., 2016; Cochran-Smith et al., 2009; Gay, 2018; Zeichner, 2017).

The literature suggests that these beliefs persist as filters, influencing how PSTs perceive and interpret new mathematical information presented during their teacher education (Borg, 2015; Farrell, 1999). As Edwards and Stoehr (2020) mentioned, the Association of Mathematics Teacher Educators (AMTE) argues that proficient BMTs know the historical implications of power, privilege, and oppression in mathematics education. These BMTs are prepared to critically examine existing educational structures perpetuating unequal student learning experiences and outcomes. Similarly, the National Council of Supervisors of Mathematics (NCSM) and TODOS: Mathematics for All (2016) assert that teachers must transcend the mere presentation of complex mathematics by creating classrooms where students engage in culturally and linguistically meaningful activities and view themselves as advocates.

Other Factors Influencing Preservice Teachers' Beliefs

Scholars have suggested that various factors may contribute to forming PSTs' beliefs. Borg (2015), Richards and Lockhart (1996), and Crookes (1997) presented evidence regarding the sources from which PSTs often draw their beliefs. For example, Richards and Lockhart (1996) proposed that teaching experiences, individual personality traits, educational or research-based principles, and principles derived from specific approaches or methods all shape PSTs' beliefs. Additionally, Crookes (1997) highlighted the importance of institutional curricula, exposure to new concepts, the prevailing teaching culture, the characteristics of the student population, and feedback from authoritative figures.

Debreli (2016) researched whether PSTs' belief formation was influenced more by their previous learning experiences or teacher education programs. The findings indicated that the nature of the teacher education program had a greater impact on PSTs' belief formation compared to the influence of their prior learning experiences. Similarly, Liljedahl (2016) conducted a longitudinal study examining the evolution of thinking in more than 600 mathematics classrooms. The study sought to implement teaching strategies such as formative assessment, collaborative groups, and complex problem-solving tasks to challenge established classroom practices and transform teachers' instructional methods. The research outcomes demonstrated that these effective teaching strategies stimulated critical thinking and collaboration among students and challenged conventional classroom practices. Furthermore, due to these changes, Liljedahl (2016) observed significant shifts in classroom dynamics for both students and teachers.

Challenges Associated with Changing Preservice Teachers' Beliefs in the Teaching of Mathematics

Influencing the personal beliefs of BMTs to foster pedagogical growth beyond those beliefs is challenging but reinforces the value of well-designed teacher education to expose, examine, and challenge PSTs' misconceptions while they are students (Buehl & Fives, 2016; Lunn Brownlee et al., 2017). Scholars suggest that teacher education programs must first examine the desired beliefs they want their students to adopt (Sonia, 2017). Second, they must help their students discover and examine individually held beliefs about teaching and provide opportunities for reflection and change when the program and individual beliefs do not match (Doyle, 1997; Hart, 2004; Lunn Brownlee et al., 2017; Minor et al., 2002; Pajares, 1992; Richardson, 1996; Sonia, 2017; White-Clark, 2005).

Many scholars who research how to influence teachers' beliefs contend that changing individually held beliefs of PSTs is, at best, complex and that teacher preparation programs are unsuccessful for the most part (Ernest, 1989; Gainsburg, 2012). Changes in beliefs about teaching primarily occur through hands-on experience in the field and extensive reflection and analysis (Endacott & Sturtz, 2015; Paakkari et al., 2015; Sheridan, 2016; Thomson et al., 2012). However, Richardson (1996) noted more than two decades ago that such changes may be fleeting for many individuals. Although PSTs might adopt evidence-based approaches in their formal pedagogical coursework at university, their pre-existing beliefs often persist once they enter the mathematics classroom. As a result, formal teacher education programs may have a limited impact on the beliefs that mathematics students bring with them (Richardson, 1996).

Pham (2021) suggested that this discrepancy might arise from mismatches between the content taught in teacher education programs and the realities of school settings. Furthermore, he proposed that there may be disparities between the skills, knowledge, and resources provided to PSTs and those required for effective teaching in schools. Beliefs, scholars suggest, are often resilient. Confronting and changing beliefs is, therefore, a task that takes time.

Hart (2004) proposed that as BMTs transition into classroom settings, they often lose the support networks provided by their preservice education programs. Consequently, PSTs may respond to the constraints of the school environment by conforming to or adopting belief systems that align with the local culture and prevailing norms. Towers (2013) uncovered consistent patterns in how participants articulated their roles, practices, commitments, and identities as teachers across varied teaching contexts. These patterns aligned with the fundamental philosophy and principles instilled during their initial teacher education program. Towers' (2013) findings indicate that some BMTs can resist prevailing discourses in the field, such as those advocating for traditional, behaviourist approaches, and that these resistances may be linked to their initial teacher education experiences.

As a result, teacher educators should devote greater attention to cultivating PSTs' awareness of their beliefs, encouraging explicit reflection on their relationship with the learning process, and when necessary, helping shape these beliefs to foster more adaptable outcomes for both mathematics students and teachers (Feucht et al., 2017; Lunn Brownlee et al., 2017). Briley (2012) also emphasized the importance of PSTs believing in their capacity to teach mathematics effectively.

Liljedahl et al. (2021) observed that changes in a mathematics teacher's beliefs often involve transitioning among three distinct categories: the toolbox aspect, the system aspect, and the process aspect. Other studies suggest that PSTs' beliefs must be challenged before meaningful changes occur (Feiman-Nemser et al., 1989). Another effective approach for inducing change in PSTs is engaging them as mathematics and mathematics pedagogy learners within a constructivist learning environment (Ball, 1988; Feiman-Nemser & Featherston, 1992). Liljedahl (2005) and Enochs et al. (2000) discovered that PSTs' experiences with mathematical discovery can have a profound and immediate transformative impact on their beliefs regarding their perceptions of mathematics and their convictions regarding the teaching and learning of mathematics.

Intervention Studies Conducted to Impact Preservice Teachers' Beliefs in the Teaching of Mathematics

The previous sections discussed an overview of PSTs' beliefs, sources of these beliefs, and challenges incurred when attempting to change some of these beliefs. Finally, this section discusses the impact of interventions on PSTs' beliefs after taking mathematics courses for their teacher education program. The studies presented below describe common changes in PSTs' beliefs after interventions in mathematics teaching. For example, changes in elementary PSTs' instructional practices resulted in increases in their levels of math confidence and a shift in their thinking.

Althauser (2018) examined changes in self-efficacy[1] levels among 347 elementary PSTs enrolled at a mid-size regional university in Kentucky after completing a semester-long elementary mathematics course. The course emphasized hands-on mathematics instruction using manipulatives. It employed a specialized constructivist instructional format, the 5E[2] Model of Instruction. The findings revealed that PSTs reported significant changes in their understanding of various instructional practices, transitioning from a traditional "tell, show, and do" model to an approach incorporating interactive and engaging activities. Moreover, they noted a significant improvement in their attitudes toward mathematics. Althauser (2018) contended that the intervention based on the 5E Model directly influenced PSTs' confidence in teaching mathematics, which is attributable to the structure of the elementary mathematics methods course.

In an urban context, King et al. (2020) conducted a study involving twenty PSTs enrolled in an advanced elementary mathematics methods course at a large urban university in the southeastern United States. The course aimed to assist PSTs in transitioning their instructional approach from traditional, teacher-centred methods to a more problem-based, student-centred approach focused on developing teaching strategies through problem-solving. The course structure included two interventions: first, the content was based on research on problem-solving in mathematics classrooms, and second, Empson and Jacobs's (2008) approach to responsive listening was employed to foster

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[1] Self-efficacy is a personal judgment of how well or poorly a person can perform a specific task, or cope with a given situation based on the skills they have and the circumstances they face (Bandura, 1977).
[2] The 5E Model of Instruction includes five phases: Engage, Explore, Explain, Elaborate, and Evaluate. It provides a carefully planned sequence of instruction that places students at the centre of learning. It encourages all students to explore, construct understanding of scientific concepts, and relate those understandings to phenomena or engineering problems (Bybee et al., 2006).

strategic interactions between students and teachers. The findings indicated that PSTs initially held traditional views on mathematics instruction at the start of the course. Still, their perspectives shifted toward more problem-based approaches as the course progressed. Therefore, the study suggests a correlation between reflective writing-to-learn activities and the adoption of problem-based thinking by PSTs.

Looney et al. (2017) researched fifteen PSTs to explore the impact of instructional mathematics courses on their beliefs about mathematics and self-efficacy in teaching mathematics. The study investigated whether teacher education could mitigate negative attitudes or beliefs about mathematics and teaching mathematics by implementing effective mathematics teaching strategies. The findings revealed that participants attributed changes in their beliefs to the teaching strategies employed in the course and increased awareness of their beliefs and opportunities for reflection throughout the mathematics course.

In conclusion, the literature about PSTs' beliefs surrounding mathematics pedagogy is limited. However, the available studies highlight that while negative perceptions exist, PSTs' beliefs about mathematics and self-efficacy for teaching mathematics can be improved. This finding raises important implications for teacher education programs. Teacher educators in teacher education programs should consider their vital role in helping to reverse the negativity that might be present in future educators responsible for teaching mathematics. While teacher educators are there to prepare future teachers for success in the classroom, success is not just about ensuring teachers can teach to specific standards (Stiggins, 2005).

There are many sources informing PSTs' beliefs about teaching. Some of these include personal experiences in the classroom as a student, field experiences, personality factors, and exposure to pedagogical knowledge and evidence-based practices and principles derived from an approach or method. Research shows that PSTs' beliefs translate into their practice and may constrain teachers' abilities to follow the practices taught in their courses. Although it is very challenging to change the deeply rooted beliefs of PSTs, a limited amount of research shows that PSTs can experience changes to their beliefs as they journey through teacher education programs. Research has shown that PSTs' initial beliefs are not static. They can change in response to different components of teacher education – course content, methodological reflection, and research – as they become aware of the different pedagogical responses to cater to different learning styles.

Self-efficacy and Mathematics Teaching

The issue of PSTs' self-efficacy holds significant importance as teacher education programs globally strive to address shortages of qualified and competent educators (Clark & Newberry, 2019; Darling-Hammond, 2013; Duffin et al., 2012). Consequently, researchers are motivated to examine PSTs' self-efficacy as it is a fundamental construct that influences their effectiveness, confidence, and ultimately, their ability to impact student achievement (Farmer, 2018; Pandee et al., 2020; Pendergast et al., 2011). Furthermore, given that PSTs are soon to become practicing teachers, they must possess adequate teacher self-efficacy to develop confidence in their teaching abilities. Morris et al. (2017) defined teaching self-efficacy as the beliefs held by PSTs regarding their capabilities to perform their professional duties. It significantly predicts PSTs' instructional practices and student achievement (Carbonneau et al., 2018). In many cases, self-efficacy gives teachers the confidence to support student success.

In mathematics, self-efficacy pertains to individuals' belief in their ability to engage with mathematical concepts effectively. This concept is typically assessed through individuals' assessments of their capability to solve specific mathematical problems, complete mathematical tasks, and excel in mathematics-related endeavours (Bates et al., 2011; Giles et al., 2016). Matney and Jackson (2017) delineated two dimensions of self-efficacy for teaching mathematics: general efficacy (outcome expectation) and personal teaching efficacy (efficacy expectation). Matney and Jackson (2017) further elaborated that personal teaching efficacy (PTE) gauges teachers' confidence in their capacity to facilitate learning for any student, while general teaching efficacy (GTE) assesses teachers' beliefs regarding the overall impact of teaching on student learning. Additionally, GTE encompasses the conviction that effective teaching will positively influence students' learning outcomes (Enochs et al., 2000). Cruz et al. (2019) characterized general efficacy as teachers' belief in their responsibility for fostering students' understanding of mathematics.

Additionally, PSTs emphasize the importance of investing extra effort in providing effective instruction to improve student motivation and achievement in mathematics. They firmly believe that students' underachievement often stems from ineffective teaching practices. This viewpoint reflects a commitment among PSTs to prioritize pedagogical excellence and student success in the mathematics classroom.

According to Zuya et al. (2016), personal teaching efficacy encompasses teachers' sense of agency within their classrooms: their confidence in their capacity to produce positive outcomes through their actions in the mathematics classroom. For example, their study findings demonstrated a positive correlation between teachers' confidence in their mathematical abilities and their beliefs regarding their effectiveness in teaching mathematics.

Some studies have shown a positive relationship between PSTs' efficacy and teaching mathematics (Özcan & Kültür, 2021; Schöber et al., 2018; Talsma et al., 2018). For example, Ünlü and Ertekin (2013) studied the relationship between mathematics teaching, self-efficacy, and mathematics self-efficacy in 144 PSTs of elementary mathematics at Aksaray University. They found a significant positive relationship between mathematics teaching, self-efficacy, and mathematics self-efficacy of the PSTs. This research highlights that preservice elementary mathematics teachers' self-efficacy in learning and teaching is essential in mathematics education.

Self-Efficacy and PST's Mathematics Knowledge and Pedagogy

Researchers have proposed that mathematics teachers with a strong sense of self-efficacy are more inclined to explore innovative teaching approaches to cater to their students' needs (Shahzad &

Naureen, 2017). Consequently, strong self-efficacy among teachers positively affects student performance, whereas low self-efficacy can have a detrimental impact on students' mathematics achievement (Mojavezi & Tamiz, 2012; Shahzad & Naureen, 2017; Woolfolk, 2016; Zee & Koomen, 2016). Moreover, it's widely acknowledged that having extensive knowledge and skills doesn't necessarily translate into effective classroom practices unless PSTs feel confident in their abilities (Zee & Koomen, 2016).

Scholars also suggest that self-efficacy related to teaching mathematics is malleable. Pandee et al. (2020) discovered that PSTs could cultivate a stronger sense of self-efficacy, influencing their classroom teaching experiences in mathematics. Similarly, Cansiz and Cansiz (2019) proposed that engaging in teaching practice is crucial for PSTs to enhance their self-efficacy in teaching mathematics. Furthermore, when teacher educators and peers encourage teaching experiences, it may bolster PSTs' confidence in teaching mathematics, helping them overcome self-doubt and perceive themselves as capable teachers, thus improving their effectiveness as PSTs. A study by Ronfeldt et al. (2014) examined teacher education programs and found that increasing the duration of PSTs' classroom experiences can enhance their readiness and future success as BMTs. Similarly, Colson et al. (2017) compared the effectiveness of teacher candidates in year-long student teaching placements to those in traditional one-semester placements (16 weeks). Their research revealed that PSTs in year-long student teaching placements demonstrated higher self-efficacy in student engagement and classroom management than in traditional placements. These findings suggest that the duration of classroom experiences during teacher preparation significantly influences PSTs' effectiveness as future BMTs.

Self-efficacy and Student Achievement

Notably, teachers' self-efficacy plays a significant role in influencing student achievement in mathematics. The beliefs that mathematics teachers hold about their efficacy can impact student outcomes in various ways: teachers with strong self-efficacy are more inclined to introduce innovative teaching methods in the classroom, employ effective classroom management strategies, utilize appropriate teaching methodologies, foster student autonomy, address the needs of diverse learners, manage classroom challenges, and maintain student engagement (Colson et al., 2017; dela Cruz & Vasquez, 2020; Mojavezi & Tamiz, 2012; Pandee et al., 2020; Yada et al., 2019). As outlined by the National Council for Teachers of Mathematics (2014) (NCTM) Principles to Action, the quality of teaching students receive in school significantly influences their understanding of mathematics, problem-solving abilities, confidence in mathematics, and overall attitude toward the subject (pp. 16–17).

According to Gulistan and Hussain (2017), a direct relationship exists between teachers' confidence in teaching mathematics and their self-efficacy. They investigated how mathematics teachers' self-efficacy correlates with students' academic performance. Their research demonstrated a significant correlation between teachers' efficacy scores and students' academic achievements, with a notable coefficient of 0.72. Similarly, Ampofo (2019) examined the connection between preservice teachers' perceived self-efficacy in teaching mathematics and their mathematics achievement. Their findings revealed a strong positive association between preservice teachers' self-efficacy in mathematics and their actual performance in the subject.

Fostering Self-Efficacy in Preservice Teachers and the Teaching of Mathematics in Teacher Education

Mathematics education scholars have emphasized the importance of teacher educators in nurturing PSTs' self-efficacy in mathematics and teaching mathematics. Nurlu (2015) agreed, noting that PSTs with higher self-efficacy tend to try new and innovative teaching methods and persevere with struggling students. These PSTs also prioritize fostering supportive relationships with their students, distinguishing them from peers with lower confidence in their ability to impact student learning.

Several studies have shown a favourable connection between the mathematics self-efficacy of PSTs and their proficiency in teaching mathematics. (Bates et al., 2011; Briley, 2012; Ünlü & Ertekin, 2013; Zuya et al., 2016). Essentially, as educators' confidence in their mathematical proficiency grows, so does their teaching effectiveness (Carney et al., 2016; Newton et al., 2012; Thomson et al., 2021). Consequently, the objective of mathematics methods courses has expanded to include two main goals: enhancing PSTs' mathematical content knowledge (Davis & Renert, 2013) and fostering their understanding of mathematics teaching methods (Chen et al., 2021; Norton, 2019; Way et al., 2020). For example, Norton's (2019) research identified a stronger predictive value of mathematical content knowledge at the study's conclusion for mathematical pedagogical content knowledge. Norton's (2019) findings suggest the importance of teacher education programs concurrently developing these two aspects.

McLaughlin and Rhoney (2015) suggested integrating methods courses within teacher training programs to foster future teachers' appreciation for STEM subjects and cultivate the essential knowledge, skills, and cognitive abilities required to become proficient and confident professionals. Similarly, Hanson et al. (2022) emphasized the importance of restructuring STEM courses, such as engineering, to focus on fostering engineering habits of mind. By providing opportunities for students to interact with practicing engineers, the study found that it was possible to deepen prospective teachers' understanding of engineering and boost their confidence in incorporating engineering principles into lessons for primary school students. It's essential for mathematics courses to continuously integrate new teaching strategies and learning activities to enhance the self-confidence of future teachers significantly.

Likewise, mathematics methods courses can enhance the self-confidence of PSTs by equipping them with specific instructional techniques and learning approaches. Cho and Heron (2015) argued that effective teacher training programs should aim to build resilient PSTs with strong self-confidence through supportive teaching communities where they can share experiences and tackle challenges together. Consequently, teacher educators should create opportunities for PSTs to cultivate strong self-efficacy regarding the knowledge and skills required for teaching mathematics (Wahyudiati et al., 2020).

While recognizing the significance of PST self-confidence in quality mathematics instruction, Kass and Miller (2015) uncovered a surprising outcome in their research. Despite including theoretical courses to bolster classroom self-confidence, their study found no statistically significant improvement in PSTs' sense of efficacy over the four-year program duration. This unexpected result led them to speculate that the teacher educators involved might not fully grasp the importance of nurturing PSTs' classroom confidence.

In summary, existing research aligns with acknowledging the crucial role of PSTs' self-confidence as a motivational factor influencing their effectiveness in the classroom. PSTs with high levels of self-confidence in teaching mathematics exhibit greater resilience and are more inclined to invest effort in helping all students succeed. Conversely, those with low self-confidence are less likely to exert extra effort in meeting the diverse learning needs of their students. Therefore, intentional efforts are warranted to cultivate teacher self-confidence during preservice teacher education.

Conclusion

BMTs represent the future of mathematics education, and their effectiveness in the field will significantly shape the success of future generations in mathematics. Transitioning from student to teacher often brings about a reality shock for BTs, regardless of their preservice training or support upon entering the profession. As they evolve as educators, they grapple with concerns about their abilities, fulfilling teaching responsibilities, and impacting student achievement.

Research indicates a strong connection between mathematics teachers' convictions regarding teaching and learning and how it directly influences their instructional approach and practices. These beliefs may vary across dimensions such as knowledge, teaching methods, and learning approaches, influenced by personal experiences and cultural backgrounds. Concerning making decisions in the classroom, mathematics teachers' beliefs interact with their subject expertise, attitudes, and emotions. Moreover, these beliefs may be deeply ingrained and resistant to change.

The literature has shown that although PSTs' beliefs do not necessarily translate into their practice, PSTs can experience changes to their beliefs as they journey through their teacher education program. Therefore, topics related to disrupting PSTs' beliefs should be included more substantially and overtly within the teacher training program.

Furthermore, research revealed that PSTs' self-efficacy is an essential motivational construct that shapes their effectiveness in the mathematics classroom. PSTs with strong teacher self-efficacy are more robust in their approach to teaching mathematics. They are inclined to exert greater effort to support all students in reaching their full potential. In contrast, PSTs with low teacher self-efficacy are less likely to try harder to achieve the mathematical learning needs of all their students. For this reason, deliberate efforts are being made to develop mathematics teacher self-efficacy in preservice teacher education.

Literature Gap and Intended Contributions

Many theoretical studies focus on BMTs. However, few empirical studies have followed mathematics teachers from the teacher education program into subsequent years of independent mathematics teaching to investigate whether and why they implement practices taught in their credential programs. Conventional wisdom holds that this impact is low, and new mathematics teachers make limited use of teacher education-promoted teaching methods, but more research is needed for an accurate assessment. Therefore, this study provides informed explanations of where the teacher education-practice disconnections lie and may inform understanding about the areas that need further intensification of efforts. These may include further developing mathematics teachers' knowledge and skills, changing teachers' beliefs, partnering with schools and districts to influence their cultures, implementing mitigating measures for new mathematics teachers against environmental pressures, and promoting reform teaching practices.

Chapter 3: Methodology

The current study focuses on beginning teachers' (BTs)[3] classroom experiences in mathematics. Informed by the constructivist paradigm (Vygotsky, 1978), this study used a qualitative case study (Yin, 2014) designed to explore BTs' perceptions of and experiences with applying mathematics teaching and learning strategies. Additionally, BTs compared what they were taught in their teacher education program to their realities in the classroom. Drawing upon the assumption that no single reality exists, I sought to understand BTs' social realities by examining their views, actions, and interactions with others in the social world within mathematics classrooms (Yin, 2014).

Research has indicated that PSTs' beliefs can influence their teaching practices (Fives et al., 2019). Also, their belief systems can act as filters through which they learn and use the information they gained from their teacher education programs (Borg et al., 2018; Dejene, 2020; Skott, 2015). This study aimed to explore elementary BMTs' perceptions of an OECS teacher education program on their mathematics pedagogy and teaching practices related to preparedness to teach in the reality of SVG. This chapter embarks on the research journey by detailing the overarching paradigm, the chosen approach, and the specific design that guides the study.

Delimitations of the Research

This research study focuses on a limited sample population drawn from three specific school districts on mainland St. Vincent, out of thirteen districts in SVG. Specifically, the study examines nine elementary school mathematics teachers with five years of teaching experience or less, representing different geographical positions on the island. It is important to note that the findings from this study

[3] The term beginning teachers (BTs), rather than beginning mathematics teachers, was used throughout the chapter to reflect the intent to invite participants who teach in an elementary school. While my intent was to focus on their mathematics teaching practices, I was mindful that as elementary teachers, they were responsible for teaching all subjects.

are not intended to be generalized to a broader population. These nine beginner teachers were selected through collaboration with the Ministry of Education and school principals. The decision to focus solely on beginner teachers was motivated by my role as a teacher educator, aiming to explore the application of teaching methods taught in my courses within real classroom settings. Additionally, I chose to include beginner teachers located close to my residence for the convenience of conducting classroom observation.

The Research Context

Figure 3

Showing Map of St. Vincent

The study was conducted in three primary schools found in the East St. George, West St. George, and West Kingstown constituencies of SVG (see Figure 3). The schools were referred to as School A, School B, and School C. The primary schools, the local setting for the research, were government-owned and situated approximately four miles outside of the capital, Kingstown, but located on the southern end, the leeward side, and the western interior of the island. They were all co-educational schools with approximately 80 teachers, 15 % of whom were beginning teachers. They all completed their preservice teachers’ training from the OECS Teacher Education program, and seven were my former students. The schools served students from middle- and lower-class social backgrounds who resided within the surrounding villages.

The proposed setting for this study included two different elementary school districts in St Vincent. Two schools (A and B) are from District 6, with populations of 269 and 218 respectively, and the other school was from District 8 (School C) with a population of 432 students. I selected two elementary schools from District 6 because this was the largest school district with 11 densely populated elementary schools, while District 8 has three schools. School A has 14 classes from grades K to 6, with an average class size of 19 students and 17 teachers; 13 of these individuals (76%) are trained teachers, and four are graduate teachers. School B has seven classes with an average class size of 31 students; all 14 teachers are trained, and four are graduate teachers. School A has 19 classes from grades K to 6, with an average class size of 23 students and 26 teachers; 23 of these individuals (88%) are trained[4] teachers, and the remaining six are graduate teachers.[5] In school A, 179 (66.5%) students benefit from the school food program. In School B, 185 students (84.9%) benefit from the school food program. In school A, 200 students (46.3%) benefit from the feeding program.

The schools were administrated by principals who held either a Bachelor of Education or a Master of Education in Education Administration, and a Senior Qualified Assistant teacher who performed the role of deputy principal. They were assisted by other members of staff with varying levels of qualifications and teaching experience. Each teacher was responsible for teaching all the subjects of the school's curriculum, except for the Grade 6 teachers, who had a team-teaching system.

Mathematics at the elementary level was usually scheduled every day (Monday to Friday) and taught mainly in the morning. These teaching periods varied between 30-minute to 1-hour sessions. In

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[4] A trained teacher is a teacher who has been certified by the Joint Board of Teacher Education (JBTE) at the University of the West Indies after completing an Associate degree in teacher education.
[5] A graduate teacher means a person who has obtained an approved undergraduate degree from a recognized university.

SVG, educational underachievement in mathematics is a significant concern affecting both primary and secondary school levels. Every year, students' mathematics performance is described as 'poor.' According to the latest data from the Ministry of Education in SVG, the pass rate at the primary exit examination ranged from below 50% to above 30% (St. Vincent and the Grenadines Education Statistics Digest, 2018–19). For instance, School A attained a pass rate of 56.4%, School B achieved 33%, and School C obtained 45.3%.

Rationale for Qualitative Research: A Multiple Case Study

I opted for a qualitative methodology in this study for several compelling reasons. First, qualitative research methods are particularly valuable for understanding how individuals interpret the events they encounter (Bogdan & Biklen, 2003; Denzin & Lincoln, 2011). Specifically, a qualitative approach is appropriate when research questions necessitate exploration (Stake, 1995). I employed various empirical sources to comprehensively depict the phenomena under investigation, including in-depth interviews, classroom observations, field notes, and teacher-made artifacts. Qualitative research questions often begin with open-ended terms such as 'how' or 'what' to encourage a deeper understanding of the phenomenon and the perspectives of those involved (Patton, 2002; Seidman, 1998). For the current study, I intended to explore participants' teaching experiences and the perceptions of their teacher education program on their mathematics classroom practices and beliefs by asking the following *what* questions:

- What are beginning Vincentian elementary teachers' perceptions about their own preparation to teach mathematics?
- What do beginning Vincentian elementary teachers identify as key factors influencing their early career mathematics regarding their content knowledge?
- What do beginning Vincentian elementary teachers identify as key factors influencing their early career mathematics regarding pedagogical knowledge?

- What do beginning Vincentian elementary teachers identify as schooling context constraints that shape how they teach mathematics?
- What do beginning Vincentian elementary teachers identify as personal constraints that shape how they teach mathematics?

Second, a qualitative methodology was selected because it empowers researchers to delve into subjective experiences, such as feelings and thought processes, that might be less accessible through traditional research methods (Strauss & Corbin, 1998). This study explored the participants' belief systems and lived experiences in the classroom (Dixon-Woods et al., 2006). This method enabled a thorough investigation of how their teacher education program shaped their instructional practices. Third, qualitative research methods are the best approach to understanding social processes in context while exploring social events' meanings for those involved (Esterberg, 2002). The qualitative approach adopted in this study aligns with an interpretive, naturalistic paradigm. Hence, researchers strive to understand the world through participants' experiences and interpretations, studying phenomena within their natural contexts (Creswell & Poth, 2018). From my observations in SVG, there seems to be a struggle for beginning elementary teachers to translate theory into practice with confidence when teaching mathematics. Instead, BTs tend to implement a more traditional teaching mode contrary to what was taught in their teacher education program.

Qualitative research prioritizes achieving a nuanced understanding of phenomena and how individuals interpret their experiences. It necessitates careful attention to the intricate dynamics within the study setting (Jones, 2002). As Dixon-Woods et al. (2006) suggest, qualitative inquiry aims to explore the complexities of human experience and the surrounding world through in-depth exploration. This study revealed the strategies BTs used to teach mathematics in classrooms in SVG and their developing content and pedagogical knowledge. Through richly descriptive data, qualitative research also utilizes the researcher as the main source for data collection (Geertz, 1973; Merriam & Tisdell, 2016). Finally, qualitative studies require an inquisitive mindset that embraces ambiguity, careful observation, and an ability to interpret data through writing (Merriam & Tisdell, 2016). Each of these was employed in this study.

The qualitative research framework adopted in this study, emphasizing epistemology, theoretical perspective, and methodology, provided a robust foundation for contextualizing and exploring the research questions. Furthermore, it facilitates exploring how the OECS teacher education program impacts early-career elementary teachers' grasp of math instruction. This approach was particularly well-suited because it facilitated a deeper comprehension of the lived experiences of the BTs and their perspectives on their instructional practices. By delving into the 'how' and 'why' behind their teaching methods, the qualitative approach offered valuable insights that might not have been captured through quantitative methods. This study allowed participants to articulate their beginning teaching and learning experiences in mathematics. In-depth descriptions were employed to capture the nuanced experiences of participants in the OECS teacher education program (TEP). These detailed accounts contribute to the qualitative research approach, which focuses on understanding participants' perspectives (Creswell & Poth, 2018).

The qualitative dissertation research is framed within the epistemological perspective of constructivism. This approach posits that individuals construct meaning differently, even when confronted with the same events (Crotty, 1998). Crotty (1998) delineated several assumptions of constructivism, three of which are pivotal to this study: (1) Qualitative researchers typically employ open-ended questions, recognizing that individuals construct meaning as they interact with their surroundings; (2) individuals interpret and comprehend their environment through the lens of their historical and social contexts; (3) the primary formation of meaning occurs within social interactions within a human community. Therefore, the research interpretations and findings in this qualitative research are specific to the meaning and interpretation BTs make of their classroom experiences and the connections they make to their teacher education program when teaching mathematics.

Because this research is based on the interpretations of BMTs' teaching experiences in mathematics founded on their teaching education program in the K–12 school setting in SVG, of particular interest is the impact of their teacher education program on how they make meaning about how to teach mathematics. The BTs constructed reality based on their individual and mathematics-shared teaching experiences. Furthermore, this study also adds to the limited research on teacher education in the Caribbean region.

Rationale for Multiple Case Study

This study adopted a multiple-case study design, which is well-suited for investigations encompassing numerous cases (Creswell & Creswell, 2018). This approach strengthens the study's credibility by drawing on data from multiple sources. The research gains robustness by incorporating data from multiple cases (Yin, 2014). Similar to repeated measures studies, a multiple-case design offers a richer understanding of the phenomenon under study and strengthens the generalizability of the results (Merriam, 1998). Given the focus on school districts in SVG and the perceptions of teacher education programs by BMTs, this design strategy was particularly fitting. Examining a single district would have yielded insufficient data to draw comprehensive conclusions. However, investigating all 13 districts in SVG was not feasible for one researcher. Three cases were selected to provide more information without sacrificing the depth required for case studies. These cases offer a greater representation of BMTs' perspectives while working in different school contexts and cultures. Using samples from different schools provided a more in-depth knowledge of issues related to BMTs and a further understanding of the patterns that emerged from various angles.

A case study is appropriate when studying a program or an activity and people in particular contexts, such as BTs' classroom experiences (Creswell, 2014). When discussing case studies, Yin (2009) emphasized that research grounded in theories of social constructivism and situated learning can benefit from employing case study methodology. Yin (2014) defines a case study as an in-depth investigation of a current phenomenon within its real-world setting (p. 18). The theoretical framework of pedagogical content knowledge (PCK), signature pedagogy, and problem-based learning (PBL) aligned well with this case study because they detailed what was studied in its context. By directing focus toward multiple cases in their context, this methodology revealed an interaction among different factors characteristic of BMTs' experiences in unique settings to achieve triangulation, thereby strengthening the study (Creswell, 2013; Yin, 2014).

In this way, it was possible to comprehensively describe what was being studied, which was the objective for all case studies (Stake, 1995). Merriam (2009) added that the phenomenon must be studied in a bounded system that can be "fenced in" (p. 40). A case study is defined as researching a bounded system that is bounded in both time and place, and the experiences of BTs in primary schools in SVG were such a bounded system. This activity takes place within the first three years of a teacher's career (for this study, a teacher with less than five years' experience was included). The geographical limitation of the classroom was also essential to the activities of BTs in primary schools in SVG.

Research on case studies classifies them into three main categories: intrinsic, instrumental, and collective (Stake, 2000). These categories of case studies were based on Stake's "interpretation of the purpose and design of the attending research activity" (Stake, 2000, as cited in Dillon & Reid, 2004, p. 25). Instrumental case studies use a case to gain insight into a phenomenon. In contrast, collective case studies use information from various cases to formulate new research, and intrinsic case studies attempt to deepen the understanding of what was known of the specific unit of analysis (Liu et al., 2010). I understood how BTs' mathematics courses during their teacher education program shaped their current mathematics teaching practices. My research used multiple case studies to attempt to understand the phenomenon of BTs' experiences in elementary schools. Engaging in an in-depth study analysis of beginning teachers' lived experiences in mathematics classrooms is essential (Stake, 2000). I addressed the same research questions with identical data collection and analysis strategies with each participant in three different schools, enhancing the ability of case study research to generalize the findings. The use of multiple case studies also preserved its characteristic in-depth description (Herriott & Firestone, 1983). Each participant inherently provided comparative data, whether those were chosen to predict similar or contrasting results (Yin, 2009). Results gathered from each participant were instantly compared with each other. Data analysis was done until saturation (Lincoln et al., 2011): for example, when no new differences, similarities, or patterns could be identified between BTs' mathematics teaching practices.

This study adopted a multiple-case design, aligning with a constructivist perspective (Maclellan & Soden, 2004). This viewpoint emphasizes how individuals and groups actively build knowledge as they interpret their experiences within their environments rather than passively receive it from external sources. Corroborating evidence from multiple participants in three different schools increased the strength and trustworthiness of this research (Anfara et al., 2002).

Limitation of the Case Study Methodology

Case studies have sometimes been dismissed as a preliminary step to "real" research (Yin, 2012). However, Yin (2012) argues that well-designed case studies can provide rich in-depth data and findings. Fossey et al. (2002) emphasize that methodological rigour is essential for any research. It translates to a well-defined design and consistent methodological decisions for case studies, including data analysis methods. Merriam (1988) highlights the suitability of case studies in education because they can yield authentic insights that can be used to improve practices reflexively. While multiple case studies offer benefits, they also come with challenges for researchers (Baxter & Jack, 2008). Notably, they can be time-consuming and expensive to conduct.

Given the variation between schools and the focus on in-depth analysis of a few subjects, case study consistency may not be perfect (LeCompte & Goetz, 1982; Merriam & Tisdell, 2016). The findings might not be applicable across different contexts or readily reproducible, given the distinct challenges encountered by each school and the context-specific variables influencing the experiences of BTs. Each school presents unique challenges that will impact BTs in varying ways. While there may be shared experiences across schools, the adaptability of BTs depends on numerous context-specific factors. This research ensured the credibility and trustworthiness of the instruments used, employed appropriate data analysis techniques, and established a clear connection between the drawn conclusions and the underlying data. In this way, I discussed the processes and procedures that undergird the case study – were the data generated valid, and do they provide insights that may resonate with other BTs? Was the content of the documents adequately analyzed; do the conclusions of the case study rest upon data? Regarding demonstrating rigour, the case study is not much different from any other technique.

No matter the type of research, creditability, trustworthiness, and transferability issues are present. It is important to note that the study cannot be replicated for a single case because it is based on a unique social context set in a specific time and place. Sandelowski and Barroso (2002) have further suggested that each reader will interpret the research differently, no matter how methodologically or theoretically robust the study is.

Critics sometimes lack trust in the credibility of case study researchers' procedures (Yin, 2012, p. 6). That can be countered by employing methodological rigour, maintaining researcher reflexivity, and following an iterative research process. My study addressed both rigour and credibility through the use of triangulated data sources and a multi-site approach.

Fossey et al. (2002) have discussed the trustworthiness of the interpretation, and Stake (1995) added that generalization is possible on a smaller scale. Generalizations from cases are not statistical; they are analytical. This research employed a multiple case study that fitted the category of abductive generalization, also called naturalistic generalization (Stake, 1995). Naturalistic generalizability happens when the research resonates with the reader's engagement in life's affairs or vicarious, often tacit, experiences (Smith, 2018). To enable naturalistic generalizability, I provide readers with enough details about the BTs' mathematics teaching experiences and beliefs through adequate 'evidence' (e.g., interview quotations, observation field notes, and artifacts). Additionally, I provided enough contextual details and richly layered theoretical expressions of BTs' reality to help readers reflect upon these and connect to their own lives.

Selecting the Sample

I used purposeful sampling to secure the desired sample size of nine participants. Participants were invited to participate if they were recent graduates (in the past five years) from Marville Community College (Division of Teacher Education), were teaching elementary mathematics, and were certified to teach. Qualitative research allows researchers to strategically recruit participants who can offer the depth and detail of the information into the research question and illuminate the problem under investigation (Creswell & Poth, 2018). Purposeful sampling was employed for this reason. Purposeful sampling uses high-value participants relevant to the criteria that fit the research questions. A deeper understanding of the problem and focal occurrence was gained by selecting specific participants.

Convenience sampling posed a potential bias risk, as the sample might not reflect the target population due to its reliance on volunteers. I intentionally targeted and handpicked (Cohen et al., 2000) participants for this research. I acknowledged that teachers' views from the other schools and the wider Vincentian beginning teaching community provided additional insights into the area of concern. However, due to data manageability and time constraints, I restricted the study to the sample described – the participants from three elementary primary schools – which ultimately afforded me opportunities for a more in-depth investigation.

This research was approved by the St. Francis Xavier University (StFX) Research Ethics Board, which follows ethical regulations set by the Tri-Council Policy Statement. To ensure confidentiality, the participants' welfare, and autonomy, I assigned numbers for the study participants and letters for the schools instead of pseudonyms. Following the approval from StFX, I sent an email to the Ministry of Education (MOE) to seek permission to conduct research in various schools (see Appendix B). The Ministry of Education forwarded the letter to the principals of the different schools of interest. The principals selected potential participants based on the criteria stipulated in the letter and granted me permission to come to the school and speak to the teachers. I met with the prospective participants and explained the ethical agreements for the research and the nature of the study. All participants who were contacted consented to be involved in the research. The recruitment process also included the alum association at Marville Community College: Division of Teacher Education. On my behalf, the administration at the school forwarded an email to graduates who had completed their teacher certification program within the last five years.

After the initial conversation with potential participants, I forwarded the invitation letter to participate and the consent form via email to all eligible participants (Appendix C). The letter outlined the purpose of the research study and interview timeline. Interested participants were asked to return the informed consent after they had an opportunity to review the document. The participants were asked to return the informed consent by email and provide tentative dates and times to schedule the first interviews via Zoom conference. Nine participants from three different schools met the criteria for the prerequisite process, including completing and returning the informed consent and scheduling the first interview with me. Within one week of the initial email invitation sent out, I was able to arrange interviews with participants. I conducted the first interview (see Appendix D) with all participants except for one who was on sick leave for eight weeks.

Preparation for teaching across different levels of the education system demonstrate diverse facets of readiness. Participants represent varying demographics: trained in primary education (PE, five participants), early childhood education (ECE, two participants), secondary education (SE, one participant), and technical vocational education (TVET, one participant).

To ensure participant anonymity and data security, I assigned a number to each participant as shown in Table 1. Participants had one to five years of teaching experience, except for one teacher who had been teaching for only four months at the start of the data collection process. The participants completed their teacher training programs between 2018 and 2022, and all identified as female. Table 1 summarizes the data collected during the initial interview of the nine participants; the data is arranged based on the schools where participants were placed. This tabulation aims to assist the reader with a summary of the individualization element of the selected sample. Within this table, each participant is given a number based on the order in which they were interviewed for the first interview phase of this study. After that, a description is provided for each participant in the following column: their qualifications, years of experience in the teaching field, specialization of their teacher education program, subject areas taught, and grade level.

Table 1

Tabulated Summary of Nine Participants

Schools	Participants	Teacher Education Program	Qualification	Experience As a trained teacher	Subjects taught	Grade Level
School A	Participant 1	Primary	Working towards a Bachelor of Education	4 years (prior experience)	Math, social studies and health	2
	Participant 2	Early Childhood	Bachelor of Education, working towards a Master of Education	5 years (no prior teaching experience) literacy coordinator	Math, Language Art, Science, social studies	K
	Participant 9	Early Childhood	Working towards a bachelor's in education degree	3 years (had prior experience)	Math and Science	1
School B	Participant 3	Secondary	Associated degree in Education	4 years (prior teaching experience)	Math, Social studies, and Health and Family Life Education	2
	Participant 4	Primary	Associated degree in Education	4 years (No prior teaching experience)	Math, Science, and Health	K
	Participant 5	Primary	Associated degree in Education	3 years (No prior teaching experience)	Math and Science	1
School C	Participant 6	Primary	Associated degree in Education	2 years (no prior teaching Experience)	Math, Language Art, Science and Social studies	1
	Participant 7	TVET	Associated degree in Education	1 year (No prior experience. Sports coordinator and Guider)	Math, Science, Social Studies and Health	3
	Participant 8	Primary	Associated degree in Education	4 months (No prior experience)	Maths and Language Art	1

School A

Participant 1 (Primary Education [PE])

Participant 1 taught for four years but worked as a relief teacher for several years before attending a teacher education program, where she completed an associate degree in primary education. She taught all grades except kindergarten and Grade 6. She is currently a grade 2 teacher who teaches math, social studies, and health. She is also her school's sports and culture officer, mainly responsible for cultural activities and football. She decided to become a teacher because she always loved teaching, and she was able to make a difference in children's lives. She is currently completing a Bachelor of Education.

Participant 2 (Early Childhood Education [ECE])

Participant 2 has been teaching for approximately five years, and before teachers' college, she had no prior teaching experience. Since leaving school, teaching has been her sole occupation. She works at the kindergarten level and has earned an associate degree in early childhood education. She works with another teacher with many years of teaching experience and is well-seasoned. They work well together; she is responsible for teaching math and social studies. She is also the literacy coordinator at her school.

Participant 2 chose to teach because she believes teachers play a pivotal role in her development as it pertains to the person she is today. When she was a child, she hoped she could instill those same values in the next generation or whoever was in her care. She completed a bachelor's degree in special education and is currently completing a master's degree in special education.

Participant 9 (ECE)

Participant 9 recently completed her one-year teacher education program with an associate degree in early childhood education. She has been teaching for three years; she taught before attending teacher's college and worked as a relief teacher. She is presently teaching mathematics and science at the grade 1 level. She also assists with the cricketers at the school, and since she is currently doing a bachelor's degree in social work, she also helps with counselling. She is part of the mathematics committee, which plans yearly literacy and numeracy activities for the different grade levels. She chose teaching because she loves children and has always wanted to be someone who can help impact children's lives, especially in education.

School B

Participant 3 (Secondary Education [SE])

Participant 3 has been teaching for four years since completing her teacher education program and had no prior teaching experience before formal training. She completed an associate degree in secondary education but was placed to teach at the primary level. She teaches grade 2 mathematics, social studies, and health and family life education. She chose to become a teacher because it had always been her dream. She loves teaching, interacting, sharing with others, and engaging in learning.

Participant 4 (PE)

Participant 4 completed an associate degree in primary education and had been teaching for four years during the study. She had no prior teaching experience before attending a teacher's college. She teaches mathematics, science, and health at the kindergarten level. She is responsible for heading the planning committee, which plans activities mandated by the Ministry of Education (for example, hats off for reading, inter-primary sports competitions, and choral speaking competitions). She is also responsible for the sports department and works with the Disaster Preparedness Committee. She became a teacher because she knew it was something she could do well.

Participant 5 (PE)

Participant 5 is currently a grade 1 teacher. She has been teaching for three years and had no teaching experience before attending a teacher's college. She completed an associate degree in primary education. Currently, she teaches mathematics and social studies. She became a teacher because she worked at a preschool and liked it, so she decided to become a teacher.

School C

Participant 6 (PE)

Participant 6 has been teaching for two years, with no teaching experience before teacher's college, and has completed an associate degree in primary education. She is presently teaching every content area in grade 1. She is on her school's Culture and Parent and Teachers Association (PTA) committee. Being a teacher was not her first choice; she wanted to be a doctor, but her parents could not afford it, so she continued teaching and now loves it.

Participant 7 (Technical Vocation Education and Training [TVET])

Participant 7 completed an associate degree in technical vocation education and training (TVET) but was placed at the primary level. She has been teaching for one year and had no teaching experience before attending a teacher's college. She teaches grade 3 and all subject areas, including mathematics, English, social studies, science, health, and family life education (HFLE). She is the sports coordinator and a Brownie Guider and is responsible for assisting the CPEA project with Grade 6. She became a teacher because it was always something she wanted to do from childhood to adulthood.

Participant 8 (PE)

Participant 8 has been teaching for four months, with no prior teaching experience. She completed her associate degree in primary education and teaches grade 1 mathematics and language arts. She is part of the PTA executive, the Child-friendly Development Activity, and the Fundraising committees. She became a teacher because she had always wanted to be a teacher since she was young.

The Researcher's Role

Throughout the study, I assumed a dual role – practitioner and researcher – which enabled me to collect data from within the practice setting while simultaneously analyzing it through a research lens (Gay et al., 2009). During the data collection process, I reflexively engaged in ongoing critical self-questioning to identify my taken-for-granted values and beliefs about my lived experiences, rooted in my experiences as a Vincentian and mathematics teacher educator at the only teacher education institution on the island. This reflection made my position within the research explicit. Seven of the nine participants were past students of mine. I taught them two methodology mathematics courses during their teacher education program as well as the course Practice Teaching 101. Table 2 shows the content of each course, and the teaching strategies utilized to teach the courses. Varying teaching strategies were commonly used in each course to teach the content. The JBTE/TP101 and

JBTE/MAT102 covered the content planning for teaching. It is essential that mathematics also include the topic planning for teaching because it is a specialized subject matter that employs unique strategies for teaching and learning.

Table 2

Overview Of Mathematics Courses Taught to BTs at Teacher Education Program

Course	Content	Teaching strategies
Developing Number Concepts and Operations at the Primary (JBTE/MAT 101)	1. Contemporary Issues in Mathematics Education 2. Early Number & Number Sense in the Primary Grades 3. Fraction Concepts in the Primary Grades 4. Decimal Concepts in the Primary Grades 5. Proportional Reasoning	Lecture / Discussion Demonstration / Simulation Problem-solving Project-based learning Guided discovery Role-playing Presentations Peer Teaching
Promoting Understanding of Key Concepts in Primary Mathematics (JBTE/MAT102)	1. Planning for instruction in primary mathematics 2. Promoting understanding through problem-solving 3. Developing Algebraic Thinking 4. Concepts and Skills of Measurement 5. Geometry Concepts and Geometric Thinking 6. Concepts of Data Management and Analysis	Lecture / Discussion Role-playing Guided discovery Problem-solving Demonstration / Simulation Presentations Peer Teaching
Teaching Practicum **(JBTE/TP 101)**	1. Planning for teaching 2. The teaching act 3. Classroom Management 4. Personal qualities of a teacher 5. Student teacher's evaluation of self and teaching	Lecture / Discussion Role-playing Questioning Storyboards Guided discovery Problem-solving Demonstration / Simulation Presentations Peer Teaching

As the practitioner, I was the primary mathematics methods class instructor for most of the participants in this study, but I have no supervisory or evaluative responsibility for them now; they are former students. My personal and professional experiences influenced my practitioner/researcher self and underlined and emphasized my stance within this study and its influence throughout my research. These factors impacted my decisions when representing and positioning my identity: they helped shape my knowledge and questions. They challenged my personal experiences as an educator in SVG. Consequently, I was privileged to better understand and interpret participants' experiences. In addition, my personal and professional background brought to light assumptions I might not have otherwise recognized, potentially impacting my research approach. For example, as a mathematics educator, I have the privilege of observing mathematics lessons on different occasions when I visit schools. Based on my observations, I assumed that many teachers are aware of best practices for teaching mathematics. Still, their weak content knowledge interferes with their ability to implement these practices successfully. What they knew in theory was not reflected in their practice.

As the researcher in this project, I had multiple responsibilities. To initiate the research, I recruited participants by introducing them to the study and its goals. Second, I ensured their informed consent by emphasizing the voluntary nature of their participation. Third, I scored each lesson plan and teaching episode based on my field notes. Fourth, I coordinated the classroom observation schedule with participants. Finally, I analyzed the data at the study's conclusion and developed warranted assertions.

My final step in the analysis of data involved interpreting the findings, or as Creswell (2014) has quoted Lincoln and Guba (1985), "What were the lessons learned?" (p. 200). I used my position as a constructivist, experienced educator, and insider in this multiple-case study. I arrived at an informed interpretation through a constructivist lens to be used by the OECS Teacher Education Program. I believe that meaning is not given to us; it is constructed based on our varying experiences, interests, and purposes. Hence, the study adopted a view of knowledge as both shaped by our experiences and grounded in the world around us (Denzin & Lincoln, 2011). The BMTs in my proposed research constructed their knowledge and realities based on their experiences teaching mathematics at the elementary level. Having worked as a mathematics lecturer at the Division of Teacher Education for the past eight years and as a teacher for the past 30 years, I was uniquely positioned to interpret the different understandings and meanings gained through this research. In the context of these multiple case studies, I was mainly influenced by the notions that (a) there were multiple routes to knowledge, (b) as a researcher, I made "warranted assertions" rather than ultimate claims of truth, and (c) theories are essential for predicting and explaining change, rather than being viewed as "true" or "false" (Johnson & Onwuegbuzie, 2004).

Data Collection Methods[6]

Yin (2009) has suggested that case study evidence comes from six sources: documentation, archival records, interviews, direct observations, participant observation, and physical artifacts. The qualitative data for this multiple case study was collected through interviews, observations, field notes, and artifacts. Their self-reported nature limited the participants' perspectives provided through interviews (Yin, 2009). To reduce this bias, I also observed participants' teaching. This study achieved its purpose using a triangulation of methods.

For triangulation purposes, data consisted of 18 interviews (both pre-and post-interviews), in-school observations (27 observations between January 2023 and May 2023), teacher-generated artifacts in the form of 21 lesson plans, 27 BTs' reflections of their taught lessons, and two mathematics courses outlines for the courses (MAT 101 &102) (see Appendix A) for Eastern Caribbean Joint Board of Teacher Education (JBTE). These outlines were from the courses I taught BTs shown in Table 2 above.

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[6] This term was adopted from the following sources:
Corbin, J., & Strauss, A. (2008). Strategies for qualitative data analysis. *Basics of Qualitative Research. Techniques and procedures for developing grounded theory*, *3*(10.4135), 9781452230153.
Denzin, N. K., & Lincoln, Y. S. (Eds.). (2011). *The Sage handbook of qualitative research*. sage.
Flick, U. (2017). Challenges for a new critical qualitative inquiry: Introduction to the special issue. *Qualitative Inquiry*, *23*(1), 3–7.

This data triangulation from interviews, observations, and artifacts allowed me to compare and infer commonalities (Hammersley, 2006; LeCompte & Goetz, 1982; Merriam & Tisdell, 2016; Pierides, 2010). Yin (2009) and Stake (2000) concurred that triangulation is crucial to perform a case study reliably. Nine teachers who participated in the research were interviewed two times each, from November 2022 to June 2023, resulting in eighteen interviews.

The interviews were the starting point for data analysis to help ensure participants' voices and beliefs were well represented in the results. Throughout the three-month data collection period as a mathematics educator, I conducted twenty-seven classroom observations where the study took place, maintained field notes, and recorded my relevant moments in the school. Finally, teachers who participated in the interviews were asked to share the artifacts, such as their lesson plans and reflections on their taught lessons for comparison against what may be stated in interviews, field notes from my observations, and JBTE mathematics course outlines (see Table 2 and Appendix A). Artifact analysis took place at a later stage of data analysis. Since the study was qualitative, I prioritized the depth of descriptive data over the breadth of data. The selection of nine participants allowed for a manageable workload as I strove to generate detailed data, since I also worked full-time during this study's data collection and analysis phases.

Interviews. One of the primary goals of this study was to understand how teacher participants made meaning of their teaching experiences in mathematics based on their teaching education program in the K–12 school setting. Interviews were chosen as a primary data collection method to gain insights beyond what mere observation could provide (Patton, 2002). To achieve this, I fostered a conversational interview style. Following Patton's (2002) recommendations, I strived to build trust and rapport by sharing personal information with the participants. This approach helped to create a more relaxed atmosphere, potentially leading to richer data through the interviews. As mentioned, teacher participants were interviewed twice, from November 2022 to January 2023, except one participant in April 2023 with the second interview conducted in June 2023. The November to January interviews were considered the baseline for interview data, with the June 2023 interviews compared to it. Final interviews occurred after the last classroom observation for each BT, which allowed the whole process to be described, and teacher changes or growth in practice emerged.

The interviews were semi-structured and conducted one-on-one, following the approach outlined by Merriam (2002). A standardized set of open-ended questions guided the interviews to foster candid and unrestricted responses, as recommended by Bogdan and Biklen (2003), Esterberg (2002), and Kvale (1996). Moreover, probing and follow-up questions were employed as needed to prompt participants to expand upon or clarify their responses, aligning with the suggestions of Denzin and Lincoln (2011). Questions guided the initial interviews (see Appendix D and Table 3 for dates) that gathered background information on each participant and their experiences as beginning teachers and what influenced their teaching practices. The final interview (see Appendix D and Table 3 for dates) was designed to address the practices without sounding evaluative or implying that I hoped to see particular mathematics teaching practices taught to them. At the same time, they were students in my classroom. In addition, these questions attempted to provide opportunities for everyone's personal experiences and opinions about teacher practices to come forward. Questions were reworked in response to ongoing data collection and analysis, and each interview took about 30 to 45 minutes. Each interview was recorded using audio technology and transcribed word-for-word for subsequent analysis. However, I, the researcher, was present during the interview to note body language, listen thoroughly, and probe appropriately. Elements of the transcribed data were coded into categories of what was being observed (see the data analysis section for further details on coding).

Artifacts. Artifacts provide a rich data source and shed light on essential aspects of a person, society, or culture, enriching any study (Norum, 2008). The artifacts included in this research helped me understand the changes and development of BTs' pedagogical knowledge and practices (Bowen, 2009).

***Artifact 1. Lesson plans from classroom observation*.** Mathematics lesson plans were collected from each of the nine BTs to gain insight into their knowledge and methods of classroom activities and strategies. Three mathematics lesson plans were collected from most participants (see Table 3 for dates and numbers), totalling 21 lesson plans. The lesson plans generated from their classroom practices were used to gather data and compare BTs.

***Artifact 2. Teacher reflection on mathematics lessons*.** After teaching, each BT was encouraged to write a reflection about the observed lessons. From January 2023 to May 2023, I observed each participant three times, and each participant wrote a reflection following the lesson, resulting in 27 entries. BTs documented their experiences during the lesson, including their difficulties, successes, and any insights about how theories learned in their teacher education program informed their current practices.

Artifact 3. Course outlines for the mathematics methods courses from the Eastern Caribbean Joint Board Teacher Education (JBTE) program. Since the study explored the impact of the OECS teacher education program on BTs' teacher practices, the mathematics course outline was included to compare BTs' actions in the classroom. The course outlines were used to determine what skills students should have developed after completing their teacher education program. Two course outlines were included, the first being "Developing Number Concepts and Operations at the primary level (MAT 101)" (see Appendix A). The primary objective of this course was to equip participants with practical strategies to foster students' development of number sense and conceptual comprehension of the four fundamental operations in primary grades. The second course outline, "Promoting Understanding of Key Concepts in Primary Mathematics (MAT 102)" (refer to Appendix A), aimed to provide participants with practical strategies to ensure students in primary grades grasp essential concepts effectively.

Observations. Collecting data on any teaching practice requires observation. Participant observation is central to qualitative research methodology (multiple case studies) (Hammersley, 2006).

Cowie (2009) described observation as a conscious noticing and detailed examination of participants' behaviour in a naturalistic setting. Notes were recorded on the events occurring. Each of the nine different classrooms was visited three times (see Table 3 for dates) from January 2023 to May 2023, which resulted in 27 classroom observations. I observed how instruction was being delivered: the extent to which the students met the objectives in the lesson plan, the representation of the math being taught, and the connections made between the representations of the math concepts. I recorded the resources students were provided with to do the mathematics and also observed BTs' disposition as they taught the content, the classroom environment, and the climate, which helped me determine whether or not these BTs are implementing strategies related to their teacher education program. The organization of the learning environments also provided pertinent information in determining whether BTs' mathematics classroom practice reflected their knowledge and skills gained from the teacher education program. Other examples observed during the lessons included learning resources and teaching and assessment strategies. The length of each observation was an entire lesson, ranging between 45 to 60 minutes. Teachers' lesson plans were also part of the data collection process. Lesson plans of the observed lessons were requested from each teacher; most teachers had them prepared and willingly shared them.

Fieldnotes. In gathering observational data for this research, I took field notes to record the BTs' verbal and nonverbal behaviour and the context in which these behaviours took place, as well as my thoughts, feelings, impressions, and insights from what I observed in the different classrooms (Maharaj, 2016). These field notes provided a rich data source for examining the meaning of BTs' words and actions in the context of their classes.

In my field notes, which were recorded three times a month in three different classrooms, I recorded dates, where the observation took place, what was going on when it took place, and the relationship between those involved in the interaction. I noted subtleties, relevant details of the scene (the gist of what was said, notes about the proximity of those interacting within a classroom), and anything that may affect my interpretation of the event. My field notes were organized in the format of a T-Chart. The left side of the chart includes a direct report of what I observed during the lessons, and the right side consists of my thoughts and wonderings about the impact of teacher education on BTs' teaching practices. These notes helped me connect what I saw with my beliefs and reactions. I always carried a notebook on my classroom visits; I recorded notes as soon as possible after observing anything significant.

My field notes allowed me to make sense of and connect ideas observed together and what they meant. I shared my observations with participants, but not my thoughts and feelings. At the start of the study, I tried to establish a habit of writing in my journal at the beginning of every classroom observation session. All my observations were recorded in one of two places: my journal or a Word document, with each entry dated. The length of each entry and its associated details varied, depending on what has been observed. In handwritten and digital forms, observations were thoughtfully read, re-read, and reflected upon continuously. I conducted a final member check during the research process by disseminating the formal research findings to all participants, inviting their feedback (McKim, 2023), and corroborating the interpretation of the results.

Table 3

Showing the Type of Data Collected from Participants and the Dates

DATA TYPE	DATES	PARTICIPANTS
First Interview	November 16th, 2022	P1 (PE)
	November 17th, 2022	P2 (ECE)
	November 21st, 2022	P3 (SE)
	November 26th, 2022	P4 (PE)
	November 29th, 2022	P5 (PE)
	December 23rd, 2022	P6 (PE)
	January 5th, 2023	P7 (TVET)
	January 9th, 2023	P8 (PE)
	April 4th , 2023	P9 (ECE)
Second Interview	June 14th, 2023	P4 (PE)
	June 26th, 2023	P5 (PE)
	June 26th, 2023	P7(TVET)
	June 26th, 2023	P1 (PE)
	June 26th, 2023	P8 (PE)
	June 26th, 2023	P2 (ECE)
	June 27th , 2023	P6 (PE)

DATA TYPE	DATES	PARTICIPANTS
	June 27th, 2023 June 29th, 2023	P9(ECE) P3 (SE)
Classroom Observations and field notes	March 5th, 2023 May 2nd, 2023 May 24th, 2023	P1
	March 6th, 2023 May 16th, 2023 May 23rd, 2023	P2
	January 16th, 2023 January 23rd, 2023 May 3rd, 2023	P3
	May 2nd, 2023 May 17th, 2023 May 31st, 2023	P4
	May 2nd, 2023 May 17th, 2023 May 31st, 2023	P5
	February 3rd, 2023 March 3rd, 2023 May 3rd, 2023	P6
	March 9th, 2023 May 16th, 2023 May 23rd, 2023	P7
	January 28th, 2023 March 28th, 2023 May 4th, 2023	P8
	May 3rd, 2023 May 16th, 2023 May 22nd, 2023	P9
Artifacts	21 lesson plans 27 reflections	

Data Analysis

Stake (1995) has emphasized that data analysis is not a linear process with a defined starting point. He argues that researchers make sense of data throughout the research journey, from initial impressions to final compilations. He suggested that to analyze means to take something apart, our observations and impressions, adding that we give meaning to the parts as we take apart our impressions; hence, "case studies are undertaken to make the case understandable" (Stake, 1005, p. 85). By analyzing the data gathered from the multiple case studies, insight was gained into the impact of a teacher's education on BTs' understanding of teaching. Data analysis took place simultaneously as I gathered data. It also allowed for finding commonalities in what has been said, observed, or interpreted and connecting individual pieces of the data to create a category or theme heading that provides insights into the research questions. As I began my data collection, I also began preliminary data analysis by maintaining “observer’s comments” (Merriam & Tisdell, 2016, p. 198) as part of my field notes. Yin (2014) provided a detailed procedure for conducting multiple case studies, which was implemented in this study. The outlined steps encompass selecting a theory or concept, identifying suitable cases, conducting individual investigations and analyses for each case, deriving cross-case conclusions, validating these conclusions against the chosen theory, conducting member checks to validate the interpretation of results, and finally, composing the final report.

To analyze the qualitative data in this research, the data analysis process for this multiple case study began with the data collection in January 2023 and continued until May 2023. Following data collection, in-depth case descriptions were developed, capturing the intricacies of each case and its context (Creswell, 2013). Consistent with the multiple-case study methodology, each case was initially examined independently to grasp its distinct attributes before conducting cross-case comparisons (Creswell, 2013; Yin, 2014). I utilized Creswell’s (2014) six steps in analyzing and interpreting data. These included the following: prepared and organized the data; read and looked at all the data for general impressions; explored and coded the database; used the coding to generate descriptions, categories, or themes for analysis; represented and reported findings; interpreted the meaning of the findings; validated the accuracy of the findings through the process of reciprocity. As Creswell (2014) suggested, first the researchers must structure and categorize the data for organized usage in preparing the data for analysis. For example, my field notes from observation were cataloged, and transcribed notes were organized. Second, I read the data to get a general sense of the information collected and its meaning and wrote my reflections on the data.

The third step involved coding the data, which Creswell(2014) referred to as the heart of the analytic process. This process was thorough and time-intensive, involving interactive engagement, as researchers could identify or refine categories to enhance the precision of their lists (Creswell & Clark, 2007). I used a combination of emerging and predetermined codes, which appeared based on emerging information, and used insights gained in ongoing research (Creswell, 2014). Creswell's process identifies a fourth step where coding describes the setting, including the people, places, and events. Finally, themes were developed from the codes and were aligned with the research questions. I connected major themes within a narrative with my theoretical antecedent.

Open and axial coding were used (Merriam & Tisdell, 2016). Open coding was sifting through the data and maintaining notes about information that could be significant (Merriam & Tisdell, 2016). Following Yin's (2014) approach to cross-case analysis, a thematic table was developed for each case. These tables served as a framework for identifying similarities and differences within the data across the cases (Yin, 2014, p. 164). This comparative analysis facilitated the identification of overarching themes and, ultimately, the construction of a comprehensive narrative that captured the phenomenon under investigation.

Furthermore, open coding comprised the language presented in the data, which helped ensure that pre-conceived commonalities were not constructed. Open codes were identified between each set of interviews by underlining and circling words recurring across interview and field note data sets, which helped ensure participant views were present and not overtaken by my subjective opinions. The lesson plan artifacts were reviewed systematically to promote consistency of content and interpretation. I reviewed each lesson plan artifact a few times; I recorded notes detailing my reactions and those elements that seemed most appropriate to my research questions. As themes emerged, I coded them as I saw fit, following the format of open coding. Open codes were identified at the beginning stage of the data collection, and adjustments to the initial data analysis process were made in the final interview questions as needed. The open codes evolved throughout the data analysis process. Reflexivity influenced which codes were considered most relevant and settled upon.

Axial coding (Merriam & Tisdell, 2016) of BTs' interview data helped to support the interpretation stage by grouping open codes based on commonalities. When open coding of initial data was formed, axial codes were developed, which created categories that acknowledged themes in the data by providing titles that inferred and united the open codes. These axial codes were created with consideration for context, belief structures of the BTs, and my observational data for each case. With axial coding, the open codes were compared for each case individually and across cases, interpreted for their meaning, and placed together in categories that provided descriptive thematic headings using a table. For example, an open code included words such as confidence, apply knowledge, obstacles, and change, which fell under the axial code "*Perceived Preparedness"* (BTs describing how prepared they felt to teach mathematics after completing their teacher education program). The initial axial coding stage took place towards the end of the data collection phase. Following axial coding, open codes were revisited and compared to the axial codes, which helped ensure that open-coded data fit into the axial codes created when cultural context and influences were considered. Through data analysis in the form of open and axial coding, as well as writing about emerging themes describing the impact of teacher education on BTs' understanding of how to teach, a sort of cognitive map was constructed that represented a socio-cultural pattern of teaching experiences and practices (Merriam & Tisdell, 2016).

In summary, this multiple-case study employed a thematic analysis approach to draw insights from data collected across three elementary schools in two districts. Detailed case descriptions were developed, capturing the unique experiences of elementary BMTs regarding their preparedness to teach mathematics. Thematic tables facilitated cross-case comparisons, revealing commonalities and variations in perspectives on preparedness among BMTs across the different school contexts. This analysis ultimately illuminated the key themes shaping BMTs' preparedness for mathematics instruction within the research scope.

Creditability and Trustworthiness

Creditability is concerned with assessing the alignment of findings with reality (Stahl & King, 2020). This aspect is subjective and hinges on individual judgments. In qualitative research, inquiries about the congruence of findings parallel questions about internal validity in quantitative research.

Creditability was enhanced because of my long-term presence in the school to observe the nine BTs' mathematics teaching. My presence three times over six months in nine BTs classrooms gave a total of 27 visits, allowing for continual comparison and inference of data, "ensuring a match between researcher categories and participant realities" (Merriam & Tisdell, 2016, p. 244), as well as disciplined subjectivity, which were essential considerations for creditability in qualitative research. Triangulation of data through multiple methods (semi-structured interviews, field notes, and artifacts) and multiple cases helped enhance creditability, as codes emerging in more than one data set indicated greater integrity (Creswell, 2009). In addition, reflexivity was a vital consideration in this study. Finally, transparency was added to the study by continuously considering and reporting how my preconceptions, biases, personal values, and assumptions influenced the data collection and analysis.

I established working relationships with everyone who was involved in the study. In one sense, these established relationships brought creditability to this case study. At the same time, my role of power as a past mathematics teacher educator of these BMTs may have influenced what participants felt they needed to say to me. This was an ongoing consideration for the data generated and analyzed. Checks relating to the accuracy of the data occurred "on the spot" after observations and at the end of the data collection. BMTs were asked to read recorded interview transcripts in which they had participated (Creswell, 2009). Here, the emphasis was on whether BTs considered their words to match what they intended.

The data of this study was considered from the standpoint outlined by Lincoln and Guba in 1985 "as "dependability" or "consistency" (as cited in Merriam & Tisdell, 2016, p. 251). Under this definition, consistency refers to the results that make sense based on study design, data collection, and analysis. In other words, the results were considered "consistent and dependable" (Merriam & Tisdell, 2016, p. 251) by the reader. Because perfect credibility is an impossibility, perfect consistency is unachievable as well. However, interpreting the data to generate plausible results was achievable. In combination with what has already been stated in the data analysis section, consistency was enhanced through the peer-review nature of the dissertation and the support of the supervisor and committee members. Data collection methods and analysis were discussed in detail with my thesis advisor. An analysis and interpretation record were maintained if questions arose.

This proposed study does have limitations. Not only was the sample size small, with only nine teacher participants but it was also conducted in only three schools, consisting of just over 25 teaching staff, where everyone knew each other on a first-name basis. This may have influenced how participants responded, even though they were assured that their statements were kept confidential, and codes were used. As stated earlier, it was also important to acknowledge that I was the BTs' past mathematics lecturer from their preservice programs. This may have influenced how participants and other staff interacted with me, spoke to me, and what they spoke about, affecting the study's findings. To ensure the anonymity of BTs, I assured participants that I removed any word or phrase from the data that would easily identify them. I also made the intended use of data clear and specific to BTs, allowing BTs to make informed choices about using their information. The discussions about data use and confidentiality were ongoing, and participants were told that modifications would be made to the informed consent process if they were uncomfortable sharing any data.

Ethical Considerations

My research sought to examine the impact of the OECS teacher education program on BTs' understanding of how to teach mathematics. This research had two types of ethical considerations: procedural and relational ethics. Procedural ethics were the formalized protocols and permissions that needed to be addressed. In contrast, relational ethics concerned my ties to those I worked with and the content at hand (Guillemin & Gillam, 2004).

Negotiating Access

Much real-world research occurs in settings where the researcher requires formal agreement from someone to gain access. For this research, access was negotiated at different levels. First, before engaging in this research, ethics approval for this project was sought from the St. Francis Xavier

University (StFX) Research Ethics Board, which followed ethical regulations set by the Tri-Council Policy Statement. Second, I sought permission from the Ministry of Education (MOE). This was done through email correspondence. Third, permission was sought from principals and class teachers at each school level. This was done via both a written letter and personal contact.

In all instances, the purpose of the investigation was clearly outlined and explained. I also indicated to the MOE, principals, and teacher participants that the study results would be made available/accessible to them if they so desired.

It was imperative to ensure confidentiality about all data collected when the research occurred. This related not only to assuring participants that I maintained confidentiality and did my best to ensure none of my findings identified any individual who was participating in the multiple case study research, and to ensure that all participants adhered to the practice of maintaining confidentiality regarding the other teachers involved in the research. I made this expectation of confidentiality explicit before working with BTs, and I worked with them throughout the time by voicing a reminder during each session. I used codes to enhance confidentiality, although complete confidentiality was impossible (Merriam & Tisdell, 2016). In addition, I assured BTs that I would not discuss their data in detail with the school's administration team or any other person. While I could not guarantee that they believed me, I asked BTs to sign documents explicitly, making these statements help support the effort.

Merriam (1988) noted that when using a case study methodology, there were two points at which ethical concerns may be an issue: "the collection of data and in the dissemination of findings" (p. 179). Creswell (2014) added that ethical issues must be anticipated and reflected through the research process. In this case study, research participants were protected at all levels throughout the research process. All BTs were required to provide written informed consent. To ensure informed consent, each BT was individually recruited, and the study's purpose and data collection procedures were explained. Participants were provided with ample opportunities to raise any potential issues they might have had. The voluntary nature of participation was underscored, and participants were assured that declining or withdrawing at any juncture would not adversely affect their employment status. Each BT was given an information sheet to explain the study further. They were given appropriate time (in this case, 24 hours up to one week) to read the information sheet and decide whether they wanted to be involved in this study. Each BT was required to sign the informed consent form before the first interview to indicate their permission to be part of the study. This signature was confirmed before the data collection (see Table 1). An explanation was given to potential BTs that they can withdraw from the study at any time, even after the informed consent has been signed.

Every interview and observation took place individually within the confines of their respective classrooms, ensuring privacy and excluding any external parties. I am the sole individual able to match the identities of the BTs with the voice recordings. Information gathered from the BTs was securely stored in a locked cabinet, inaccessible to anyone other than myself. This personal data was disposed of in compliance with the research governance procedures at StFX.

As the researcher, I developed a trusting relationship with the participants. In adherence to relational ethics, I prioritized trust, respect, and open communication with participants in this study. Informed consent procedures were meticulously explained, ensuring participants were thoroughly informed about the study’s purpose, their expected contributions, and any potential drawbacks involved in participating. Ongoing dialogue was encouraged to address concerns and maintain ethical integrity. I also recognized my debt to the community of teachers in which I worked, and I plan to provide advice and recommendations where necessary related to the teaching of mathematics. In addition, I plan to exchange labour at the schools where I gained entry to conduct my research. I will do this by volunteering to conduct a workshop at the schools on any aspect of teaching and learning mathematics. Therefore, I am obligated to reciprocate appropriately with the teachers who participated in the study. I also involved the research participants in interpreting data and communicating the results.

Research Timeline

Table 4

The Complete Timeline

Steps	Timeline
Dissertation Proposal Defense	October 2022
StFX Ethics Board Approval	October 2022
School Board Research Request Approval	October 2022
Data Collection:	
First set of Semi-structured interviews	November 2022
Second set of Semi-structured interviews	June 2023
Classroom Observation and field notes	January - May 2023
Teacher Participant Generated Artefacts	January – May 2023
Data Analysis:	
Open coding	On-going, starting January 2023.
Axial coding	May - August 2023
Writing of results	September 2023- March 2024
Revision of Writing	April-July 2024
Final adjustment and dissertation defense	October 2024

Conclusion

Case studies investigating contextually unique phenomena often focused on the researcher's professional practice (Stake, 1995). My proposed research was directed at beginning elementary teachers and the teaching of mathematics. Having spent 30 years working in education, I have a great interest in the art and skill of teaching mathematics, what Van Manen (1991) would term pedagogy. Harland (2014) has emphasized that case studies can yield unforeseen insights. These unexpected findings, when encountered, hold the potential to significantly contribute to advancements in knowledge, theory, and practice (Harland, 2014). This research aimed to influence the practice and sustained support for beginning teachers teaching elementary mathematics. As was emphasized earlier in this paper, case study research done well may provide the researcher with deep insight into the phenomenon studied. I understood this to be my individual interpretation of beginning teachers' lived experience as they sought to apply skills and knowledge gained from their teacher education program.

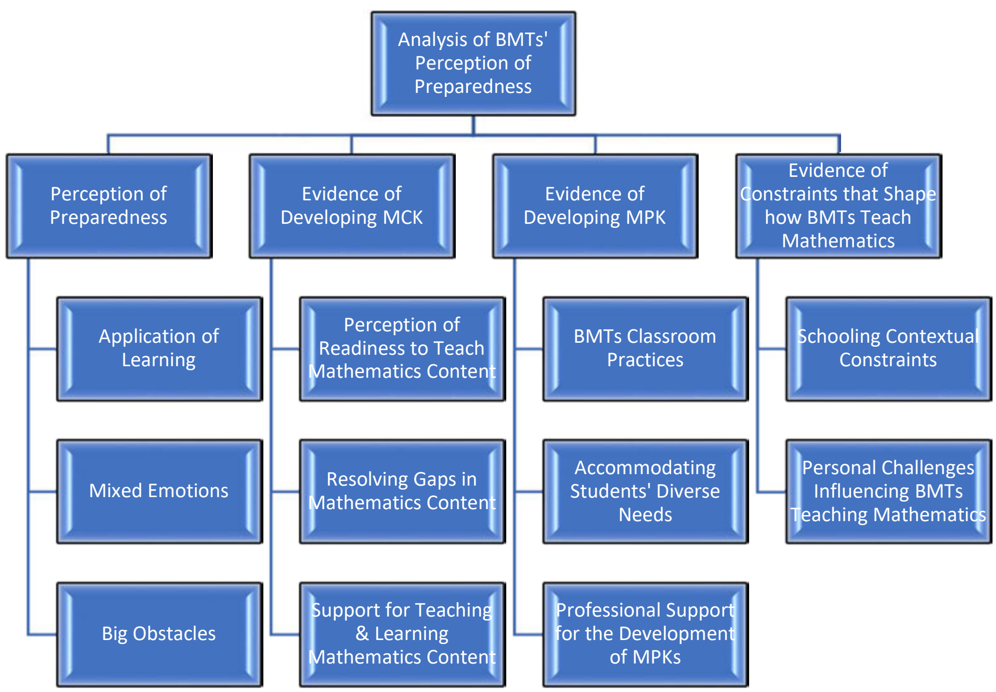
Chapter 4: Perceptions of Preparedness: Relationships with Teacher Education Training

Introduction

The purpose of this qualitative study was to explore elementary BMTs' perceptions of an OECS teacher education program on their mathematics pedagogy and teaching practices as they relate to preparedness to teach in the reality of SVG. Chapters 4 to 9 present the findings of this multiple case study based on data analysis of the nine research participants' responses to the first and second semi-structured interview questions, classroom observations, and artifacts (see Figure 4 for a graphical representation of the data analysis).

Figure 4

Showing a Graphic Representation of the Data Analysis Illustrating the Systematic Treatment of the Topics



These findings are organized according to the research questions, shedding light on the extent to which the teacher education program adequately prepared its candidates for teaching elementary mathematics. The study employed frameworks such as pedagogical content knowledge (PCK) (Shulman, 1987), signature pedagogies (Shulman, 2005), and problem-based learning (PBL) (Barrows, 1996) to assess how well the institution's courses equipped teachers with an understanding of both mathematics content and pedagogy and how these aspects influenced their teaching plans and strategies.

A meticulous analysis of the collected data was imperative for identifying significant themes and patterns (see Figure 4). The Beginning Teachers (BTs) exhibited openness, honesty, and reflection in their responses. The researcher systematically analyzed the diverse data, linking emerging themes to the research questions and the overall purpose of the study.

The first research question (RQ1) of this study – What are beginning Vincentian elementary teachers' perceptions about their preparation to teach mathematics*?* – focused on BMTs' perceptions regarding their readiness to enter the teaching profession and how well they were prepared by their teacher education program. Nine participants were interviewed during the first interview. These interviews were conducted individually with all participants based on their availability from November 2022 to April 2023. All participants are primary school teachers, although some completed different teacher education programs (see Table 5). Each participant is identified throughout based on the type of teacher education program they completed: that is primary education (PE), early childhood education (ECE), secondary education (SE), and technical vocational education training (TVET). This is necessary because BTs' perception of teaching mathematics will vary, and not all programs expose participants to mathematics content and pedagogy courses.

Table 5

Tabulated Summary of Nine Participants

Participants	School Location	Teacher Education Program	Experience as a trained teacher (years)	Experience Before training (years)	Grade Level
1	District 6 West St. George	Primary Education (PE)	4	5	2
2	District 6 West St. George	Early Childhood Education (ECE)	5	0	K
3	District 6 East St. George	Secondary Education (SE)	4	0	2
4	District 6 East St. George	Primary Education (PE)	4	0	K
5	District 6 East St. George	Primary Education (PE)	3	0	1
6	District 8 St. Andrews	Primary Education (PE)	2	0	1

Participants	School Location	Teacher Education Program	Experience as a trained teacher (years)	Experience Before training (years)	Grade Level
7	District 8 St. Andrews	Technical Vocation Education & Training (TVET)	1	0	3
8	District 8 St. Andrews	Primary Education (PE)	0.3 (Newest BTS)	0	1
9	District 6 West St. George	Early Childhood Education (ECE)	3	1	1

The data collected was reviewed several times, and direct quotations from the participants were used throughout. Pseudonyms were not assigned to participants in this study; instead, any data shared or discussed is presented in a manner that ensures the protection of their identities without the use of fictional names. Participants were asked questions about their perceptions of the teacher education program and how well they were prepared to teach mathematics at the primary level. First, I discuss participants' ratings of how well they were prepared to teach mathematics in their Teacher Education program. Following this, I discuss the factors that shaped participants' teacher perceptions of their preparedness (see Table 6). I chose to employ a hat metaphor to present the data, which aided in portraying the distinct voices and personalities of each participant during the interviews. Based on my field notes, I selected a specific hat that encapsulated the personality of each participant. The factor "Application of learning" is discussed first because it was most influential in shaping BTs' perceptions of their preparedness to teach mathematics. Application of learning may be defined as the degree to which BTs effectively apply knowledge, skills, and attitudes gained in a training situation to the job environment (Sasson & Miedijensky, 2023).

Table 6

Factors Shaping Participants' Teacher Perceptions of Their Preparedness

Factor 1: Application of learning	Factor 2: Mixed Emotions	Factor 3: Big Obstacles
Class Projects Learned theories	Feeling of confidence Feeling of abandonment	Lack of tools and resources Limited knowledge of teaching math content

Factor 1: Application of learning	Factor 2: Mixed Emotions	Factor 3: Big Obstacles
Experience from practicum and classroom instructions Helpful Courses	Feelings of frustrations	Classroom management Limited knowledge of the curriculum

Perceived Preparedness

To better understand the term perceptions, a quote from Skaalvik and Skaalvik (2007) was adopted: that is, perceptions are those "teachers' beliefs about their own abilities to plan, organize, and carry out activities required to attain given educational goals" (p. 69). BTs were asked to rate between 1 and 10 how well their Teacher Education program prepared them for the mathematics classroom, with 10 defined as "exceptional." Participants ranked the program between 5 and 10 in terms of preparation for the classroom. Specifically, 11% rated the program a 5; 22% rated the program a 6; 11% rated the program a 7; 11% rated the program an 8; 33% rated the program a 9; and no one rated the program a 10. In this section of the analysis, participants described themselves in relation to their understanding or feelings about mathematics. BTs' feelings about mathematics, that is their self-efficacy (Bandura, 1997), seemed to affect their understanding of how well they were able to teach mathematics. See Figures 5 and 6.

Figure 5

Participants' Perceived Preparedness

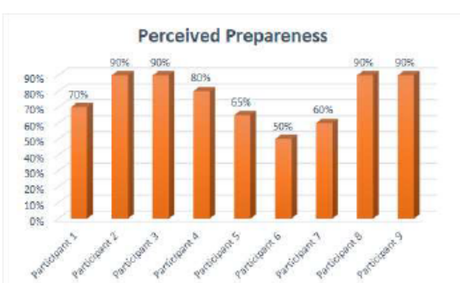


Figure 6

Summary of Participants' Perceived Preparedness

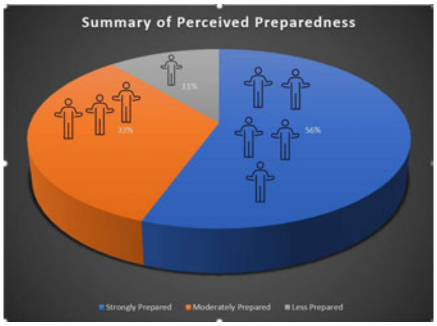


Figure 6 shows that most of the participants indicated that they were strongly prepared (56%), while 33% indicated they were moderately prepared, and 11% indicated that they were less prepared. Overall, participants seemed to have a positive perception of their teacher education program, but commonly described feeling underprepared for mathematics classroom teaching. Several participants described a lack of mathematics content knowledge, not enough exposure to the mathematics curriculum, and insufficient mathematics teaching experience during their taught courses as some of the reasons for feeling unprepared to teach mathematics. It's noteworthy that I served as the mathematics lecturer for seven out of the nine participants in the study, those who completed both the PE and ECE teacher programs (Table 5). I believe that they were trying to be modest in their responses and were trying to avoid saying anything negative about their teacher education program. But upon further probing, they seemed comfortable to share less than positive elements about the program. Teacher participants articulated an assortment of challenges about their perceived preparedness to teach. As Participant 1 (PE), one of my past students, explained in her first interview,

> I will say 6.5. When I heard that I was going to teach math I was a little bit scared because I didn't want to teach the wrong content, but I had to do it. I had to do a lot of self-talk like I'm

> going to teach you. I'll make sure to go and do a lot of research to make sure that that content is correct.

The participant's fear of mathematics influenced her perception of the math education she received at the Marville Community College (MCC) (a pseudonym): Division of Teacher Education credential program. It seemed that she was still not confident that she could teach the content. On the other hand, Participant 4 (PE), another past student, expressed in her first interview that the math education she received changed her concerns about the teaching of mathematics: “I would give the program an 8 because there is always room for improvement. …I'm seeing things differently I am not fearful of math, [it] is not that big, that big scary subject that we think it is.” Hence, this implied that Participant 4 fears math less because she became more comfortable with the mathematics course content and experiences, and this has deepened her understanding.

Three participants agreed independently that more needed to be done to prepare teachers to teach mathematics specifically with more exposure to the mathematics curriculum, teaching practice opportunities, and time allotted for taught courses. For example, in her first interview, Participant 6 (PE), one of my past students, stated, “We needed more math teaching practice opportunities,” and Participant 1 said that they needed more instructional time so that they could develop a greater love for mathematics. Also, Participant 9 (ECE) commented in her first interview that she lacked knowledge of the mathematics curriculum. She echoed, “I will say nine out of 10 because I'm still trying to understand the different parts of the mathematics curriculum. I was not exposed enough to the curriculum.” Part of Participant 9’s challenge in understanding the mathematics curriculum may be attributed to the fact that Participant 9 was enrolled in the early childhood program, and the math course outline did not cover lesson planning and unit planning. Hence, they received a quick introduction to the curriculum document in their mathematics course and during teaching practice.

The findings revealed that the type of teacher education programs students took influenced their perceptions of their preparation for mathematics teaching. Both participants 3 and 7 completed the secondary and technical vocational education training (TVET) program respectively. Therefore, their scores were based on the overall rating of their program. In her first interview, Participant 3 stated:

> I will rate the program a 9, even though they've not prepared me for math, you know, there were still things that I could have incorporated … I believe that once you go to a teachers' college, it doesn't matter, especially if you do the primary program. You can teach, whatever subject.

This excerpt from my field notes shows Participant 3 underestimated her abilities:

> Participant 3 (SE) exceeded my expectations during the observed mathematics lesson. She seamlessly integrated innovative instructional methods, using real-life examples and engaging activities to teach the concept of Subtraction. Participant 3 (SE) demonstrated a deep understanding of subtraction, maintained a dynamic classroom environment, and employed varied teaching aids to cater to diverse learning styles. Additionally, Participant 3 adeptly addressed student questions, fostering a positive and collaborative learning atmosphere. The overall performance highlighted exemplary pedagogical skills, enthusiasm, and a strong commitment to student success in mathematics (Observation 1, Participant 3 [SE], February 16, 2023).

Participant 6's thoughts about the MCC teacher education programs may be due to the efforts made to provide a comprehensive coverage of professional knowledge, values, and skills. At MCC, BTs are required to take general courses other than mathematics such as Teacher Practice (TP) 101 (see Appendix A for course outline). Some of the topics covered in TP101 include teaching strategies, creating teaching aids, and creating unit and lesson plans.

Participant 7 (TVET) shared a different experience from Participant 6 (SE). Even though she learned about lesson planning and teaching strategies, she found it difficult to apply the knowledge gained to another subject area. In her first interview, she lamented,

> I will rate the program around 6 because I learned from the teachers' college about the lesson planning and teaching strategies and all of that. However, applying them to other subject areas like mathematics was a problem for me because I had to think, brainstorm, and research on my own so I could get to use them in primary school since I did the TVET program.

An excerpt from my field notes confirms Participant 7 had some deficiency in the teaching of mathematics, especially with the scope and sequence, because of not taking a mathematics course.

> During the observation, it was evident that Participant 7 attempted to cover an extensive amount of content on Capacity within a single lesson. She introduced multiple concepts (definitions, units of measurement, measuring Capacity correctly, and converting from one unit to the next) without allowing sufficient time for students to grasp each one thoroughly. As a result, the pace appeared rushed, and students struggled to keep up with the abundance of information. Some students seemed overwhelmed, and there were signs of confusion as they tried to process the numerous details presented. The attempt to cover too much content in one lesson potentially hindered the depth of understanding and may have impeded the effectiveness of student learning (Observation 1, Participant 7(TVET), March 9, 2023)

Participants had varying ratings of their overall perceived preparedness from their teacher education program as it related to teaching mathematics. Most of them gave a high rating but identified areas for improvement, such as the inclusion of more teaching practices, instructional time, greater confidence in the content, and exposure to the curriculum. The participants' own fear of mathematics was also influential in BTs' perceived preparation to teach math. Finally, the teacher education program that participants were enrolled in at MCC: Division of Teacher Education also affected their perception of teaching mathematics because, for some of the programs, participants did not take a mathematics course, but they were placed at a primary school where they were assigned to teach this subject.

There were several factors identified in the findings that shaped BTs' perceived preparations. BTs' ability to transfer their learning from their teacher education program to their classrooms was the most common factor and will be discussed first, followed by mixed emotions and big obstacles.

Factor 1: Application of Learning

In this study, the application of learning refers to participants' application of the knowledge and skills gained from their teacher education program to their current mathematics classroom. BTs were asked to reflect on their teacher education and identify aspects of the courses they frequently incorporate into the teaching of mathematics. The first interview with the participants revealed three distinct categories, yet it's important to note that other components of their teacher education programs were not addressed. These included projects, theories, and experiences from the different courses that BTs felt were valuable and consistently incorporated into their mathematics classrooms. Table 7 displays the various aspects within each category that BTs recognized as relevant to the teaching and learning of mathematics. This table is not exhaustive or representative of the entire program.

Projects. Some of the projects BTs experienced during the teacher education program that they incorporated into their classrooms were using 3D shapes to build real-life features (e.g., a doghouse), creating big books, creating visual aids (e.g., an addition machine, that is a working model that allows students to visually demonstrate addition), and making model classrooms.

Table 7

Application of Learning: Projects, Theories and Experience

Projects Applied	Theories Applied	Experiences Applied
Geometry projects (created 3D shape doghouse) Big book assignment Making teaching aids Making classroom model	Concrete, Pictorial, Abstract (CPA) Approach Behaviourist Theory of Learning Montessori Theory of Learning Cooperative Learning Theory Concept Maps	Teaching practicum Instructions - Modelling Disposition of lecturer

Projects Applied	Theories Applied	Experiences Applied
	Constructivism theory with learning approaches e.g. Differentiated Learning	

Participant 6 recalled in her first interview that she was able to incorporate in her teaching the instructional approach of project-based learning grounded in constructivism theory. Having been exposed to it in her mathematics course (MAT 102) as an assignment, she had to complete a geometry project. She explained,

> I can recall that in our math course at teachers' college, we were supposed to create a dog home as a group project using specific measurements and 3D shapes. So, I had my students build a doghouse while we looked at different 3D shapes. So, they were able to build the doghouse while learning about the concept.

Participant 2 (ECE) revealed that Unit 4 in the course ECMT101, using Literature to Explore Mathematics, was most helpful. In her first interview, this participant said,

> I remember vividly when we did Literature in Mathematics, we did an assignment where we had to make big books and so on. And that is something that I carried with me in the classroom. So even when we're doing Math. I would do stories. I would write little, short stories and the children really enjoyed that. So, I would say it would have to be that aspect of Literature and Math.

The pedagogical training Participant 2 received during her teacher education program made her more aware of her approach to teaching and teaching methods in mathematics. She successfully linked literature-related information to incorporate mathematics into the teaching-learning process, guiding her subsequent teaching actions. Participant 4 (PE) also highlighted in her first interview how she was able to utilize a teaching aid she created in her math class to assist her with the teaching of the concept addition. She highlighted:

> When I was at Teachers' College, I had to do a final assessment in Math, in the course (MAT 101). That's where we had to create a visual aid for any concept, and I built what I remember to be an addition machine that was something that I enjoyed building. I had it after teachers' college and I kept it at home all that time because I felt so proud of myself for doing this. Never did I know you could do things like that. And then when I was placed in kindergarten, that machine became a part of me where I was able to use it to show the children how to actually add 1-digit numbers and I think it was something that I brought from Teachers' College that I was able to implement into my classroom.

Although Participant 3 (SE) did not take a math course during her time at the MCC: Division of Teacher Education, she too was able to successfully apply an aspect of one of her courses to the teaching of mathematics. In her first interview, she explained,

> Yes. In the course I did. I majored in business studies and minored in social studies. So, from one of the business courses, I used some of the techniques in my mathematics class. For example, one of the projects I had to do was to make a model of an office, using 3D shapes, so I was able to adopt the idea in my math class, so. I decided to have students create models of different things using 3D shapes.

These projects seemed to have had a positive impact on BTs' perceptions. The projects appeared important for BTs to develop skills and confidence in different aspects of teaching mathematics.

Theories Transferred. An understanding of learning theories can help educators "reflect on their practice, improve upon, reshape and refine their work, and contribute to advancing the discipline" (Harasim, 2017). Learning theories are important in helping teachers connect to all different kinds of students. The pedagogical theories acquired through the teacher education program, which BTs highlighted as routinely incorporated into their mathematics classes, involved applying reinforcement to nurture desired behaviours in the classroom, drawing on Skinner's (1948) behaviourist theory. For teaching mathematical concepts, the application of the Concrete, Pictorial, Abstract (CPA) approach is a cornerstone of Jerome Bruner's (1966) theory of learning and cognitive development. The BTs emphasized the adoption of carefully designed materials and activities that foster hands-on exploration and discovery, aligning with a pedagogical approach inspired by Montessori's (1994) educational theory. Additionally, they incorporated cooperative learning (Vygotsky, 1978) and differentiated learning (Tomlinson, 2000) approaches, both rooted in constructivism theory (Vygotsky, 1978), into their instructional strategies (see Table 7). Participant 2 (ECE) discussed how she frequently incorporated Skinner's (1948) behaviourist theory in her classroom; this was one of her favourite theories she learned during her teacher education program because it helped her with classroom management issues. Participant 2 (ECE) believed that positive reinforcement could be used to strengthen students' good behavior by presenting a desired stimulus, for example, rewards after a desirable action. In her first interview, she stated, "I frequently do adapt the behaviorist theory as it pertains to using reinforcement, incentives, and so on to motivate my children or to get them to desist from certain behavior."

Similarly, Participant 9 (ECE) frequently utilized learning theories to guide her teaching and learning of mathematics, but she was more captivated by Bruner's CPA approach. As she indicated in her first interview,

> Bruner's theory stood out to me: using the Concrete, Pictorial, and Abstract approaches to teaching math. Using manipulatives, like based ten blocks, fraction circles, number lines, and so forth, I have implemented this theory when I'm doing my math sessions.

I noted during the classroom observation that Participant 9 made an effort to apply the CPA approach in her teaching. In my field notes, I wrote,

> Participant 9 effectively implemented the Concrete-Pictorial-Abstract (CPA) approach in a mathematics lesson on Fractions. The teacher began by introducing a concrete experience, using manipulatives such as fruits, sandwiches, and cakes to represent halves and quarters. This

hands-on activity was followed by creating pictorial representations on the board, allowing students to visualize abstract ideas. Finally, Participant 9 seamlessly transitioned to the abstract phase, where students engaged in finding halves of different numbers and shapes. The structured highlighting concrete, pictorial, and abstract stages facilitated a comprehensive understanding of fractions and promoted active engagement among students (Observation 1, Participant 9 (ECE), May 3, 2023).

Both theories favoured by participants 2 (ECE) and 9 (ECE) helped to inform how they taught mathematics. For example, the behaviourist theory encourages teachers to provide valuable and speedy feedback, rewarding good behaviour and getting students used to routines. These actions potentially help them to create habits in students that make them improve their learning (Shan,2021). Arguably, this might provide these participants with greater control and empower them to take the lead in mathematics lessons.

In this field notes extract, I noted,

> Participant 2 (ECE) applied elements of behavioral theory during the observed lesson. She utilized a strategy involving reward charts to acknowledge and commend students for positive behaviors, prominently displayed in the classroom. The chart featured a visual ladder leading to the concept of "amazement." Students could ascend the ladder by demonstrating desired behaviors, such as active participation and cooperation. Participant 2 combined verbal praise with the reward chart, creating a positive and supportive classroom atmosphere. This approach motivated students to actively seek recognition and progress on the ladder, fostering a structured framework for reinforcing a positive behaviour environment (Observation 1, Participant 2 (ECE), March 16, 2023).

Overall, the use of reward charts appeared to be a successful tool, contributing to a sense of accomplishment and excitement while cultivating positive learning.

Additionally, the CPA approach helped students learn new ideas and build on their existing knowledge by introducing abstract concepts in a more familiar and tangible way. The concrete is the ‘doing’ stage that brings concepts to life; the pictorial is the ‘seeing’ stage, which enables learners to make mental connections between physical objects and abstract levels of understanding (Seto et al., 2020). Understanding and applying learning theories is crucial for BTs in the transition from teacher education to practice in the mathematics classroom. BTs highlighted various encounters throughout their training program. These experiences were not uniformly positive as they involved some challenges and limitations. Nonetheless, the BTs also derived satisfaction and acknowledged that experience serves as the most effective teacher.

Experience Transferred. Becoming a teacher is more than learning content and teaching strategies. It also means developing certain behaviours and attitudes that guide actions and beliefs. The experiences BTs found that they could apply to their classroom were the teaching styles employed by lecturers, practicum experiences, and the professional demeanour demonstrated by their lecturers (see Table 7): that is, caring, fairness, honesty, responsibility, and social justice. BTs found that the mathematics instruction they received was very helpful in preparing them for the mathematics classroom. They claimed they were able to transfer the learning of their mathematics lecturer's teaching style, especially the use of manipulatives, hands-on activity, and student engagement in their classrooms. Participants claimed that the lecturer had a variety of representations and visual aids to support their conceptual understanding of mathematics concepts, and these were most frequently adopted in their teaching.

One teacher participant (9) said in her first interview, “Being in a mathematics class and using manipulatives was a novelty that I now use to engage students and help with understanding concepts.” Participant (4) agreed: “I learned to make manipulatives and I am now using that knowledge in the classroom.” Seven out of nine participants agreed that they all utilized manipulatives, hands-on activities, and visual aids in their teaching because, during their teacher education, they were exposed to these things. They further claimed that this was the first time they realized that math is fun and that they could understand math.

In the field notes for lesson 3 of Participant 4's observation, I documented evidence of intentional efforts being made to incorporate manipulatives:

> Participant 4 made deliberate efforts to integrate clocks as manipulatives as a teaching aid. Analog clocks were hand-made, and teachers actively involved students in hands-on activities to practice reading and understanding time throughout the lesson. Clear explanations and interactive discussions were used to reinforce the importance of time in daily life (Observation 3, Participant 4, May 31, 2023).

Participant's 4 intentional use of clocks as manipulatives appeared to effectively engage students and enhance their understanding of time concepts in a dynamic learning environment.

The teaching practicum was another experience participating teachers revealed from which they were able to transfer knowledge and skills to the classroom. All participants said they gained confidence through the practice of teaching and improved their knowledge and skills through effective feedback they received from faculty supervisors. In describing their teaching practicum experience during the first interview, Participant 3 (SE) stated:

> Mostly the practical teaching prepared me more for the classroom and becoming a quality teacher. We were exposed to lesson planning. Um, professionalism, time management. Time management was a big problem for me because before I went to teachers' college, I had a problem with time management. Not having enough time during my activities. For example, I would spend too much time on an activity and too little time on another activity, and sometimes the class would go longer than I planned; the practicum was very helpful for me.

Most participants stated that the teaching practicum was a learning experience. They claimed that this provided them with teaching experience within a classroom setting. Faculty supervisors played an important role in BTs' growth and development in becoming effective teachers. Participant 1 (PE) shared in her first interview that in her practicum experience, some of her misconceptions about teaching the concept of 2D shapes were cleared up after she received feedback from her faculty supervisor. She noted,

> During my teaching practicum, I taught the topic of 2D shapes, and I remembered, I did a chart and I cut the shapes out and I put them on it. I had an assessor; he came to listen to my lesson, and he told me my chart was incorrect and I should take it down. He explained to me that what I have on the chart are 3D shapes and not 2D shapes…if I take the shapes off the chart, I will see that there are faces and so on the other side …. so now I always tell my students we can't cut out 2d shapes, but they have to draw it.

Furthermore, some participants identified that their experience of the math lecturers' ability to integrate human elements with knowledge and skills when teaching mathematics was worthwhile adopting in their own classrooms. They claimed this experience facilitated significant learning in their teacher education program and was a key factor that helped to eliminate their feelings of fear of mathematics. Participants expressed that it is experiences like these they will seek to emulate in their future teaching. As Participant 4 (PE) stated during the first interview,

> One of the things that stood out to me was that I had a math lecturer and [who] was really, really calm. The lecturer who I thought was very caring and very concerned about how we get things done. And what helped me most was always the fact that we had to do something hands-on. I think that is what really pulled me into liking math.

The teaching of mathematics goes beyond just the content and pedagogies; it includes helping students with all their human strengths and frailties and understanding the importance of maintaining positive relationships with students.

Finally, the application of learning involves the ability of BTs to apply the knowledge and skills learned from their teacher education program to their classroom settings. Participants asserted that they successfully applied the knowledge and skills acquired through project assignments in their mathematics classrooms. They also mentioned effectively integrating theories into their teaching practices, resulting in notable success. The participants described their practicum as an immensely valuable learning experience. Participants also shared that the lecturer's teaching style during math instructions was very impactful, and they were able to employ teaching strategies and resources they were exposed to in their classrooms, which helped the mathematics class to be fun and engaging. Participants also highlighted the importance of professional demeanour in the teaching and learning of mathematics.

Factor 2: Mixed Emotions

This theme refers to what BTs think they can do and their emotions about their abilities. It also relates to the belief that BTs have in their teaching skills and their confidence in their teaching abilities.

Table 8

Factor 2: Mixed Emotions

Types of Emotions	Sources of Emotions
Positive (feelings of confidence)	Using Mathematics manipulatives effectively Acquired experience gained from Teacher Education Maths Courses Planning lessons effectively Support received from principals and colleagues
Negative (feelings of abandonment) (feelings of frustration)	Did not receive support or mentoring Limited resources

The level of confidence teachers have in their ability to guide students' learning is known as teacher efficacy (Gkolia et al., 2014). The participants described themselves in relation to their understanding or feelings about the teaching and learning of mathematics (see Table 8). They identified both positive and negative events or situations that affected their self-efficacy, but the findings revealed that BTs experienced more positive emotions. They attributed positive emotions (feelings of confidence) about available resources, the ability to keep students engaged, and a good support system in their schools. On the other hand, three participants identified the lack of support and ability to use technology devices in their classroom as sources of negative emotions (feelings of abandonment and frustration). For example, Participant 3 (SE) explained in the first interview,

> When I'm doing hands-on stuff, you know, using concrete objects. Like last week I was doing measurements, mass and you know, students were really excited to be using the scales and all of those things and I believe they grasp the concept more when they are using hands-on manipulatives. … I am able to make math more relevant to the real world. So, I feel confident connecting math to real life for them. And I think that they get more interested in learning. I don't think I have any child in my class who doesn't like math.

Similarly, Participant 6 (PE) described how she was most confident in her ability to make math fun and more engaging for students:

> I was teaching skip counting and the student had difficulty understanding the concept. So, I had to create a game on the floor like hopscotch, so they had to skip numbers in the hopscotch game. Once the students played the game, they had fun became more engaging, and started to understand the concept I was teaching (First Interview, Participant 6, PE, December 23, 2023).

In addition, Participant 4 (PE) and Participant 1(PE) explained that they developed positive emotions towards teaching mathematics from the experience they gained from the teacher education mathematics courses. They both agreed that they were no longer fearful of doing math. As Participant 4 said during the first interview,

> Well, I discovered that I was not as fearful as I thought I was of the subject. Honestly, …I find that my most positive aspect of teaching is that I could get my job done and I don't have to be using the chalk and talk. I could get it done using technology, I could get it done using manipulatives and the children understand.

Participant 1 (PE) agreed that she too discovered that she could "actually do the math and teach it," especially since she was very fearful of the subject.

However, Participant 8 (PE), when asked during the first interview what aspect of teaching mathematics she was most confident in, described her ability to write effective math lesson plans. Participant 8 claimed,

> I am confident in planning my lessons, I always like lesson planning. I believe you should always plan before you go into the classroom. Yes, because if you don't plan, and you go in front of the classroom, you don't know what to do.

Though Participant 8 was the newest teacher in the group, I believe she was most confident in planning lessons because she had ample practice with writing lesson plans. During her time at MCC, she had to constantly write lesson plans for coursework assignments and during her teaching practice, not only for mathematics but also for social studies, language arts, and science.

Several BTs attributed their confidence and success thus far to the support they received from their principals and other teachers on staff. They claimed this support was critical to their development of important teacher skills and practice from the start of their career to help improve learner outcomes. As Participant 3(SE) stated in the first interview,

> Over the years I have seen myself grow because when I just entered the classroom, especially when teaching mathematics, I had no clue, you know, what I was getting into, especially when I finished, teachers' college, and I was told that I was placed at a primary school. It was strange

> although I had the experience before, but as time went by, you know, with guidance from my principal and others, I was able to, you know, teach the concepts in a more structured way.

Participant 1 (PE) also shared in the first interview that the support she received at her school helped in developing her confidence:

> So, when I was unsure about how to go about teaching a topic or whatever, I would go to the Math coordinator in the school and another experienced teacher and they would give me ideas and so on, yeah, and develop my confidence.

When observing Participant 1's lesson 2, I observed the benefit of having a more experienced teacher paired with a BT. As I recorded in my field notes,

> Today's observation underscored the positive impact of pairing an experienced teacher with a BT, particularly in the realm of classroom management. Participant 1 engaged students with enthusiasm and effective instruction of tell time half past the hour, fostering a positive learning environment. Simultaneously, the more experienced teacher who was paired with her skillfully managed behavior problems with calm assertiveness, ensuring a focused atmosphere for the lesson. The mutual support between the teachers demonstrated a harmonious teaching dynamic, with the experienced teacher providing timely behavioral interventions, such as a quick sharp look and quietly whispering to the student (Observation 2. Participant 1(PE), May 22, 2023).

On the other hand, Participants 6 (PE), 8 (PE), and 7 (TVET) expressed negative emotions as BTs (see Table 8). One participant (6) described a feeling of abandonment because she didn't receive support or mentoring from the principal, colleagues, or past faculty. In her first interview, she said:

> They just dropped me in a class, and they didn't have anybody coming to see how I was doing, that is to check on me to see if I was doing the right thing. I was appointed as a teacher at the same school where I did my teaching practicum and it was like just after PT everybody

(teachers) in the school went their way, and I went my way. I was not given any formal support.

I was sent to a school, and I was expected to do everything that I learned at the teachers' college. The absence of support emerged as a substantial issue during the observational phase of data collection. In my field notes, I documented a poignant incident that evoked a strong sense of sympathy for BT. I wrote,

> Participant 7 (TVET) encountered the dual challenge of independently delivering instruction and managing behavior problems in an open space with classes divided by chalkboards. Handling behavior problems proved particularly arduous due to off-task behavior among some students and considerable noise emanating from adjacent classes above and below her room, as her class was situated in the middle. I think Participant 7 demonstrated adaptability and resilience by promptly trying to address disruptions using verbal cues and proximity. However, it was evident that the lesson delivery could have been significantly enhanced with additional support in managing disruptive behavior and mitigating noise levels from neighboring classes (Observation 3, Participant 7 (TVET), May 23, 2023).

In her first interview, Participant 8 (PE) shared similar experiences to Participant 6 (PE). She said, “No one is assigned to me but when I wrote my lesson plans a more experienced teacher would take a look at it but no one guided me in any way.” Participant 7 (TVET) also expressed negative emotions when she explained her frustration with the limited access to technological devices and sources of electric power in her classroom. In the first interview, she said,

> Using technology in my class is not always convenient because the school has a laptop, but I think it's one, I don't really use it. Most of the time another teacher might be using it. My laptop is usually slow and sticking, and then I usually have to borrow a projector from another teacher. Sometimes he is using the projector when I might want it to borrow. Also, I need an extension cord hooked up to my laptop so all that that's being done from some else class because in my

classroom don't have an outlet so I have to bring it to my class, hook up my tablet, and my laptop.

Finally, the results indicated that BTs undergo a spectrum of emotions, encompassing both positive and negative aspects. Positive emotions arise when BTs actively involve students in meaningful mathematics teaching and learning. Their confidence is bolstered by the support received during their math course in teacher education programs, as well as from principals and colleagues. On the flip side, negative emotions, including feelings of abandonment and frustration, were also reported by BTs. The findings revealed that it must be noted that the level of support BTs received varied based on the schools in which they were placed.

Factor 3: Obstacles Faced by BTS

Participants revealed that since starting their teaching careers, they have faced several problems. These include limited resources, classroom management, and limited content and curriculum knowledge (see Table 9). Classroom management and available teaching resources were the most common obstacles among participants, followed by limited content and curriculum knowledge.

Table 9

Factor3: Obstacles Faced by BTs

Obstacles
Lack of tools and resources
Limited knowledge of teaching math content
Classroom management
Limited knowledge of the curriculum

Participants 1 (PE) and 2 (ECE) identified a lack of resources as a major problem in the teaching and learning of mathematics. These resources allow teachers to model or demonstrate representations of mathematical ideas and help support children's development of mathematical understanding and thinking. In her first interview, Participant 1(PE) lamented,

> My number one obstacle is resources, so at teachers' college, I know we were encouraged to use what we have and take it into the classroom and so on. But sometimes we just don't have the tools or resources and I would tell children to bring. Then I am really looking forward to starting to teach a concept or a topic. And then the children don't bring these resources, which is a big problem.

Participant 2 (ECE) agreed and re-echoed that a lack of resources impacted any potential benefits to her lesson. These resources include visual aids, manipulatives, technological devices, and mathematical software. In her first interview, she stated,

> My main obstacle. Well, as I would have to say um, we have to go back to lack of resources. Right. Because sometimes, you know, yes, we do have some, but of course, there are others that would make the lessons better or more engaging. I do use what we have, but I think if I had some other resources, my lessons would be much better.

The content of my field notes supports the assertions made by Participant 2. I documented,

> During today's observation, a noticeable challenge emerged as Participant 2 (ECE) grappled with a lack of available resources for effective teaching. As Participant 2 explained the concept of heavy and light, she had only one balance scale at her disposal. She ingeniously attempted to make the most of the only balance scale, engaging students by taking turns to demonstrate the concept. However, the scarcity of equipment hindered the opportunity for every student to actively participate and explore the concept independently. The teacher's efforts to maximize the use of the available resources were commendable, but the limitation underscored the impact of inadequate teaching materials on the overall quality of the learning experience (Observation 2, Participant 2 (ECE), May 16, 2023).

Participants implied that resources help them structure their lessons and incorporate a variety of ways of learning into a single session. In the absence of resources, BTs mentioned that they find it challenging or monotonous to effectively utilize a full hour of teaching time.

As expected, many BTs were troubled by the classroom management conflicts they encountered in their own classrooms. One BT (Participant 6, PE) stated during the first interview,

> Yes, I did encounter obstacles, mostly with classroom management and behavioral problems. I had some issues because the classroom, the environment of the school, is so noisy so it is difficult to keep the students' attention as noise would distract them…classrooms are just separated by a piece of board, so all the students are close by.

In her first interview, Participant 5 (PE) agreed that classroom management was also a major problem. She revealed that,

> One obstacle was classroom control. That was one of my biggest challenges because going into the classroom as a new teacher and to children who had never seen me before. They figured out, OK, I could do what I wanted, so classroom control was my number one.

The common problems BTs experienced with classroom management were behavioural problems and elevated noise levels.

However, Participant 3 (SE), who was a secondary trained teacher, complained in her first interview that her main obstacle was limited content knowledge, and she had to consult her friend and spend lots of time researching. She said,

> I had a lack of math content knowledge. I mean, I wasn't exposed to the mathematics contents at teachers' college. This was one of the challenges I had, and I did not like Math. So, I think that was a barrier in the beginning. but now it's much better. Because I have a friend who is a mathematics teacher, she used to encourage me and I did lots of research.

The observation of Participant 3's (SE) lesson highlighted her significant growth during her tenure at the current school, indicating effective mentorship. In my initial field notes, I expressed my surprise upon witnessing her adept delivery of a mathematics lesson on subtraction. I documented,

> Today, I was pleasantly impressed by Participant 3's teaching approach. This came as a surprise because, in our interview, she mentioned feeling less confident about her math content knowledge. However, during the lesson, she showcased significant knowledge and skill while teaching subtraction. Participant 3 employed multiple representations of subtraction, included various problem types and structures, and adeptly engaged students. Additionally, she seamlessly linked the lesson to students' everyday life experiences, creating a meaningful and relatable learning atmosphere (Observation 1, Participant 3 (SE), February 16, 2023).

Similarly, another participant highlighted that her biggest challenge is understanding the mathematics curriculum and content. This challenge is not uncommon for BTs as I've learned in my role as a teacher educator. The skill of transforming the curriculum into effective lessons takes time to develop and can be particularly challenging in the initial stages. Participant 9 (ECE) remarked in the first interview, “My obstacle is with the curriculum. I am having difficulty understanding the curriculum and getting the right content and age-appropriateness.”

Other obstacles identified by some participants included completing the “Scheme-of-work Book” that was provided to teachers to document their teaching weekly plans. Most BTs were unfamiliar with this book since they were not exposed to these requirements during their teacher education program. The Ministry of Education in SVG requires all teachers to submit a weekly scheme of work book, a minimum of three lessons per week, and a term plan.

Overall, classroom management, limited resources, content knowledge, and curriculum knowledge were the major obstacles BTs encountered. I strongly believe that no amount of preparation can prepare one for the classroom and the obstacles that BTs will face in their own classroom, but they need to grow.

Recommended Changes. This section highlights participants' comments related to the areas where they believe the teacher education program at the MCC needs to improve to better prepare BTs for the classroom. BTs highlighted two categories as areas for improvement. These include more microteaching activities and adding a math content course for all students or having subject seminars (see Table 10).

Table 10

Suggested changes to Teacher Education Program

Recommended Changes
Micro-teaching activities
Adding a math content course or offering subject seminars for all students

More microteaching activities were ranked high amongst BTs as an element that will make the MCC: Division of Teacher Education program better. Microteaching is a teacher training technique for learning teaching skills. It involves planning, teaching, and getting feedback and reflection on the lesson. Four out of nine participants agreed that the MCC teacher education program needs to add more micro-teaching activities. During their first interviews, participants 1, 4, 8, and 9 all agreed that more micro-teaching activities should be embedded during their taught courses. Participant 9 (ECE) said,

> I will recommend more micro-teaching activities meaning for students to get the opportunity to actually teach the math subject in front of the lecturer you know, and getting much feedback and you know, we have to wait until we do go to practicum. So, I think there should be more micro-teaching sessions within the program.

Participant 4 (PE) agreed that more microteaching activities are needed throughout their program:

> I would add the micro-teaching a little bit more … We won't shy away from practical experience and think that we are not capable. Giving teachers and students the opportunity to do micro-teaching activities at different levels so that they can have an idea before they go into the classroom.

The next category BTs suggest that should be added to the MCC teacher education program is a course in content math. The teacher program courses mainly focus on methodology, and the expectation is that preservice teachers come to the program with the prerequisite math content. But this is not always the case. Participants recommended introducing a content course that is accessible to all preservice teachers enrolled in the MCC teacher education program as well as past students who may not have completed the primary teacher education program but are being placed at primary schools to teach. During the first interview, Participant 5 (PE) stated,

> Yeah, well, the only thing I was thinking of is adding the math content courses. So like novice teachers, if they are not familiar with the content they can at least have and get an idea of what they are supposed to teach. So, if it is not an entire course, we can offer Seminars with different aspects of the math content.

Another participant (Participant 3, SE) agreed, remarking

> We are all quite aware that sometimes teachers, teachers may end up in the primary school to teach and did not complete the primary program. So, I'm thinking if we, let's say for example, could have offered a math seminar or content course for students. An open class and maybe past students could also take it. So, like, you know, students who didn't do the primary program, if you want to learn more math strategies or a particular content it can probably be offered to them so they could take the course and learn the content and feel more confident.

These recommendations are important since a teacher’s content knowledge affects their ability to teach mathematics effectively to their students, and it also affects their confidence. Microteaching plays a pivotal role in teacher education training programs and contributes greatly to a better understanding of the teaching process and its complexities (Mahmud & Rawshon, 2013; Remesh, 2013). According to participants, microteaching sessions allow them to provide and receive constructive feedback with an open mind and achieve appropriate teaching-learning goals. Participants recommend that it is necessary for MCC teacher education programs to offer more opportunities for microteaching and math content courses to adequately prepare preservice teachers for the classroom.

Finally, when I asked the participants during their first interviews how they would describe their experiences as preservice teachers, most participants initially had difficulty remembering specific experiences. They had vague, if any, memories of mathematics learning in the classroom. Some of their recollections included the lecturer's demeanour, using hands-on manipulatives, and projects completed. They did not remember any form of social interaction. Their memories stemmed primarily from the relationships they formed with former mathematics teachers, both positive and negative. It intrigued me to discover that the first encounter with using manipulatives in mathematics for most participants occurred during their training program. All participants were able to recognize a difference in the way they learned mathematics in comparison to the methods by which they were expected to teach. Also, participants were able to recognize a difference in the way they perceived their teacher education program and the preparedness in which they were expected to teach. (See Appendix F for a comprehensive table with participants' direct quotes related to each factor related to participants' perceived preparedness.)

In Summary

In conclusion, the factors shaping participants' teacher perceptions of their preparedness to answer RQ1 corroborated with the theoretical framework for this research. The idea of the factor application of learning is reminiscent of both PCK (Shulman, 1987) theory and the signature of pedagogies (Shulman, 2005). The findings from the factor application of learning revealed similar findings to Shulman's (1987) PCK theory. These findings showed that BTs were able to combine content knowledge and pedagogical knowledge from their past experiences as students to their current teaching practice. Also, Shulman's (2005) work with signature pedagogy advised that the type of teaching BTs receive from their teacher education program should prepare them well for their new professions.

PBL emphasizes active student participation, placing learners at the core of the educational experience (Magnussen et al., 2018). A key aspect of PBL is the application of knowledge through experience (Savery & Duffy, 1995), which was reflected in the findings of this study. Participants identified that they could apply different aspects of their training and experience in their current classrooms. For example, participants successfully applied theoretical knowledge from their teacher education program to practical classroom scenarios. They integrated mathematics course projects into their teaching, demonstrating the direct application of instructional strategies. Additionally, by creating 'big books,' participants translated theoretical concepts from their teacher education program into practical, hands-on tools that align with PBL, promoting a more interactive and inquiry-based teaching approach.

Although participants were able to describe tenets of PBL, due to classroom constraints related to limited resources, participants tended to focus on minor problem solving during the teaching of lessons. It suggests that when BMTs are engaged with real-world, complex problems during their teacher education program, PBL helps them build a robust and adaptable understanding that can be applied in diverse situations. This hands-on approach supports BMTs in transferring their skills and knowledge into practical classroom environments, although their ability to enact all aspects of PBL may be limited depending upon what is available to them in terms of resources and mentorship

Further research, including studies by Shetty (2010) and Gezim and Xhomara (2020), supports the idea that PBL effectively bridges theory and practice. Teachers who experience PBL are more likely to adopt reflective teaching practices, adjusting their methods based on classroom realities. These findings align with other research indicating that PBL is a powerful tool for helping BMTs link theoretical concepts to real-world applications, enhancing their overall understanding (Connolly et al., 2023; Aidoo et al., 2022).

Finally, according to participants, mixed emotions were the third factor. Participants in this study identified events during their teacher education program that increased their feelings of self-efficacy to teach mathematics. As stated in Chapter 2, a review of the literature, Zuya et al. (2016) revealed that teachers' conviction in their abilities to do mathematics correlated positively with their beliefs in their capabilities to teach mathematics. Participants identified obstacles and recommendations as another factor impacting BT's perception of their preparedness to teach mathematics. Correa et al. (2015) and Towers (2013) agree with the obstacles and recommendations mentioned by participants in factor 3 above. They found that BTs typically face numerous challenges during their transition into a school's culture, some of which they may feel unprepared to handle.

Chapter 5: Evidence of Developing Mathematics Content Knowledge (MCK)

The central theme from research question 2 (RQ2) – What do beginning Vincentian elementary teachers identify as key factors influencing their early career mathematics regarding their content knowledge? – revealed evidence of BTs' developing content knowledge. Content knowledge encompasses the "structure of knowledge" – a particular discipline's theories, principles, and concepts (Schulman, 1986, p. 9). Evidence of BTs' developing content knowledge in this research refers to the mathematics subject matter that BTs identified they were ready to teach and the different supports in place that reportedly helped shape their conceptual understanding of mathematics content.

Since teachers' ability to teach mathematics is connected to their mathematics content knowledge (MCK) (Ball et al., 2005; Ma, 1999), a better understanding about their perceptions of their own MCK is critical. For example, BTs' knowledge of mathematics content can influence their perceptions of teaching preparedness. Clear evidence indicates a strong relationship between teachers' MCK and their ability to teach well in classrooms (Norton, 2019). Yet, many elementary PSTs do not enter teacher education programs with adequate knowledge of mathematics (Ball et al., 2008; Scheibling-Sève et al., 2020). The majority of participants would have achieved a grade 3 in the CSEC examination, which is recognized as the minimum passing level. Because of this, many scholars argue that teacher educators must provide opportunities to support elementary PSTs and their development of MCK (Garner et al., 2023; Livy & Vale, 2011; Wu, 2018).

In SVG, all teachers are required to teach four mathematics content strands (Organization of the Eastern Caribbean States [OECS], 2006; Caribbean Examination Council [CXC], 2018).[7] These

[7] Two curriculum documents are cited; the learning outcomes of the first curriculum document, OECS 2006, were revised to include learning standards from the CXC (2018). Elementary teachers presently use both documents and move back and forth between them.

include Number Sense, Understanding Measurement, Geometric Thinking, and Data Handling. Number sense refers to a student's intuitive understanding of numbers and their relationships, as well as the ability to use and manipulate numbers in various contexts (Maghfirah & Mahmudi, 2018). Understanding measurement focuses on learning around the development of skills that allow pupils to perform tasks of estimating, comparing, measuring, and recording different attributes of measurement. The geometric thinking strand helps students develop awareness of objects' size, shape, and position. Data handling provides students with the necessary skills to develop the ability to collect, organize, represent, and interpret data.

Perceived Mathematics Content Competencies

Mathematics teacher competencies are the skills and knowledge that help a teacher with the effective teaching of mathematics (Saeed & Mahmood, 2002). Using the data gathered from interviews and field notes, I identified common trends and patterns that informed the development of various themes and factors. The findings identify three factors that BTs described as shaping their mathematics content competencies. These include participants' perceptions of readiness to teach mathematics content, resolving gaps in mathematics content, and the necessary supports for teaching and learning mathematics content (see Table 11).

Table 11

Factors Influencing Readiness to Teach Mathematics Content

Perceptions of readiness to teach mathematics content	**Resolving gaps in mathematics content**	**Supports for teaching and learning mathematics content**
Most Prepared	Research	Mentorship programs
Data handling	Self-learning	Professional development
Geometry	Practice	Conferencing
Operation with numbers		Workshops
Least Prepared		Modeling

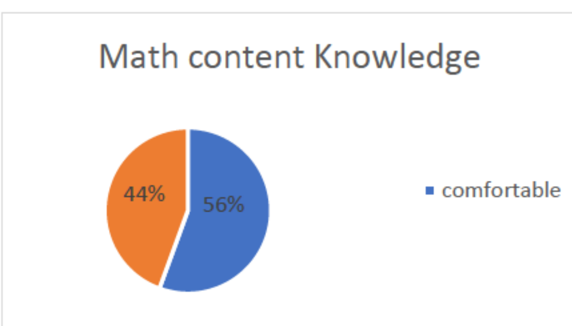
Perceptions of readiness to teach mathematics content	Resolving gaps in mathematics content	Supports for teaching and learning mathematics content
Measurement Fractions Multiplication		

In this research, I wanted to determine how confident BTs were with their content knowledge and their perceived confidence in teaching the content. The more competent BTs are with mathematics content (knowledge and skills), the more positively they perceive mathematics. In turn, this assists them with crafting more effective and challenging mathematics lessons (Findell et al., 2001).

During their first interviews, I asked Participants how comfortable[8] they are teaching elementary mathematics. I used the term 'comfortable' during the interview to determine the participants' perceived competencies to teach elementary mathematics content. Five out of nine participants acknowledged they were comfortable, while four out of nine indicated they were uncomfortable (see Figure 7).

Figure 7

Showing: Participant Comfort Level to Teach Elementary Mathematics



[8] The word comfortable was used during the interviews with participants, and examples were given to convey to participants that I was most interested in their perceptions about their confidence about teaching competencies and mathematics content knowledge.

Overall, the findings shown in Figure 4 reveal that 56% of participants were comfortable with teaching elementary mathematics content; however, 44% described themselves as not comfortable. BTs' perceived competence in teaching mathematics content is significant because high-quality classroom instruction depends on their competencies. Such confidence allows them to build relationships in the learning environment and scaffold learning while organizing, crafting, and managing interactions in the classroom (Wasserman & Ham, 2013). Relatedly, Hill et al. (2005) found that BTs with competent MCK develop a deep and flexible understanding of math concepts, helping them to provide richer learning opportunities for students. Further, Hill et al. (2005) found that BTs who developed and advanced competent MCK were more likely to supply effective explanations of mathematics terms and concepts, use better concrete models of mathematics processes, and accurately bridge the gap between students' everyday language to mathematics language.

In what follows, I discuss participants' perceptions of their readiness to teach elementary mathematics. This factor was selected to be discussed first because of its importance: BTs cannot teach what they do not know or what they feel they do not know (Ball et al., 2008). Zuya et al. (2016) agree that perception of readiness is an important factor. They suggested that BTs with high levels of self-efficacy tend to be more motivated to learn than their peers and are more likely to persist when presented with challenges. Following this, the two remaining factors – resolving gaps in mathematics content and support for learning and teaching mathematics content – are discussed (see Table 11 above).

Factor 1: Perceptions of Readiness to Teach Mathematics Content

Participants' readiness to teach mathematics content was based on how well they felt their teacher education program prepared them to teach elementary mathematics and perceptions of their comfort level with mathematics. All participants (9 of 9) felt positive about their readiness to teach mathematics at the elementary level. BTs indicated their readiness to teach elementary mathematics by identifying those different content areas and topics they felt most comfortable teaching. One third of participants claimed they felt most prepared to teach data handling, geometry, and computations. One third also declared that they were at least prepared to teach measurement. Notably, no participants selected measurement[9] as an area they felt most prepared to teach (see Table 12). I believe BTs were taught measurement using traditional approaches focusing on "the procedures of measuring rather than the concepts underlying them" (Stephan & Clement, 2003, p. 3). This focus on procedures may be because measurement is a very physical activity, and it is easier to focus on the activity rather than on the development of students' thinking and conceptualizations of measurement. Table 12 below summarizes participants' readiness to teach various content areas, including fractions, data handling, geometry, measurement, and computation (encompassing addition, subtraction, multiplication, and no mention of division). One participant felt most prepared to teach fractions, while two felt least prepared. Three participants were most ready for data handling, geometry, and computation, while none felt least prepared in data handling. For geometry, three felt most ready, with one feeling least ready. None of the participants felt most prepared for measurement, while four felt least prepared. In computation, three felt most ready, while one participant specifically felt least ready in multiplication..

Table 12

Participants' Perceptions of Readiness to Teach Mathematics Content

Content Areas Identified by Participants	Number of Participants Most ready to teach	Number of participants least ready to teach
Fractions	1	2
Data handling	3	0
Geometry	3	1

[9] The measurement strand involves the development of knowledge, procedures, and strategies for a wide range of content; these include length, mass, volume, area, and time.

Content Areas Identified by Participants	Number of Participants Most ready to teach	Number of participants least ready to teach
Measurement	0	4
Computation (addition, subtraction, multiplication, and no mention of division)	3	1 (only multiplication)

The information in Table 12 suggests variations in participants' perceived readiness to teach different content areas within mathematics. For instance, while most participants felt prepared to teach data handling, geometry, and computation, fewer felt ready to teach fractions and measurement. Additionally, there seems to be a particular challenge with teaching measurement, as none of the participants felt fully prepared in this area. These variations could indicate differences in participants' levels of comfort and expertise across different mathematical concepts, which may have implications for teacher training and professional development.

Participants were asked which mathematics content area topics they felt ready to teach and why. Some participants attributed their readiness to teach different content to the course assignments they were exposed to during their teacher education program. Participant 3 (SE) said,

> I love statistics mostly. After all, I minor [ed] in social studies because I did the secondary program, and from doing my research in social studies, I must do a lot of, you know, statistics. Yes. So, I think that's why I am almost ready to teach data handling.

Similarly, another participant (6, ECE) described her feelings of readiness to teach geometry based on the teaching strategies (including manipulatives) that she was exposed to during her teacher education program. She explained,

> The math program gave me things like strategies and manipulatives. So, it aided in some respects. For example, if I'm teaching geometry because I could recall you were bringing

> manipulatives into the classroom and different things that we could have used in some lessons, I was able to use them in my lessons when I started teaching.

The ECE and PE programs at the MCC teacher education prepared BTs to teach mathematics based on effective strategies to teach elementary mathematics. In this instance, I was the participant's former instructor. For example, I modelled the teaching practices I wanted the students whom I taught – Participant 1(PE), 2(ECE), 4 PE, 5 PE, 6 PE, 8 PE, and 9 (ECE) – to employ when teaching their students. I regularly utilized manipulatives (hands-on tools) and visual images to make learning math easier to understand. Additionally, I modelled incorporating storytelling to make connections to real-world scenarios and finding opportunities for differentiated learning (see course outlines in Appendix A).

Participants were also asked to share those content areas topics they felt less prepared to teach. Most participants shared that they felt uncertain about teaching measurement; for most of these responses, participants articulated their dislike for some aspects of measurement. It seemed BTs had not grasped the concept well when they were students. For example, participant 6 (ECE) explained that she struggled personally with the concept of capacity. Participant 5 (PE) and Participant 8 (PE) said they did not like teaching nonstandard units of measurement because their students took a long time to grasp the concept. Participant 3 (SE), who did the secondary program and did not take any elementary mathematics courses, did not identify a particular area of measurement. She expressed emphatically, "I'm not comfortable with measurements. Well, I mean, I use it in everyday life. I just didn't, you know, know how to bring it out in the classroom." These revelations were surprising as the concept of measurement is fundamental in mathematics. Additionally, it is a necessary human activity and provides a useful link between mathematics and a central topic in the teaching and learning of elementary mathematics. Not only did measurement pose challenges for participants, but other topics, such as multiplication, were also identified as challenging to teach. For example, Participant 1(PE) stated,

> I find I am least prepared to teach multiplication. Multiplication does stress me out. It is not that I don't know my tables or whatever, but I just find it hard, hard to teach multiplication. To me, the children, no matter how much I drill that in them, they're not seeing it as repeated addition. I put them in groups, but they do frustrate me. I don't like to teach it.

This was not a shocking discovery because traditionally, many students in SVG were traumatized when the concept of multiplication was taught. When this concept is taught, it is not unusual for students to recite their tables, and if mistakes are made, punitive measures may be implemented. Participant 1(PE) recalled that she was taught multiplication through memorization and repetition. She described how intimidated she felt when she could not recite her tables.

In addition, Participant 9 (ECE) felt least prepared to teach fractions because she had never taught the concept before, so she was uncertain of her ability to help students develop an understanding of the concept. She said,

> Well, at the moment, I am least prepared to teach fractions, I don't think I have ever taught fractions. But while at the college… So, I am at least comfortable with it right now, but I think that once I start it, I will get the hang of it because I know fractions are the concept that frightens students.

Although most participants could identify multiple math content areas that they felt prepared to teach, some identified areas that they felt least ready to teach. Both Leacock (2020) and Lam (2007) recognized the problem of weak mathematics content areas among Caribbean BTs. In their research, elementary teachers admitted that though they had passed high school mathematics (CSEC), they did not understand what they had learned and felt ill-prepared to teach certain areas. They also asserted that BTs' limited mathematics content knowledge interferes with BTs' ability to successfully implement effective practices they may have learned in their teacher education programs, yet these practices are not reflected in their pedagogical decision-making.

Factor 2: Resolving Gaps in Mathematics Content

At the beginning of their careers in SVG, BTs have little choice over their assigned school and grade levels. They may not be familiar with all the content knowledge needed for the grade level assigned by the Ministry of Education, and they may have studied a different stream (elementary, secondary, or technical/vocational) in their teacher education program. In response to such situations, participants used different strategies to mitigate any skill or concept gap that they may have had in their MCK. In their first interviews, BTs were asked how they addressed such limitations. They reported that they engaged in regular research, practised, and observed more experienced colleagues.

Six out of nine participants claimed that they conducted research when they were uncertain about what to teach at the specific grade level. To do so, they reported mainly utilizing the internet and textbooks. While a textbook can be a helpful guide to BTs in areas when a comprehensive curriculum is unavailable, relying on a textbook has its limitations. Scholars note that an over-reliance on textbooks can be detrimental to both teachers' development and student learning (Ceglie & Olivares, 2012).

Participant 5 (PE) stated that she conducted research and practised mini-lessons at home to address gaps in knowledge and skills. Interestingly, she was the only participant who mentioned that she practised her teaching. Participant 5 (PE) did these activities before teaching any new mathematics content with which she was not familiar. For example, she said,

> I usually do my research, get my facts together, and make sure I have the correct content... Then, what I normally do before I deliver the lesson is when I finish writing my lesson plan, I sit down and I will go through it, and I'll put it in my head. And then, I think out loud and then

deliver the lesson, like doing a little mini-teaching session myself and determining how I will deliver that lesson.

Another participant (6, PE) also shared that she researched unfamiliar content areas before teaching. She highlighted,

> Yes, I taught myself and I researched. I would go on the Internet and ask the best way to get my grade one to understand, for example, nonstandard measurement. I had to go and find out on my own, how to get my students to get it, and what different manipulatives I should use, and so forth.

Most BTs mentioned that they used the internet to resolve mathematics content gaps. Participants did not mention if they took the time to evaluate the source of the information for quality or accuracy.

Another popular method was observing an experienced colleague. Participant 2 (ECE) also shared that they asked for advice from more seasoned teachers. She said, "In my classroom, I had the support of a more experienced teacher … And I always had her [to] guide me along. So, my support structure to teach math was very good." Scholars have noted that good classroom support can temper the negative effects of insufficient teacher preparation. Such supports have the potential to lead to BTs developing positive relationships, self-confidence, and a commitment to teaching (Meredith et al., 2023; Skaalvik & Skaalvik, 2018). While some participants acknowledged that they were well supported, it was not a common feature for all BTs; some complained that they were left alone. Participant 6 (PE) lamented,

> They just dropped me in a class, and they didn't have anybody coming to see how I was doing, to check up on me to see if I was doing the right thing… I was not given any formal support. I was sent to a school, and I was expected to do everything that I learned at teachers' college.

However, Participant 9 (ECE) had a different experience, sharing that she could get assistance from another colleague:

> Because right now there is another teacher that used to teach grade one. But she's right now in kindergarten (at the same school) and I already went to her and asked about the fractions. So yes, this is where I get some experience before teaching a concept, I am not confident about.

Participant 9 also benefitted from good support, a safe workspace, and a learning climate in her school. She was confident that she could get assistance with the teaching of math. Most participants also mentioned that they got assistance from more experienced teachers in their schools. In some cases, help was readily available for BTs in their classrooms, which suggests that these positive relationships with other teaching staff were vital and provided emotional and professional support. They reported coping better and feeling more confident when they experienced support from other teachers in the school. However, others had to seek assistance.

Factor 3: Supports for Teaching and Learning Mathematics Content

A comprehensive support system for BTs is vital in helping a beginning teacher transition into the profession (Thomas et al., 2019). Little (1982) suggested that when BTs are supported by colleagues, this tends to improve classroom instruction. The term ‘support’ is defined as any assistance BTs receive from experienced teachers and school administrators to help guide them through transitions into full-time teaching and stressful situations while helping them build resilience as professionals (Thomas et al., 2019). Participants highlighted several support mechanisms that were in place at various schools to help them. These included workshops, mentoring programs, professional development (PD), conferencing, and modelling. Some schools were more deliberate than others in ensuring BTs were well supported. Participant 9 (ECE) mentioned that her principal had an organized mentoring program. I was pleasantly surprised when one participant (Participant 9, ECE) described her support as a mentorship program for BTs:

> The principal had a mentorship program going on. The principal put some senior teachers in place to mentor us to look at our lesson plans and so forth. If we want some, you know help in

> doing something or whatever content, we will go to our mentor. Sometimes sit and write a whole lesson plan with the person, so I do have support.

Participants were asked if there were any support systems to assist them with learning MCK, and all participants received some support. Participant 2 (ECE) described that she had excellent support:

> Oh yes. So, when I was placed at the school I was actually in the class with the same teacher, my cooperating teacher from practice teaching, and she was amazing. She showed me what I could do, what I shouldn't do, and so on. She was supportive, so I had a very easy transition. I cannot complain.

Another participant (Participant 7, PE) shared that she gained support to teach mathematics content through a PD session organized at her school":

> Yes, through professional development. Like if another teacher was sent to learn something new, like at a workshop. They will come back in and teach us what they have learned. They did something with math the last time, just a couple of weeks ago. And the teacher came back and taught us about different strategies other than what we were using. And she kept reinforcing the use of manipulatives.

Participant 6 (PE) experienced PD at her school, an area of reported support for her. It is important to note that her PD took the form of the trainer-of-trainer model: the staff learn content or skills from an experienced teacher who has completed the training and then practise teaching segments to other staff members.

Participant 3 (SE) also received support for learning MCK through one-on-one conferencing with her principal. She stated, "Well, currently, we do more one-on-one conferences. When I get stuck with any content, I would have a one-on-one conference with the principal, you know."

When support systems are in place for BTs, it has been found to help them understand the school's policies, strengthen content area understanding, help create lesson plans, manage stress, and provide guidance in assessment (National Research Council, 2015). These supports can be offered through different outlets.

In Summary

Participants in this study had mixed feelings about their preparedness to teach elementary mathematics content. However, they all indicated an interest in expanding their MCK and seeking ways to improve. It was evident that BTs experienced different levels of support within schools. Some administrators saw it as important to provide a structured program to assist BTs in developing their MCK. Shulman (1987) emphasized that teachers must possess content knowledge to teach effectively. According to Shulman (1986), content is the domain of scholars and focuses on the subject matter knowledge for teaching.

The findings from this research showed that most BTs consulted an experienced colleague when in doubt about their mathematics content, which suggests that these colleagues were more knowledgeable. This shows that the knowledge and skills of beginning teachers evolve in response to school contexts, colleagues, and students' learning. According to Shulman (1986), the teacher should not only understand a concept but must be able to explain why it is so, which implies that with time and practice, BTs' content knowledge could represent a deep understanding of the material to be mastered by students. If BTs have mentors who have little MCK, there is a danger that they, too, will replicate this in their teaching.

The findings show that BTs took different actions to ensure that they learned the necessary mathematics content and how to perform as a professional in the classroom. The theory of signature pedagogy (Shulman, 2005) helps me to understand that the BTs will move through a series of stages as they progress in their mathematics competence and the acquisition of effective teaching practices. This theory sheds light on the evolutionary process BTs experience as they learn to fulfill the role of a teacher in the field of mathematics. BTs' success in teaching mathematics content depends on their ability to enact theory in practice (Tan, 2019). Theories provide BTs with the conceptual understanding and framework for teaching mathematics concepts. A combination of theoretical knowledge and practical application is essential for a comprehensive understanding and mastery of mathematics.

The findings suggest that the teacher education program may not have placed enough emphasis on PBL, particularly in mathematics content areas where participants lacked confidence. For instance, 44% of BMTs expressed uncertainty about teaching elementary mathematics. These findings indicate the need for more effective integration of PBL principles into the mathematics courses of the teacher education program. Novikasari (2020) highlighted that PBL actively engages learners with content, enhancing their enthusiasm. Research also shows that PBL fosters positive attitudes and critical thinking, which helps BMTs become more effective educators (Thomas & Harnett, 2014). The findings from this study underscore the importance of cultivating positive attitudes amongst BMTs towards mathematics to support learning and critical thinking. Further inclusion of PBL pedagogies in mathematics courses could improve BMTs' content knowledge.

Finally, in the reviewed literature, Ingersoll and Strong (2011) highlighted the importance of supports for teaching and learning mathematics content. They noted that the presence or absence of organized support makes a difference in how capable BTs feel about teaching mathematics content.

Chapter 6: Evidence of Developing Mathematics Pedagogical Knowledge (MPK)

The central theme from research question 3 (RQ 3) – What do beginning Vincentian elementary teachers identify as key factors influencing their early career mathematics regarding their pedagogical knowledge? – revealed evidence of BTs' developing pedagogical knowledge. Pedagogical knowledge involves methods and processes of teaching including the understanding of classroom management, tasks, lesson planning, and students' learning (Shulman, 1987). This research defines mathematics pedagogy knowledge (MPK) as a variety of methods participants used to identify strengths and weaknesses of individual learners, plan differentiated instructional activities, engage in questioning and listening, and assess student's knowledge. Further, mathematics pedagogical competence refers to the ability of a teacher to apply a combination of mathematics instructional materials such as books, diagrams, manipulatives, and technology such as software and hardware and knowledge, skills, and experience to optimize the development of learners from many aspects (intellectual, emotional, and moral) (Akhyak et al., 2013; Ningtiyas & Jailani, 2018).

Evidence of BTs' pedagogical knowledge in this research refers to participants' descriptions of their pedagogical practices (classroom management, teaching methods, classroom assessment, differentiated instruction) that they reportedly implemented in the classroom. This theme is important since teachers' pedagogical knowledge serves as a significant predictor of student achievement and better instructional quality (Ball et al., 2005; Blömeke et al., 2015; Depaepe & König, 2018; Pavinee et al., 2013). Arguably, competent MPK can influence BTs' perceptions of their teaching preparedness.

Perception of Mathematics Pedagogical Competences

Three factors that BTs described as informing their mathematics pedagogical competencies are discussed. These include participants' perceptions of mathematics classroom practices, perceptions of their ability to accommodate student's needs, and the professional support they received for the development of MPK (see Table 13).

Table 13

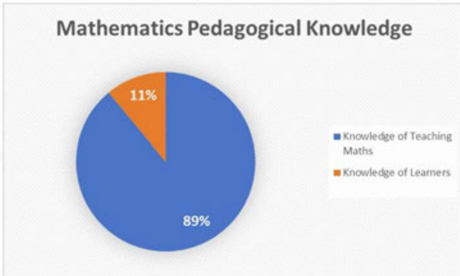
Factors Influencing the Development of BTs' Mathematics Pedagogy Knowledge

BTs' Classroom Practices	**Accommodating Students' Diverse Needs**	**Professional Support for the Development of MPK**
Mixed Feelings about Lesson Planning Limited understanding of Differentiated Instructions Availability of curriculum resource material Forms and Practice of Classroom Assessment Uses and Challenges of Technology Engaging in Reflective Practices	Gender inclusivity Accommodating multiple viewpoints Demonstrating care and commitment to students	More knowledgeable other Collaboration Professional development

In this study, I wanted to determine the area of mathematics teaching in which BTs were most confident. Six out of nine participants (Participants 1PE, 4 PE, 5 PE, 6 PE, 7 TVET, and 8 PE) said that they were most confident when teaching mathematics lessons, one participant (Participant 3, SE) said she was most confident with assessment, and another participant (Participant 6, ECE) reported feeling most confident with lesson planning. Only one participant (Participant 2, ECE) said she was most confident with two areas of her teaching practices, both the teaching of mathematics lessons and classroom management (see Figure 8). I believe that the teaching of mathematics was most popular among participants because as beginning teachers as this aspect of teaching is what they all experienced as students during practicum. Important to consider is that they may have felt obliged to report the act of teaching as the area in which they felt most confident.

Figure 8

Participants' Confidence in MPK



Overall, the findings in Figure 8 revealed that 89% of BTs (8 out of 9) were most confident when teaching mathematics lessons. This suggests that they were confident with the pedagogy associated with the teaching of mathematics. In contrast, only one participant, Participant 3 (SE), was most confident with the assessment. Participant 3 completed the secondary teacher education program with a major in business and a minor in social studies and was not trained to teach elementary mathematics At the MCC: Division of Teacher Education, all secondary preservice teachers take a course in assessment, so I was not surprised that Participant 3 said she was most confident with assessment practices.

I first discuss participants' perceptions of their mathematics pedagogical practices, followed by the remaining factors – accommodating students' diverse needs and support for the development of pedagogical knowledge (see Table 13).

Factor 1: Perceptions of Mathematics Classroom Practices

Classroom practices are related to the actions and strategies teachers and students deploy during the teaching and learning process (Best et al., 2018). Liepertz and Borowski (2018) and Sorge et al. (2017) describe pedagogical knowledge (PK) as comprising classroom management, teaching methods, individual learning processes, and assessment of (student) performance. For this research, classroom practices included descriptions and observations of lesson plans, differentiated instruction, curriculum resource materials, assessment practices, technology use, and reflections on lessons.

BTs' Mixed Feelings about Lesson Planning. Planning lessons is at the heart of teaching (Slavin, 2018). Lesson planning can have a positive impact on teaching. However, the mathematics plan must be implemented diligently to create the desired impact on both the lesson and the learners (Ali, 2019). Generally, participants reported both positive and negative attitudes toward mathematics lesson planning.

During their first interviews, participants were asked how well prepared they were by their teacher education program in planning mathematics lessons and how that preparation has impacted their practices. These discussions were about overall mathematics lesson planning and not about planning for specific concepts. All nine participants agreed that learning how to develop lesson plans was a lengthy and detailed process in their teacher education program, and this had prepared them to write lesson plans for the teaching of mathematics. They also agreed that the lesson plan format used at the MCC: Division of Teacher Education is aligned with the format used in SVG's elementary mathematics classrooms (see Appendix E). The mathematics lesson plan is a detailed plan of instruction that BTs write before executing a lesson. Elements of the lesson plan format used at MCC: Division of Teacher Education were adopted from Gagne's (1968) events of instruction. This plan includes a list of objectives for the lesson, checking for students' prior knowledge, teacher and learning resource materials, an introduction to the lesson, the developmental procedures, assessment, and a space for a teacher's reflection on the lesson.

In 2018, with the introduction of standards to the OECS curriculum, changes were made to the lesson plan format to include these standards, and at the MCC these changes were also implemented. Participants expressed the need to thoroughly understand these curriculum standards. For example, participants stated that they needed to be able to examine a given standard, determine student prior knowledge and skills needed to satisfy that standard, determine criteria that assess the standard, and determine for instructional purposes if the standard needed further distilling into sub-standards.

All BTs stated that, to some extent, they still used the lesson plan format they were taught in their teacher education program. Four participants – 2 (ECE), 6 (PE), 8 (PE), and 9 (ECE) – stated that they still used the same lesson plan format learned in their teacher education program, which meant that they were introduced to the standard-based format during their preservice teacher training. The other participants – 1 (PE), 3 (SE), 4(PE), 5 (PE), and 7 (TVET) – stated that they had to make slight changes by including standards to the format of the lesson plan that they learned at their teacher education program.

Participant 4 (PE) stated that her teacher education program prepared her to plan mathematics lessons, but the lesson plan format changed, and she was able to adjust. Once she started full-time teaching, she learned how to unpack the standards through in-service training. She reported,

> Well, when I started teaching, I was using the same lesson plan I learned from the teachers' college for mathematics. Then my principal was doing a training session on the addition of standards to the lesson plan, and what I saw was an upgraded version of the lesson plan. Then, she did some workshops on unpacking these standards to guide us in lesson planning. …So, we are still using that same lesson plan format with the additions of standards.

Participant 1 (PE) agreed that she learned how to write mathematics lesson plans during her teacher education program but did not share the same opinion as Participant 4 (PE) about adjusting well to the new format. She lamented,

> We are presently following the standard-based lesson plan format but when I went to Teachers' College, it was not the standard-based lesson plan. Now we have to do standard-based lesson plans and learn to understand these standards. It was a difficult transition for me because I didn't understand why they wanted all of that. It was more work.

Participant 1 may not have expressed negative feelings because she did not fully understand the importance of standard-based instruction. Recognizing the critical role of dissecting standards to ensure students meet targeted demands becomes increasingly significant for teachers as they develop a heightened awareness of what is most essential for their learners.

Some participants also complained that even though there were no major differences between these formats, they were required to plan mathematics lessons for one week in contrast to the expectation at teachers college, where they planned daily lessons. The MOE provides workbooks for all teachers to account for their lesson planning. Teachers are required to use these books to document their work each week. When reviewing mathematics lesson plans, principals tend to request lesson plans for the week rather than per lesson. Participant 8 (PE) stated,

> The lesson plan format I use is the same, it's similar to what we learn[ed] at Teachers College. The only difference I encounter with the lesson plan is that I am required to write lesson plans for 1-week teaching of mathematics rather than daily. So that took some getting used to, but it wasn't difficult because the mathematics lesson plan was less detailed.

BTs had mixed feelings towards their lesson planning preparation. Some seemed to have adjusted well to adopting a few changes to the lesson plan format, while others expressed feelings of being intimidated and considered planning to be a tedious and demanding process. Lesson planning provides evidence of BTs' developing MPK. In developing mathematics lesson plans, BTs have opportunities to think deeply about the concepts they are expected to teach as curriculum standards/benchmarks, including the way the concept is represented in textbooks. They also have time to develop activities or methods that enable students to grasp the concept. Finally, adequate planning enables teachers to consider what students know and how they may best understand the content.

Limited Understanding of Differentiated Instruction. Differentiated instruction (DI) allows BTs to present a range of learning activities with the same content to reach all learners in their classrooms (Davis and Autin, 2020). All participants agreed that they had some form of instruction in differentiating lessons to meet the needs of students. They also described differentiation instruction as a strength in their teacher education program, but they had difficulties implementing it into their teaching practices. The participants who claimed they used DI said that they varied the way concepts were taught by using visual, auditory, or kinesthetic activities during their teaching. Some participants also mentioned creating different student groups based on abilities as part of their lessons. Some participants, however, labelled DI as a support mechanism for weaker learners rather than an approach that supports learners at a variety of places in their learning.

Two participants, 6 (PE) and 7 (TVET), did not feel confident about implementing DI on their own. They said that if they were to make use of DI in their classrooms, they needed assistance. Participant 7 (TVET) stated,

> I do not use a lot of differentiations, because it's not easy to always differentiate in the classroom with one teacher. Because I have 20 students and I am teaching mathematics concepts and if I do differentiation then I have to be back and forth. I have these students over here to deal with. I have these students here, I have fast-paced students, I have students with disabilities. So, what I do, regarding differentiation, is, try to give the ones that are weaker less to do. And the faster ones I give them something else to move on. However, it is difficult since I am the only teacher in the class with the children.

The findings suggested that Participant 7 (TVET) had limited knowledge about DI, and she understood DI as supporting each type of learner; however, she had a lack of knowledge about providing instruction that would meet the diverse needs of learners simultaneously. She also did not mention ongoing assessment as part of DI to know how to adjust teaching for a range of learners.

Participant 6 (PE) also recognized that she needed assistance with DI. She also identified a misconception that she had about DI, which was the practice of giving students more work when they already understood the concept. She explained,

> With my weaker students like when I'm teaching addition, I have my weaker students using counters and their fingers and basic objects in the classroom, but my strongest students understand that in their minds can count on. I taught them to count on like three plus three and I

> told them to count on the amount in their heads, so they grasp it that way. The worksheet that I prepared is different as well as the workload. I gave my stronger students more work than my weaker students… I find that when I'm doing differentiation, I think I need assistance to do it.

These results reveal Participant 6 (PE) had limited understanding and practice of differentiated instruction. Specifically, her accounts depicted a lack of knowledge on specific strategies to manage mixed-ability classrooms in a way that engages each group of learners during instruction. These findings were common across participants and point to the possibility that BTs' limited knowledge of differentiated instruction could negatively impact student learning and their own perceptions, as revealed through descriptions of their pedagogy.

In the next section, I discuss the findings from curriculum resource materials. The results revealed that BTs used several resources to assist them in developing an understanding of MPK. These resources included the OECS curriculum and standards, textbooks, workbooks, internet, and colleagues.

Curriculum Resource Materials BTs Used to Develop MPK. Curriculum resources for teaching mathematics are designed to support BTs in planning, delivering, and assessing lessons. In this research, curriculum resources are the materials that participants used to help them understand what and how to teach different topics in mathematics. Among these curriculum resources, participants described more knowledgeable colleagues as well as print or digital materials found on the internet. BTs were asked what curriculum resources they perceived as most helpful for the teaching of mathematics. Table 14 shows the curriculum resources BTs identified that helped them understand how to teach different topics in mathematics. These resources are listed in order of frequency of use.

Table 14

Curriculum Resources BTs Used to Develop MPK

Curriculum Resource to develop MPK
Internet
Numeracy Coordinator
More knowledgeable Colleagues.
OECS Curriculum and Standards
Textbooks
Workbooks
YouTube videos

The internet, textbooks, and curriculum documents were the most popular resources that participants identified as useful for their mathematics teaching. All nine participants stated that they used a combination of resources to guide how and what they taught:

Participant 5 (PE): “Sometimes I use curriculum and the standards together. Yeah, I usually use the internet and textbooks also as a guide.”

Participant 3 (SE): “I used multiple resources, the Internet, textbooks, and the curriculum guide, not so much the standards. I'll use the standard sometimes. Most of the time I use the Internet to get content materials and teaching strategies.”

Participant 2 (ECE): “Usually I'm using the Internet and the textbook. I get most of my information from the Internet. I even get some activities from the Internet. Most of my activities I do make up myself.”

Notably, all participants used the internet, no matter their teacher training background. A major advantage of the internet is the ability to access all types of information, but the validity of internet sources varies considerably from website to website, which means BTs may have easily acquired inaccurate or outdated information. Therefore, it becomes crucial to incorporate critical thinking and foster critical media awareness in the education of beginning teachers (BTs). They should be equipped with the skills to not only evaluate content from the internet but also to discern and seek out more reliable sources of information. This ensures that they can navigate the vast digital landscape with a discerning eye, promoting a thoughtful and informed approach to accessing and utilizing online resources.

Participant 4 (PE) was the only one who stated that her greatest resource was her colleagues:

> I used my textbook, and I used YouTube videos, but my greatest resource is my teaching colleagues. We have [Microsoft] Teams, so um, grade one, kindergarten, and grade two teachers, we plan our lessons together and learn from each other, So, you know, we use different things too like the Internet. We use all of that to plan our lesson.

Participant 4 confirms that some BTs seek out the support of colleagues to gain confidence in their skills and ideas of practice, which in turn increases their commitment to their colleagues at the school they are serving and the profession. Collegial relationships can be a powerful tool for supporting mathematics instructional improvement and sense of efficacy (Horn et al., 2020).

BTs' Developing Practice of Classroom Assessment. Assessment is an important part of the learning process and can provide evidence about the learner's insights into the quality of a teacher's pedagogy (Camacho-Miñano et al., 2020). Brookhart and McMillan (2020) defined classroom assessment as a process where teachers and students gather evidence of student performance to make decisions about further planning, instruction, and grading. Assessment of student learning is based on information acquired during the instructional process and can be collected/tapped using assessment procedures and instruments that are relevant to the desired competencies and subject matter being assessed (Kang & Furtak, 2021; National Research Council, 2001). Furthermore, assessment should demonstrate the extent to which students have grasped the intended learning outcomes, while instruction ensures the acquisition of that knowledge. To achieve this synergy, it's crucial for assessments, learning objectives, and instructional strategies to be closely aligned, reinforcing each other in the educational process (Maghnouj et al., 2020).

The findings reveal that participants used mainly traditional forms of assessment (testing) – in other words, assessment of learning. This may reflect the pressure that many BTs face daily from high stakes testing at both elementary and high school levels. BTs were asked to identify the methods of assessment that they used for assessing students' mathematics learning and what informed their choices (see Table 15).

Table 15

BTs' Assessment Method and Why

Participants	Method of assessment	What informed decision-making
1 PE	worksheets, tests, and projects	Observing more experienced teachers and mathematics course
2 ECE	Performance tasks (sorting and matching)	ECE mathematics course and personal experience
3 SE	Worksheet and students' math workbooks	Observing experienced teachers
4 PE	Oral assessment	Personal Experience
5 PE	Worksheets and projects	Mathematics course
6 PE	Oral questioning, test	Observed other teachers
7 TVET	Pop quizzes, puzzles, Kahoot	Personal experiences
8 PE	Worksheets and oral questioning	Observed other teachers
9 ECE	Worksheets, oral questioning, homework assignment, test	ECE Mathematics course and observing other teachers

Table 15 shows the method of assessment BTs frequently used in their classrooms and what they described as informing their choice of assessment. Worksheets and oral questioning were the most popular (5 out 9 participants) assessment methods selected by BTs; most of them said that the choice of these methods was informed by observing experienced teachers. Performance-based assessment and oral assessment were the least popular methods identified by BTs (1 out of 9 participants).

Most participants claim that they basically observed the more experienced teachers and saw what assessment strategies they were using and adopted these strategies. This type of learning can have both positive and negative impacts on BTs' MPK. If the more experienced teachers were observed to implement poor assessment strategies, then BTs may tend to adopt these strategies. Hence, BTS must be paired with mentors who can model best practices in MPK and apply theories about assessment to practice.

Participant 6 (PE) claimed that she did lots of questioning and testing, but it was difficult for her to implement some of the strategies taught during her teacher education program because of time constraints and large class sizes. She said,

> I assess students by oral questioning at the end of a lesson and I will give them a test after 2-3 weeks also. Well, teachers' college taught us several ways of assessing. But with the younger students now, I had to do a lot of questioning. Yes, some of them can't write so I have to do a lot of questioning to see if they understand. Actually, I just taught one of my students how to write. He just learned how to form his letters and everything. I developed a lot of strategies through observation of other teachers.

Participant 6 (PE) described the students as having limited ability to use other methods of assessment This perception can have a negative influence on students' learning. It seems that Participant 6 may have difficulty integrating multiple forms of assessment, learning, and instruction together.

Similarly, Participant 2 (ECE) shared that she chose an assessment method that didn't require students to write much. She stated that

> I use mainly performance tasks; we don't really do the writing thing so much. I would say that is my downfall. That is what I hate to do. I don't like this because I observed that children are more into the activity when they can touch and move it than to write. They don't want to sit down and write.

Participant 2 (ECE) selected assessment methods based on her students' preferences and not on their learning needs. These findings revealed that BTs' perceptions and their practices in classroom assessment may not be totally aligned; instead of applying theory to practice, they chose to observe more experienced teachers. Both participants found that children did not like writing, and they adjusted their assessment practices to accommodate what they assumed to be students' preferences, but they demonstrated some level of responsiveness by identifying students' needs through careful observation.

BTs Use of and Challenges with Technology. Technology provides dynamic opportunities for math instruction (Scharaldi, 2020). The findings reveal that participants exhibited positive perceptions regarding technology integration in mathematics teaching-learning practices. They believed that technology-incorporated teaching assisted them in enhancing their instructional practices effectively, making the learning process exciting and interactive and keeping learners motivated. All BTs stated that they incorporated technology in their lessons in the form of videos, PowerPoint presentations, games, and quizzes. Video was the most popular form of technology used by participants. Most BTs incorporated technology to introduce their lessons to stimulate and captivate students' interest. BTs were taught different courses in technology while at the MCC: Division of Teacher Education. Participant 2 (ECE) claimed that the incorporation of technology into the teaching of mathematics helps students to be motivated and excited about their learning. She stated,

> Yes, I incorporate videos in the teaching of mathematics, I learned this from Teachers' College, and after trying it while I was on practice teaching, I realized that it did wonders. The children were very excited, motivated, and engaging. And I decided that it was something that I had to keep in practice.

Although participants said that they incorporated technology in their lessons, they did not reveal using technological tools to enhance cooperative learning and shareable experiences of metacognition, fostering multiple perspectives, and scaffolding learning. When technology is used in these ways, it can promote meaningful learning. For the participants, it may seem that technology was used mainly to grab students' attention rather than deepen learning.

Overall, most participants focused the discussion on the challenges of limited technological devices in schools. They claimed that most of the time acquiring devices was a personal expense, or sometimes a group of teachers would pool monies together to purchase their own devices, such as laptops and projectors, to use in the classroom. Some participants claimed that sometimes they would bring along their personal devices. Participant 1(PE) said,

> I try my best to incorporate technology in my class even though it is difficult with limited resources. Sometimes I even use my phone and my tablet. But it depends on what we are doing in the class and if it's a group of students that doesn't understand the content, I try to assist by using technology as another means to help students, I will pull up videos in front of them on the phone, the tablet or the laptop.

Participant 5 (PE) shared a similar experience:

> Yes, I use technology in the teaching of mathematics, but I sometimes have to join my class with two other classes like to show them a video and so forth. But sometimes when it is not possible to merge classes I use my tablet and you know the tablet is very small. I might use my laptop, but that is very small too. They can't get to see everything.

Adequate resources and updated infrastructure play a key role in the effective integration of technology in SVG elementary mathematics classrooms. In contrast, inadequate infrastructure and limited resources emerged as a major challenge that hindered participants from effectively integrating technology into their mathematics instructional practices. The availability of technological tools is essential in the development of BTs' MPK because these tools facilitate a shift from the BTs as a centre and only source of knowledge to the BTs as facilitators and directors of the teaching and learning process.

BTs Inconsistent Reflective Practices. According to Richit et al. (2022), reflection comprises the mental act that leads to the development of new forms of knowledge, enriches established knowledge, and fosters awareness. When BTs engage in reflective practice, it helps them to develop their MPK and move beyond any existing routines or habituated actions that could be improved (York-

Barr et al., 2016). Reflective practice may help BTs better understand the factors of classroom practices because it is a form of professional development that allows BTs to notice both the positive and negative aspects of their practice to help improve students' performances (Ponte et al., 2016).

Most BTs claimed they engaged in reflective practice but not in structured ways. They did not record their thoughts and described taking mental notes of their mathematic teaching practices. Participant 7 (TVET) admitted that she did not engage in reflection, while Participant 3 (SE) highlighted that she reflected personally and with her colleagues. She said,

> Yeah, I do a lot of reflection. I do it orally not like journalling. Sometimes I will go to another colleague and when we meet in our learning circles of kindergarten, grades 1-4. Also, we will discuss what worked well in our teaching of mathematics and areas for improvement. Um. Yeah, when I'm home, I will also reflect, going through, what I had done for the day, and sometimes I record it in my diary.

Participant 1 (PE) admitted that she was not good at recording her reflections, but she would usually reflect with her colleague:

> Yes, I do reflect, but you see the part that says teacher reflection on the lesson plan. I don't fill that out at all. But then after I have taught, I would know if I find the children grasp the concept. So, I would sit down and I would say what could I have done differently? Why these children ain't get this? What did I do wrong? You know, and I just think that I would try to find a different way to bring it to them the next time. My problem is documentation. I also reflected with my colleague, because, you know, we do team teaching. So after I would ask her you know how you think the lesson went and so on because sometimes after teaching I don't feel confident, I will say, something ain't right, I missed something.

Participant 1 seemed to engage in reflective practices and asked some very important questions, but it would be difficult for her to learn from her teaching experiences in an ongoing manner since she did not document her thoughts. It will also be difficult for her to measure her growth and development in MPK over time. However, it was important that Participant 1 was able to reflect with her colleague, as this provided an opportunity for them to learn from each other to adjust instructional techniques, environment, or content to help students engage in their learning.

A lack of time was mentioned by one participant as a reason for not documenting her reflections. Participant 7 (TVET) revealed, “No, I don't. I don't do reflection because sometimes I am so busy, don't even have time to write a reflection on how the lesson went. So, it's kept in my mind.” Participant 7 (TVET) may not have grasped the importance of reflective practice in improving the teaching and learning of mathematics.

Two participants – 6 (PE) and 8 (PE) – claimed that documenting their reflections after teaching a lesson was a requirement from school management. They were the only participants who recorded their reflections after teaching mathematics. Participant 6 said, “Everybody has to do reflection, whether they do complete the lesson plan or not, they have to reflect for the school management team to see and question oh, why are you still on this topic for so long?” Participant 8 agreed: “Yes, I do reflect. There is an area in the lesson plan where we have to talk about how the lesson went, so I record my thoughts there.”

Reflection can be done individually or collectively and therefore is not restricted to the class teacher. Since the most powerful changes in BTs’ MPK result from experiences in reflective practice (Park & Oliver, 2008), BTs must make a greater effort to engage in structure reflection to gain insight as to how to improve their teaching practice, and structural supports also have to be in place to encourage reflections. However, a lack of time at the end may be a reason for participants not documenting their reflections.

Factor 2: Accommodating Students Diverse Needs

BTs need to provide opportunities for learners from different cultural perspectives and knowledge backgrounds; these differences may include diverse racial, ethnic, religious, linguistic, gender, socio-economic status, and sexual orientations. In this section, I discuss how participants reportedly paid attention to and encouraged equal contributions from all students, and the steps they took to ensure that students participate equally and actively throughout different mathematics classroom activities. Participants discussed three elements that enable their ability to accommodate the diverse needs of all students. These include accommodating gender inclusivity, accommodating multiple viewpoints, and demonstrating care and commitment to students.

First, the findings revealed that all participants tried to accommodate the diverse needs of their students in the mathematics classroom as it relates to gender, class, and race, but in the Vincentian elementary classroom, the issue of gender bias is most popular. BTs stated that they made deliberate efforts to encourage all genders to participate equally in the mathematics classroom. Participant 5 (PE) explained her method of avoiding gender bias in the classroom:

> So, if I ask a male to do something, if I ask a male a question, then the next question I would try to ask a female. I tried to use both genders fairly. I try not to call on just males as only females.

Similarly, participant 2 (ECE) found a strategy that allowed her to treat all students the same:

> I treat all students the same, I think it's just natural because I don't think any student is impacted based on their background or gender. Even though they come from a poor family, I see all students as they are, you know, willing to learn.

Participant 2 (ECE) claimed that it was a natural process for her to promote gender inclusivity in the mathematics classroom.

Second, participants were asked to describe their method for accommodating multiple points of view or experiences in their mathematics classroom. All participants stated they allowed for multiple perspectives in their classrooms. Most of the participants had rules in place to allow students to participate in an orderly manner and to respect each other's opinions. Participant 8 (ECE) stated,

> To get as much perspective from students when doing mathematics, I will usually pick their name from a particular direction, e.g. From the right or left or will do it randomly. I have a spin the wheel that I had with students' names, so when I present a task to students, I will use the spin the wheel to pick a student to share his/her strategy. I will explain to students that no laughing at students' responses is permitted, you know, not everybody will be right, and the important thing is to hear everybody.

Participant 9 made a great effort to demonstrate inclusivity in her teaching practices. Her comments suggested that that she attempted to create a safe classroom environment for all students and set up her classroom in a way to enhances the participation of all students. Similarly, Participants 1 (PE), 7 (TVET), and 8 (PE) commented that during the teaching and learning of mathematics, they allowed students to share their strategies to solve problems and to engage in class discussion, but students must follow the rule of raising their hands to share their thoughts and listen to each other. Finally, all participants acknowledged that demonstrating care and commitment to their students is an important aspect of their teaching practice. Participants commented that they all try to help meet their students' individual needs.

In addition, in an effort to include all students, make them feel adequate with their peers, and increase their participation and performance in the mathematics class, participants found different ways to demonstrate their care and support for all students. Three participants – 5 (PE), 6 (PE), and 7 (PE) – demonstrated care by conducting one-on-one conferencing with students who require more time or additional support to help fill their mathematics learning gaps, improve their performance, and increase their class participation.

Another participant shared that her strategy to demonstrate care to students was to assist in buying food for students who came to school hungry and needed something to eat. When students are not hungry, they can concentrate more in class and won't feel left out. Participants 3 (SE) and 9 (ECE) stated that they demonstrated care to students by giving tokens to reward students' efforts in mathematics. This will motivate them to want to continue to do well and feel more included in the mathematics class. Participants 4 (PE) and 8 (PE) stated that they demonstrate care to their students by speaking positive words into students' lives. For example, Participant 4 (PE) said she will usually tell her students, "Everyone can learn math and you can do it." Participant 4 provided individual attention to learners' social-emotional learning and development.

Participant 2 (ECE) had a unique way of demonstrating care to her students. She revealed she knows her students well and that she took time to think about each student's needs while planning her lessons. She said that when planning, she practises identifying and addressing students' misconceptions in mathematics: "So even before I teach students, I try to think ahead and I foresee some of the problems students will encounter and I plan accordingly to address them." When BTs are committed to their learners, they tend to assist learners and help them take accountability for their education. The care and commitment that BTs have for their students serve to motivate them to find novel methods of instruction that will provide rich and diverse classroom experiences for students. The anticipatory skill exhibited by Participant 2 is a crucial ability for new teachers.

Factor 3: Differing Professional Supports for Development of Mathematics Pedagogy

It is impossible for BTs to gain all the pedagogical knowledge they need to teach mathematics effectively from their teacher education program. The most consistent observable characteristic associated with quality teaching is experience (Kraft & Papay, 2014). As such, BTs need a variety of professional supports that allow them to "bridge from student of teaching to a teacher of students" (Smith & Ingersoll, 2004, p. 29). A growing body of literature identifies professional supports – such as mentoring and professional development – as essential for strengthening the practices of BTs and encouraging their persistence (Darling-Hammond, 2000; Goldhaber et.al., 2020; Kraft et al., 2018; Wood & Stanulis, 2009). In this research, professional support may be defined as formal and informal collegial collaborative support for BTs in improving practice, confidence, and connectedness to the school they are currently serving. The collaboration may be shared with school leadership, networks outside of their current assignment, and with teaching colleagues that BTs teacher currently works with (Johnson, 2007).

When participants were asked to describe the level and type of professional support they received at their different schools, they identified the importance of both formal and informal collegial support. Participants perceived the professional support they received to be of relatively high value. In most cases, participants had positive experiences with mentors and closest colleagues. BTs appreciated the accessibility of colleagues; Participant 2 (ECE) spoke highly of her collegial experience when working with another teacher:

> We, the both of us, like if she's teaching something, I would provide feedback and say you could have done that to improve the lesson. And then she would tell me too that you know, you maybe you should have done this. And we do work together like that, and I value her feedback very much. We have that relationship.

Principals were also a significant support in influencing BT's teaching practices. Participant 3 (SE) spoke of her appreciation of the principal's guidance and observation:

> Well, she will help me with the lesson planning. Um. Give me tips on different strategies to use to incorporate in the lesson. Sometimes you look at the lesson and give me tips and then after, you know, we will talk about, you know, what I can do to improve and so on.

Other participants spoke of collaborative professional support. They expressed that these planning sessions were important to the growth and development as BTs. As Participant 5 (PE) revealed,

> At my school, they will usually split us up, as well they will usually tell us to meet in communities, meaning lower grade teachers would meet and plan at the beginning of the term for example, what you want to accomplish by the end of term, so like kindergarten, grade one and two, sometimes grade three teachers will meet and we will plan the topics that we want to teach for that, term. We will also share strategies to teach different topics and how to deal with classroom management issues. These meetings are very helpful for me.

Similarly, Participant 9 (ECE) expressed the value of collaborative support:

> Whatever concept we are teaching, we will meet and discuss it at a grade level and share our opinions on the best way to teach the topic. For example, I will suggest videos that could be included and manipulatives we can use. We also shared learning resources, if I have a chart and another teacher wants to use it I will share it, and vice versa. We work together and help each other.

Participant 8 (PE) also voiced a positive sentiment about collaborative collegial support. As she highlighted,

> We plan together maybe at the end of the week. I would meet with the grade head and the other teachers at my grade level, and we would decide what topics we were going to do for the next week. So, if there is something I don't understand in the discussion, they will explain further to me and say what is expected to be done in this class and stuff like that, these sessions have helped me to grow as a teacher.

Beyond colleagues, another form of support for BTs is professional development. Participant 2 (ECE) found this support to be highly relevant in improving classroom practices:

> Yes, we do get support, we have frequent professional development sessions. I know the Ministry has some on the timetable and sometimes the principal would ask for a half day if she think that we need special training because she may notice that the school has a specific

> problem that is ongoing, so she will ask the Ministry of Education for a half day. These PD sessions are very helpful and help us improve our classroom behaviours and practices.

Participants shared common experiences of support from their colleagues to improve their teaching of mathematics and classroom practices. The support participants received was through different means: some met with colleagues to plan and discuss strengths and weaknesses; others interacted with their colleagues through professional development.

However, these positive experiences were not shared by all. Participants 6 (PE), 7 (TVET), 8 (PE), and 1 (PE) felt unsupported. They claimed the only time they saw someone in their classrooms was for administrative purposes, where they often only found time to visit participants' classrooms for mandatory observations and to provide feedback but failed to provide deeper support. Participant 1 (PE) shared,

> Since I started teaching, I had one person who was in place to provide some assistance to me, but that was when I was teaching at another school. That person was not effective at all. I did not learn anything from him. Eventually, he told me to go on the Internet and get everything.

Collectively, these findings demonstrate that a sense of collegial climate is critical. When teachers have a broader community of supportive colleagues on which they can rely, this has a direct impact on their personal growth and development.

In Summary

The study's findings indicate that most participants were still in the process of understanding effective mathematics classroom practices that support student learning. The theory of signature pedagogies (Shulman, 2005) is used to define the roles of beginning teachers (BTs) in the classroom. A signature pedagogy has three dimensions. First, it has a surface structure, which involves recognizable teaching and learning acts such as lesson planning, differentiated instruction, assessment, technology integration, and reflections, as seen in this research. Second, a signature pedagogy has a deep structure, reflecting a shared understanding of how to convey professional knowledge effectively. In this study, deep structures are linked to meeting the needs of all learners. Additionally, signature pedagogy includes an implicit structure: a moral dimension consisting of beliefs about professional attitudes, values, and dispositions. The implicit structure involves the teacher demonstrating care for students.).

The results showed that some participants demonstrated a poor attitude toward lesson planning: they had a limited understanding of differentiated instruction, used technology in limited ways, and used narrow assessment practices based on traditional methods. These findings are not surprising; they are aligned with Shulman's (2005) description of the support BTs need to strengthen their MPK. He found that teaching experience promotes the development of MPK. This means that until BTs have gained experience, confidence, and basic classroom skills, their process of developing and implementing MPK in the classroom is still evolving.

A sense of care was a fundamental teaching practice essential to student learning. Participants' reflections showed a commitment to meeting student needs by promoting gender inclusivity, embracing diverse perspectives, and demonstrating care. This focus on equity aligns with PBL (Barrows, 1996) and PCK (Shulman, 1986), both of which emphasize critical thinking, creative expression, and peer communication. The theory of PBL is well aligned with the findings; PBL supports equity through student-centered learning, real-world relevance, collaboration, and cultural sensitivity, fostering inclusive environments where all students feel valued (Thomas & Harnett, 2014; Barrows, 1996; Shulman, 1986).

Finally, the findings reveal that participants valued collegial support, and their involvement was valuable in helping them with developing MPK. Research has shown that pedagogical ability is not acquired suddenly but is obtained through continuous and systematic collaborative learning efforts, both in the preservice teacher education period and in the teaching profession (Kadarisma et al., 2019).

Chapter 7: Evidence of Constraints that Shape How BTs Teach Mathematics

The central theme from research question 4 (RQ4) – What do beginning Vincentian elementary teachers identify as schooling context constraints that shape how they teach mathematics? – and research question 5 (RQ5) – What do beginning Vincentian elementary teachers identify as personal constraints that shape how they teach mathematics? – revealed evidence of different constraints that shape how BTs teach mathematics. The qualitative analysis indicates that constraints can be categorized into two sorts: schooling constraints and personal constraints. Schooling constraints may be referred to as factors outside the teachers' control: for example, limited resources (e.g., technological devices, manipulatives etc.), noisy and limited classroom space, and lack of classroom assistance support. Personal challenges may be defined as factors related to the teachers themselves: for example, the depth of their mathematics knowledge, their ability to manage a classroom, and teachers' professional skills.

Both types of constraints were shown to be interconnected and affected BTs' perceptions of how well they were prepared to teach mathematics. Research on BTs and mathematics has often focused on their professional development, classroom practices, and the challenges they face in teaching mathematics effectively. There has been limited research on schooling and personal challenges as they relate to BTs' teaching and learning of mathematics. The chapter will discuss schooling constraints and personal challenges that influenced BTs' teaching of mathematics.

Factor 1: Schooling Contextual Constraints Influencing BTs' Teaching of Mathematics

School context is important because it sets the foundation for teaching and learning at all levels (Stiglitz, 2019). It shapes the expectations, resources, and environments in which BTs and their students operate. Instruction in elementary mathematics is influenced by numerous factors in and outside of the classroom. These factors range from policies and curriculum to school-specific factors such as available tools and resources in the classroom. BTs described three major constraints influencing their teaching of elementary mathematics. These included limited resources (i.e., technological devices and manipulatives), noisy and crowded classrooms, and a lack of classroom assistant support. Table 16 shows schooling constraints and personal challenges identified by BTs in order of popularity amongst participants, with limited technological devices being the most popular constraint and lack of classroom assistant support being the least popular.

Table 16

Schooling Contextual Constraints Identified by BTs

Schooling contextual constraints shaping the teaching of mathematics
1. Limited resources • technological devices • manipulatives 2. Noisy and limited classroom spaces 3. Lack of classroom assistant support

Limited Resources

A lack of resources was identified by all participants as a major issue impacting the teaching of mathematics. The participants expressed that the available resources did not align with the number of classrooms. Participants explained that there was limited physical space for movement and interaction in classrooms, as well as a limited number of instructional materials such as textbooks, technological devices (projectors and laptops), and hands-on manipulatives to teach a variety of mathematics concepts (place-value blocks, pattern blocks, ten frames, and charts). Adding to this was a shortage of classroom assistant staff.

Limited Technology Devices. Even though internet access is widespread across SVG, not every school is able to access what is needed to make use of technology successfully. Some schools do not have the financial means to afford internet access. During their first interviews (see Table 3), participants commonly agreed that their schools had an inadequate number of computers and computer software, and they encountered difficulties in implementing the use of technology in the teaching and learning of mathematics. The budget for technology in schools is limited and becomes meaningless if only one computer is available for the whole school. Participants revealed that the limited number of technological devices led to BTs spending more time writing material on the chalkboard and engaging in direct instruction. Participant 1 (PE) explained,

> We have one projector in the school. Sometimes you would want to use it for a particular lesson, and you would not get it, so you have to shift [your lesson plan] because you have prepared for that. Sometimes I do direct instruction and spend more time writing stuff on the chalkboard.

Participants also explained that there were difficulties in attending to individual learners and ensuring that all of them participated in the lessons when there was a limited number of technological devices. Participant 6 (PE) revealed,

> We have to wait for other teachers to get the projector. So, the projector is always in grade 6. So, a teacher had to buy a projector that she usually uses among the grade ones, so anytime we were using the projector with the computer and so forth, we had to join all the grade 1 classes together in a small space. All 50-plus students and it was difficult to get all students to participate in the lesson.

Participant 7 (TVET) commented, “Even though I wanted to use technology in my class, I don’t have an outlet to plug in any device. I usually have to get an extension cord from another class.” Not having access to a projector or other technological devices was a common constraint identified by participants. This shortage of technology necessitated didactic teaching and arguably had negative ramifications for students’ mathematics learning.

Another challenge stemming from the restricted access to technology was the loss of instructional time. In the observation phase of lessons, the majority of BTs had to set up projectors and computers before commencing their lessons, and for some BTs, this process consumed a significant portion of their teaching time. For example, I noted that

> Although Participant 7 (TVET) effectively utilized a video to teach the concept of comparing fractions using pizza, it's noteworthy that the setup process for the projector and computer took approximately 15 minutes. Throughout this period, the students became quite noisy, and Participant 7 faced the challenge without any assistance in the classroom. (Field Note, Observation 2, Participant 7, May 16th, 2023)

Limited Availability of Manipulatives**.** Manipulatives used in the teaching and learning of mathematics are physical objects that are designed to represent explicitly and concretely abstract mathematical ideas (Moyer, 2001). These tools can be blocks, patterns, and number lines or more complex geometric shapes such as graphs, charts, and interactive software. The use of manipulatives in mathematics has been shown to support students' conceptual understanding, encourage active learning, support different learning styles, and improve problem-solving skills (Ekohariadi, et al., 2020). Amongst participants, the limited availability of manipulatives was a common constraint. They complained about the limited manipulatives that must be shared with all mathematics teachers and the challenge of getting teachers to return the manipulatives that were borrowed. Participant 9 (ECE) stated,

> Well, the main challenge that I would really say is that it arose because of limited manipulatives that are being stored in the library. So, when the stuff is being borrowed, teachers are expected to return them, so, that other teachers can use them for the benefit of the students. The problem is that when you think something is there when you go for it, it is not there. We had a lot of mathematics manipulatives, you know, especially with measurement. We have a lot of those things we could have used but the teacher doesn't return the stuff.

Participant 4 (SE) also shared a similar experience: “Manipulatives are very limited. Well, [it] is more like a first come first serve. I will have to make sure I get my stuff early but whoever gets them first will use them.” Despite the many advantages of using manipulatives in teaching mathematics, one of the biggest challenges of accessing manipulatives is cost. Manipulatives can be expensive, especially for schools with limited budgets.

While manipulatives have the potential to enhance students' attention, classroom observations revealed that this heightened attention may not always translate to improved learning outcomes. In fact, the very characteristics of manipulatives that capture students' attention – bright colors, visual appeal, and realistic features – could be counterproductive. I noted that in some classes, manipulatives that are visually interesting or realistic tended to lead to off-task behaviour, such as building or sorting. For instance, Participant 2 (ECE) consistently had to remind her students not to play with the manipulatives and only use them as instructed (Field note, Observation 2, Participant 2, May 16th, 2023). In other cases, BTs had to intervene by taking the manipulatives away from students. For example,

> Participant 9 utilized fruits and various food items for an interactive activity in which students were instructed to divide them into halves and quarters. However, some students became more interested in consuming the manipulatives rather than participating in the task. In response, Participant 9 had to intervene by removing the items from those students who were unable to resist the temptation to eat during the activity. (Field note, Observation 1, Participant 9, May 3rd, 2023)

Noisy and Limited Classroom Space. The design of the physical classroom space plays an important role in shaping mathematics teaching practices and supporting a conducive learning environment for students (Malik & Rizvi, 2018). A lack of conducive classroom space was identified as a constraint by some participants, but it was a significant constraint for two participants: Participants 2 (ECE) and 3 (SE). They expressed concerns about the restricted space, which essentially led to organizing students in rows, resulting in increased levels of teacher-led instruction and guidance. Participant 2 (ECE) explained,

> So yes, there is limited classroom space, and the classroom layout is challenging. Because when it's time for group work, I mainly must stick to pairs because of the way they are seated. Because I would have to move around the furniture. So, it is a bit difficult.

Similarly, Participant 3 (SE) commented, "My greatest challenge, is no space in the classroom." In a cramped classroom, participants experienced a chaotic and cluttered environment that restricted students' movement. This environment led to feelings of agitation among both teachers and students. The lack of space caused disorganization, resulting in wasted time searching for materials and supplies. Additionally, the limited space hindered the free movement of students and teachers, impacting the ability to diversify learning activities. A classroom with little space can result in a chaotic, cluttered environment and limit students' movement. A chaotic classroom may result in teachers and students feeling agitated. In a cluttered classroom, students and the teacher may feel more disorganized, and valuable time is lost searching for the correct materials or locating needed supplies. Classrooms with limited space also prohibit the free movement of students and teachers to help vary learning activities.

At School C, participants complained about the noisy classroom environment because classes were separated by a chalkboard or sheets of thin plywood. Participant 6 said,

> I had some issues because the classroom, the environment of the school, it's so noisy so it was difficult to keep the students' attention as noise would distract them ever so often. …The main reason for my job stress is the overcrowded classrooms, there are too many students in a class. This is the major cause of my tiredness. I have to talk more, I have to work more, and I have to explain more.

The participants observed that excessive classroom noise significantly impacted the teaching and learning of mathematics. The noise led to multiple distractions and disruptions, hindering the ability to concentrate. Furthermore, the high classroom density noted by the researcher posed challenges for the teacher in providing individualized guidance and support, particularly in inquisitive, problem-solving, and cooperative learning techniques.

During classroom observations, I saw the challenge of limited classroom spaces in School C. In my field notes about Participant 6 (Observation 1, March 3rd, 2023), I commented on the numerous cramped classrooms that had restricted physical space which created crowded and cluttered environments. This limited movement and flexibility posed challenges for both students and BTs at School C to navigate comfortably. The close arrangement of desks and furniture caused congestion, impeding smooth transitions and hindering varied learning activities. For example, I observed Participant 6 take the students outside in the open space of the schoolyard to conduct her introduction to the lesson on 'time' because there was not enough space in the classroom (Field note, Observation 3, Participant 6, May 3rd, 2023). Furthermore, the lack of space likely contributed to classroom management issues and a general sense of disorganization, impacting the maintenance of an optimal learning environment for all individuals in the classroom.

Lack of Classroom Assistant Support. Pedagogical and logistical support for BTs is associated with improvements in teacher effectiveness (Smith & Ingersoll, 2004). Several participants reported not having any follow-up support after they were hired. In several cases, BTs had to take the initiative to figure out who to go to for help and how to get things done (e.g., what curriculum to use, which students have special needs, and what are the numeracy needs of students). While these teachers often found some support among other teachers in their schools, these experiences speak to the importance of clarity concerning whose responsibility it is to reach out and address immediate school concerns. Three participants stated there was a shortage of classroom assistant support staff, which meant fewer opportunities for students to access school learning facilities. Employing differentiated instruction enables BTs to effectively address students' unique needs, even in classrooms with limited assistance, fostering an equitable and supportive learning environment. Participant 6 (PE) explained,

> One constraint I had was no mentoring, they just put me in a classroom, I was placed in the early childhood classroom, and I did not know how to teach children how to write. I wasn't even writing properly on the chalkboard either. It was the grade head teacher that I noticed her teaching writing to her students, so I patterned after her, how she was forming her letters, and so forth. And that is all I can now teach my students. And she will tell them different phrases to help them form letters. I developed a lot of strategies through observation ty students to write using my own initiative.

Similarly, Participant 7 (TVET) shared,

> Being the only teacher in a room challenges you. You have to find ways of managing the diverse needs of students. Sometimes you might have students who are very disruptive students and can’t read. Well, you know some of them who are disrespectful. So, you have to find ways of managing different students in one class. Some students are really slow. I don't think it should be only one teacher in a classroom. Especially with one teacher. You have to be moving all over the classroom.

Participant 7’s (TVET) challenges of being the sole teacher in a classroom are multifaceted. They involve managing the diverse needs of students, including disruptive behaviors, reading difficulties, and disrespectful attitudes. Additionally, addressing the varying paces of learning among students adds complexity. The need for a classroom assistant to navigate these challenges while constantly moving around the classroom is evident.

During the observation phase, it became evident that some BTs required assistance in managing their classrooms. For instance, when I observed Participant 4 (PE) during her lesson, she was the sole teacher with many students, and they were particularly noisy and not focused. It took her approximately 10 minutes to settle the students, distribute manipulatives, and prepare the class for the lesson (Field note, Observation 3, Participant 4, May 31st, 2023). Consequently, Participant 4 lost valuable instructional time, which could have been minimized with the assistance of an additional classroom assistant.

Participant 8 (PE), the least experienced BT in this study, revealed, “No one is assigned to me but when we write lesson plans someone above me would take a look at it, but no one guides me in any way.” Participants felt that they needed a more knowledgeable teacher or just another person paired with them in the classrooms to be better able to manage and monitor students.

Factor 2: Personal Challenges Influencing BTs’ Teaching of Mathematics

Participants found themselves impacted by challenges that, at times, hindered them from implementing effective teaching strategies in their classrooms. As expected, and expressed by most BTs, participants commented that most of them struggled with classroom management. Classroom management has always ranked high with beginning teachers as an obstacle in the classroom (Burnard, 1998; Martin et al., 1999). Cooper et al. (2014) attributed a large portion of lost academic engagement time to teachers who do not know how to manage their classes, resulting in students who are not productively engaged in the learning process. Handling discipline problems emerged as a major challenge for BTs.

All participants experienced some level of problematic classroom management when teaching mathematics. Participant 1 (PE) explained,

> I am still struggling with classroom management; I have triplets in my class, and they are boys. They fight during the lesson. I'll be up in front of the board, and they'll be there, they’ll be fighting. I also will hear lots of bickering from time to time... I have a special needs child in my class, and he does have some outbursts in class. Oh, and yeah, and some students make some kind of sounds that I can’t describe and disrupt my lessons. And then I have ones who will give some attitudes, who would curse. Miss, you would be surprised.

The experience described by Participant 1 became notably clear to me. When I visited her class immediately after lunch, I observed the students' restless behaviour during the lesson. The students, particularly the triplet boys, were frequently moving around the classroom instead of focusing on their individual tasks. Participant 1 (PE) had to address them multiple times and even requested them to change seats with other students in an effort to manage their behaviour (Field note, Observation 3, Participant 1, May 24th, 2023).

Participant 7 (TVET) shared similar struggles in her attempts to manage disruptive behaviours. She revealed,

> There is a wide range of different diversity and students' behavior and the different issues they're coming with from their background in the classroom. They challenge me, I have to find ways of managing diversity. Sometimes I might have students who are very disruptive and disrespectful. So, I have to find ways of managing different students in one class at the same time.

Similarly, Participant 4 (PE) pointed out that,

> Many students in my class come from homes that have no structure and they are not accustomed to expressing common courtesies such as, excuse me, thank you, good morning. These simple things that you're expecting, sitting, and behaving themselves even when the teacher asks them not to talk or to look at the board. These children just move from one chair to another, and they have a conversation as if nobody [the teacher] is there.

Participant 8 (PE) agreed that classroom management was an issue she struggled with. She stated,

> I know the teacher educators taught us about different behaviors children can exhibit but for the age group of my class, their language really surprised me. Many complaints come to me, and I would be surprised that kids at that age would say such things. Most of the time I experience disruptive behavior when students return from the lunch break.

Participant 5 (PE) explained that "A personal constraint was classroom control. That was one of my biggest challenges because going into the classroom as a new teacher and to children I had never seen before. They figured me out and I could not do what I wanted."

Classroom disruptive behavior was a common problem identified by most participants and, to a lesser extent, students' inappropriate language use and lack of courtesies. Participant 8 observed that disruptive behaviour was more common after the lunch break, and Participants 4 and 7 claimed that students' misbehaviour might be attributed to their family backgrounds. It is believed that good classroom management helps establish an effective and conducive learning environment (Kubat & Dedebali, 2018); hence, BTs must implement intervention strategies to address classroom management issues.

Participants also identified limited content knowledge and curricular knowledge as contributing to classroom management issues. Participant 3 (SE) said,

> I wasn't knowledgeable about the mathematics contents, and I didn't use a hands-on approach. One of the challenges I believe affects me personally is that I did not like Math. So, I was the individual who didn't like it before. So, I think that was a barrier in the beginning. So yeah, I think I'm learning I am becoming passionate.

Participant 3 had limited mathematics content knowledge but did have the opportunity to take a mathematics course in her teacher education program. Although only one participant admitted a lack of content knowledge, recent evidence suggests that many primary school teachers may not possess sufficient mastery of the concepts they have to teach (Brunetti et al., 2023). Teacher content knowledge is important; research has shown that a 1% increase in teachers' knowledge may result in a 9% increase in students' learning in mathematics (Bau & Das, 2020). Participant 9 (ECE) shared that her main challenge was related to the curriculum. As she explained,

> I will have to go back to the curriculum. I am having difficulty understanding the curriculum, and getting the right contents, age-appropriate and so you know, the curriculum has a part to do with a bit of my challenges at the moment as well.

Participant 9 described struggling to understand the curriculum. These obstacles impacted her ability to deliver effective mathematics instruction and ultimately affected student learning outcomes. Hence, BTs must be provided with targeted support and resources, as well as enhanced professional development opportunities, which are crucial in addressing these challenges and empowering teachers to navigate the mathematics curriculum successfully.

In Summary

BTs have identified two major factors that serve as indicators of constraints influencing their approach to teaching elementary mathematics. These factors encompass schooling constraints, which involve limitations in resources (such as technological devices and manipulatives), noisy and crowded classrooms, and a lack of classroom assistant support. Additionally, personal challenges, including classroom management difficulties and insufficient content and curriculum knowledge, were highlighted.

Participants expressed that financial constraints significantly hindered their ability to integrate educational technology into their teaching. The limited availability of technological resources often forced BMTs to rely on traditional methods, potentially negatively affecting student learning outcomes. Salik and Kecik (2018) noted that insufficient instructional materials can adversely influence teaching practices. To address these challenges, PBL can be employed to foster creative and resource-efficient teaching strategies (Barrows, 1986). PBL encourages the use of low-cost or no-cost materials and promotes innovative learning methods (Savery, 2006). By focusing on problem-solving and critical thinking, PBL helps BMTs navigate resource limitations while enhancing student engagement (Ping et al., 2018).

Additionally, BMTs identified personal challenges, particularly in classroom management. Issues such as disruptive behavior, discourtesy, fights, outbursts, and inappropriate language presented significant hurdles for these educators. Although Veenman's (1984) research was conducted some time ago, it remains evident that BMTs struggle with classroom management. Furthermore, limited content and curricular knowledge further impeded their ability to teach mathematics effectively. Shulman (1986) emphasized the importance of content knowledge, and more recent studies by Ball et al. (2008) confirm the critical role this knowledge plays in teaching, highlighting a common deficiency among participants.

These challenges underscore the need for a strong foundation in PCK, combining subject expertise with effective teaching strategies (Magnusson et al., 1999). PCK is essential for effective instruction, enabling BMTs to adapt their teaching to the diverse needs of their students (Park & Oliver, 2008). On the other, signature pedagogies empower BMTs to tailor their instruction to their strengths, enhancing student engagement and promoting a positive classroom climate (Graham, 2011). Moreover, developing a unique teaching style boosts BMTs' confidence and passion for teaching, enabling them to navigate challenges and effectively address their students' varied needs (Wong et al., 2020). PBL is a valuable resource for BMTs, fostering resilience and self-efficacy through problem-solving and peer collaboration (Benson et al., 2020). By integrating PBL into teacher education programs, BMTs can adapt to evolving circumstances and create student-centered learning environments, equipping them to overcome personal challenges and become effective educators (Chung & Kim, 2020).

These findings highlight the considerable impact of school constraints and personal challenges on participants' instruction in elementary mathematics. They emphasize the need for strategic interventions, support systems, and professional development to enhance teaching practices and student outcomes. Teacher educators should prioritize PCK, signature pedagogies, and PBL as essential tools for effective teaching, equipping BMTs to overcome challenges and excel in their roles.

Chapter 8: BTs' Perceptions of Their Preparedness: Before and After

Gaining insight into the experiences and viewpoints of BTs and their perspectives on classroom preparedness is crucial for enhancing teacher education in the OECS. This chapter explores a comparison of first and second interviews (see Table 3) with the nine research participants and delves into BTs' understanding of their experiences. Discussion of the interviews provides valuable insights into the evolution of BTs' perceptions and the influence of their full-time teaching experiences on their understanding of preparedness. This discussion provides insights into BTs' understanding of their readiness and provides insights for educators, researchers, and policymakers located in SVG. Aligned with the research questions of this study, the discussion is organized into four themes. These are Perceptions of Preparedness, Evidence of Developing Mathematics Content Knowledge (MCK), Evidence of Developing Mathematics Pedagogical Knowledge (MPK), and Evidence of Constraints that Shaped How BTs Teach Mathematics.

Perceptions of Preparedness: Relationships with Teacher Education Training

During the first interview, participants generally gave high ratings for how well their teacher education program prepared them while also identifying areas for improvement, such as the inclusion of more teaching practice opportunities, more instructional time, further opportunities to increase their confidence in teaching mathematics content, and additional exposure to the curriculum. Overall, the influence of participants' fear of mathematics and whether they learned elementary mathematics pedagogy or not in their specific teacher education program at MCC played key roles in shaping their perceptions of their preparedness to teach mathematics. Additionally, opportunities to apply what they learned (knowledge and skills) in their teacher education program during practicum also influenced their perceptions of preparedness. Finally, BTs' emotions and significant school-based constraints were also influential.

In the second interview, BTs discussed their readiness to teach mathematics. Their ideas were closely aligned with those from the first interview, and in some cases, showed an even more positive outlook. Participants consistently provided high ratings for their teacher education, emphasizing positive aspects of the program. Participants 1(PE), 2 (ECE), 3 (SE), 4 (PE), 5 (PE), 6 (PE), 8 (PE), and 9 (ECE) emphasized the usefulness and appropriateness of the knowledge and skills acquired for their teaching practice. Participants uniformly asserted that they were unable to pinpoint any elements from their learning experiences that they deemed inappropriate or unhelpful in the context of teaching mathematics. Arguably, BTs may not realize the full importance of their teacher education until they have accrued practical experience and discerned the relevance of their previous academic training. For example, in her second interview, Participant 9 (ECE) stated: “So far, there isn't anything inappropriate or unhelpful in my current teaching situation which I would've learned from my mathematics education program. Everything is helpful, and being a part of mathematics education is beneficial.” Like Participant 9, most participants generally held a positive view of the content in their teacher education program, with an acknowledgment of the significance and practical applicability of acquired knowledge.

While participants mostly identified positive elements about the program during the second interview, they also pointed out aspects that needed improvement. For example, Participant 8 (PE) noted in her second interview that some teaching strategies taught in the primary mathematics program were more suitable for upper grades, requiring her to find alternative strategies for the ECE grade level where she was placed. As she stated, “I would say some of the teaching strategies I learned were mostly for upper grades and was not helpful.”

Additionally, Participant 7 (TVET) highlighted that the TVET teacher education program focused on preparing students for and conducting practical assessments in the classroom. This content appeared useless to Participant 7 (TVET) because it was not required for her to use these skills in the primary school in which she was placed. In her second interview, she stated that “preparing students for and conducting practical assessments, which were covered in my area of specialization (TVET), is very unhelpful at the moment as a beginning teacher." Looking across the suggestions of both Participants 7 (TEVT) and 8 (PE) reveals that the classroom placement of BTs at the start of their careers is crucial because it significantly influences their practical application of training and their overall effectiveness in the classroom. A well-matched placement provides BTs with the opportunity to apply their acquired skills, gain relevant experience, and build confidence, ultimately contributing to their success as educators. Participants 3 (SE) and Participants 7 TVET were both trained to teach high school students but were placed at the elementary level. All other participants were appropriately placed where they were trained to teach. Despite their overall positive views of their program, BTs expressed mixed feelings about their preparedness to teach elementary mathematics content during the first interview.

Evidence of Developing Mathematics Content Knowledge (MCK)

Participants underscored the necessity of broadening their MCK to excel as mathematics educators. During the first interview, BMTs emphasized the significance of seeking advice from experienced colleagues when encountering uncertainties in mathematics content. This highlights the influential role mentors can play in the development of knowledge. Some BMTs pinpointed specific areas within mathematics where they felt less capable – for example, the concept of fractions – indicating a demand for increased support.

The second interviews align with insights from the first regarding BMTs' MCK. Four participants still grappled with confidence in teaching mathematics content, as I observed when I visited their classrooms. During the second interview, four participants disclosed that one of the most challenging aspects of their role as mathematics teachers, especially when I observed their teaching, was ensuring accurate delivery of content. Participant 4 (PE) reflected that "the most challenging aspect of my lessons being observed was making sure my content was correct and coming across to my students in a way they can understand and relate to. I get slightly nervous under observation."

Similarly, Participant 5 emphasized, “I was very mindful to make sure the correct content was being taught and students understood.” The preoccupation with correctness reveals uncertainty about content background. This is likely to impact the prevalence of constructivist activities in that the comfort level is not there to relinquish control in student-centred activities. Also, during her second interview, Participant 6 (PE) pointed out that she learned a lot about her teaching and elements of her own MCK when I visited her classroom to observe her: “I am discovering that teaching is a lifelong learning experience. It's one step at a time. There is still some room for improvement, and I still have a lot to learn about teaching mathematical topics.” Likewise, Participant 7(TVET) revealed, “I am discovering the value of research, I realized that it doesn’t matter what area of mathematics I am teaching. Doing my research helped me a lot when teaching the math content.” It is crucial to note that not all participants received training in elementary mathematics instruction; specifically, Participant 3 (SE) and Participant 7 (TVET) did not receive such training. However, classroom observation and reflective discussions play a pivotal role in the BMTs’ journey, helping them bridge the gap between theory and practice, develop essential skills, and cultivate a reflective and growth-oriented mindset (O'Leary, 2020). These experiences can positively contribute to BMTs’ readiness and effectiveness in their classrooms.

During the second interview, four participants – 3 (SE), 5 (PE), 6 (PE), and 7 (TVET) – continued to describe their concerns about the possibility of presenting inaccurate content during teaching. This point suggests that these BTs were not well-positioned to teach elementary math and had little support. This apprehension was particularly evident when I observed BTs teach, as was the pressure for participants to accurately convey mathematical concepts. For instance, as part of my field notes, I wrote,

> During today's observation, I noted a sense of apprehension in Participant 7 (TVET), as she prepared to deliver a lesson on capacity. While reviewing her lesson plans and instructional materials, she displayed visible hesitation and concern regarding not only ensuring the accurate

> delivery of content but also determining the appropriate amount of content to cover within the allotted time frame. (Observation 1, March 9, 2023)

Following this observation, Participant 7 (TEVT) and I engaged in a reflection on the lesson. She assessed the lesson's strengths and weaknesses. She acknowledged that certain students had difficulty understanding the unit of measurement, and she expressed concern that she might have covered too much content given the class timeframe and the age group of the students. This lesson made me recognize that placing a teacher in a position where they lack training can hinder their effectiveness and have a negative impact on students' learning experiences. Participant 7's classroom behaviours underline the significance of thoughtful teacher placement and the necessity for continuous professional development and support to ensure success in diverse mathematics classroom settings. As BTs navigate these challenges, seeking advice from experienced colleagues and embracing teaching as an ongoing learning journey are essential elements of professional development. However, it is crucial for beginning teachers to have structured and formalized support systems in place.

Conversely, four participants – 1 (PE), 3 (SE), 8 (PE), and 9 (ECE) – expressed positive feelings about my visits to their classrooms. It seemed for these BTs, observations of their teaching served as positive reinforcement of their teaching abilities and an opportunity to showcase and reflect on the skills, techniques, and theories they had acquired during their teacher education program. In her second interview, Participant 1 (PE) reflected on her personal growth, expressing how the observation allowed her to demonstrate what she had learned and apply concepts. She noted, "I felt more confident in myself delivering the mathematics content during the observational phase of the research because I am now accustomed to the classroom."

For some participants, for example Participants 1 (PE) and 8 (PE), classroom observations seemed to play a pivotal role in cultivating positive feelings for the teaching of elementary mathematics by offering a structured opportunity for discussion about their growth and reflection on how to improve. Positive classroom observations can create a supportive environment that encourages continuous learning, instills confidence, and reinforces the belief that BTs' contributions are valued (Beltman et al., 2015; Glickman et al., 2018).

Evidence of Developing Mathematics Pedagogical Knowledge (MPK)

During the first interview, BTs described that they were still developing their understanding of mathematics classroom practices that promoted student learning. They noted that they were still grappling with the dynamic nature of the classroom environment, striving to create conducive conditions that foster student comprehension and participation. During the first interview, despite positive ideas about cultivating positive conditions in the classroom, some participants demonstrated a poor attitude toward lesson planning. For example, Participants 1 (PE) and 3 (SE) did not always present lesson plans during the classroom observation phase of the data collection. Participants 1 (PE), 3 (SE), 4 (PE), 5 (PE), 6 (PE), 7 (TVET), 8 (PE), and 9(PE) demonstrated a limited understanding of differentiated instruction. Furthermore, Participants 1 (PE), 3 (SE), 5 (PE), and 8 (PE) exhibited a narrow understanding of assessment practices. However, participants' commitment to addressing student learning requirements and fostering equity was discernible. For instance, during classroom observations, it was noticeable that participants exerted considerable effort to ensure equal participation of all genders in class discussions and activities, thus revealing a moral dimension to their understanding.

In their second interviews, BTs continued to recognize the ongoing challenges they encountered. These persistent issues in understanding specific classroom practices align with the findings from the first interview. For example, Participants 1 (PE), 3 (SE), and 8 (PE) expressed a desire to do more in terms of differentiation. They recognized the importance of tailoring teaching methods to meet the diverse needs of students and seeking ways to enhance their differentiation strategies. As Participant 1(PE) said,

> I use a variety of strategies in my teaching. Yes, I try my best to differentiate and use engaging activities to capture my students' attention, but I feel like I can do more. Therefore, in order to work on this, I would need to conduct some research on how to approach my new batch of students.

Participant 3 (SE) shared a similar sentiment: "I am discovering that there are more things I can do such as using differentiation more often as well as use more manipulatives." Additionally, Participant 8 (PE) pointed out that "I need to work more on differentiation."

These participants acknowledged the significance of implementing differentiated instruction in education to meet the diverse learning needs and styles of students and pinpointed the specific aspects of their own classroom practice that required improvement. They recognized that a standardized teaching approach might not adequately address the unique strengths, challenges, and interests of each student.

Additionally, during the second interview, participants disclosed how they consistently made attempts to integrate teaching strategies that they had acquired during their teacher education program. Six participants – 2 (ECE), 4 (PE), 5 (PE), 6 (PE), 8 (PE), and 9 (ECE) – highlighted the significance of using manipulatives in their teaching practices. For instance, Participant 5 (PE) mentioned, "I use a lot of manipulatives or teaching aids so students can understand the different mathematic concepts." Similarly, Participant 9 stated, "I regularly use manipulatives to help students acquire knowledge, through the active processes that engage them. I find using manipulatives helps students to engage during lessons." The incorporation of manipulatives in the classroom creates a dynamic and interactive learning environment that not only strengthens mathematical comprehension but also nurtures a positive attitude toward the subject (Borthwick, 2019).

Furthermore, participants – particularly 2 (ECE), 4 (PE), and 6 (PE) – underscored the importance of connecting mathematical concepts to real-life experiences (Siregar & Siagian, 2019)

This approach aims to make abstract concepts more tangible and relatable for students. Participant 6 explained,

> I adopted the use of concrete manipulatives to help students better understand math concepts rather than just chalk and talk. I also adopted the use of authentic scenarios to connect students to real-life situations while teaching mathematical concepts.

Also during the second interviews, some participants – 2 (ECE), 3 (SE), and 9 (PE) – recognized the importance of integrating literature into mathematics lessons as a beneficial strategy. Using stories and big books can serve as an engaging method to introduce and explain mathematical concepts (Furner, 2018). As Participant 2 (ECE) stated, "The math program taught me the benefits of using literature to engage students during math lessons. Since children love stories, I usually introduce topics and even explain concepts using literature."

Furthermore, Participants 3 (SE) and 7 (TVET) highlighted the importance of collaborative learning experiences in the mathematics classroom with an emphasis on group work (Sofroniou & Poutos, 2016) Participant 7 highlighted the importance of group activities and peer work, particularly through the think-pair-share strategy when learning mathematics. This approach, fostering collaboration and diverse perspectives, is a distinctive feature of Participant 7's teaching strategy as I observed:

> Today, for the first time I am pleasantly surprised to see students actively engaged in a group activity. They measured the capacities of different liquids using tools like cups and beakers. Working collaboratively in groups of four, they encountered challenges related to reading the measurements correctly. The task prompted lively discussions and problem-solving. Overall, the students demonstrated a developing understanding of capacity as a measure and connected mathematical concepts to real-life situations (Field notes, Observation 1, March 9, 2023).

This lesson marked the first time I observed a BT integrating a group work activity. I was delighted to witness students collaborating, learning, and teaching each other mathematics. Additionally, I was pleased to see that a BT from the TVET program could apply what she learned as part of her teaching approach. During the second interview, Participant 7 revealed her belief in creating opportunities for students to work together. She explained,

> The strategy that I use most in my teaching is pair grouping. I use this mostly in the form of think-pair-share activities. This enables students to think about a concept and compare their findings with others. This strategy helps students to have a wider understanding of the concept. In mathematics, it helps students to learn different strategies that can be applied to solve a problem.

During the observation and second interview, Participant 7 showed that she understood the importance of using various representations and provided students with numerous chances to enhance their mathematical creativity (Boaler et al., 2016). By providing the opportunity for students to apply different ways of representing mathematical objects, Participant 7 seems to be on the path of empowering her students to adapt their solutions flexibly when faced with new situations.

During the second interview, the participants collectively highlighted the success of classroom practices learned during their teacher education program. They emphasized hands-on activities, manipulatives, real-life examples, and group work in their teaching of mathematics. These effective practices have been found to contribute to student engagement, understanding, and collaboration in the learning process (Harbour et al., 2015).

Evidence of Constraints that Shaped How BTs Teach Mathematics

During the first interview, BTs revealed that they encountered numerous challenges in teaching elementary mathematics in the form of schooling constraints and personal challenges. Schooling constraints encompassed limitations in resources like technology and manipulatives, overcrowded classrooms, and insufficient support. Financial limitations constraining their schools impeded BTs' access to educational technology and affected how they taught. BTs described experiencing personal challenges while teaching, which included classroom management (i.e., disruptive behaviours) and a lack of mathematics content knowledge. The scarcity of instructional materials and reliance on outdated practices compounded these challenges. These findings emphasize the need for strategic interventions, support systems, and professional development to overcome these constraints and improve teaching practices for better student outcomes.

During the second interview, six participants – 1(PE), 2 (ECE), 4 (PE), 6 (PE), 7 (TVET), and 8 (PE) – identified a major challenge associated with limited resources. Whether it was concrete objects, technology, differentiated instruction materials, or teaching aids, participants described challenges in accessing and providing resources for their students. Participant 1 (PE) and Participant 4 (PE) both mentioned the school's financial constraints as a hindrance, influencing them to purchase resources themselves. In a post-interview (June 26, 2023), Participant 1 noted,

> Having enough concrete objects for all of my students can sometimes be a bit expensive which hinders me from always providing them. Even when parents are asked to send objects or to help create aids, students come without, and I have to provide them with those aids.

Participant 4 (PE) also shared in her second interview that having enough concrete objects to use in the teaching of mathematics was expensive. As she stated, "From my mathematics education program I learned to create my own teaching aid. This is extremely difficult as I have to buy everything for myself to get it done. It is a financial constraint."

Three participants, including 2 (ECE), 6 (PE), and 8 (PE), emphasized limitations associated with technology. This included the cost of equipment, a lack of compatible devices, and a limited availability of projectors, all of which affected their ability to integrate technology into teaching. As Participant 2 (ECE) expressed, "I wish I could use more technology during my lessons. The cost of equipment and the lack of devices that are compatible with those that are available prevent me from doing so." Participant 6 (PE) also shared a similar experience:

> I wish I could make more use of technology; however, the school only has two projectors, and most times when planning lessons, we have to bear in mind that the projector may not be available at the time when I might want to use it.

BTs frequently encounter constraints that extend beyond their influence and surpass the content covered in their teacher education programs. These limitations typically stem from broader systemic issues, including a lack of funding and staffing.

Classroom management was another challenge that BTs encountered. Participants 6 (PE), 7 (TVET), and 8 (PE) described difficulties associated with classroom management that were influenced or caused by poor environmental conditions. Participant 6 (PE) disclosed,

> The noise level from the other classes is a big problem. The classes are separated by partitions and sometimes it is difficult for students to hear what the teacher is saying when mathematical concepts are being taught.

Participant 7 (TVET) described a similar problem: "To ensure that my students were not distracted by background noises. This is because my classroom sits between other classes with just blackboard partitions." Both Participants 6 and 7 highlighted the challenge of background noises due to the classroom's location between other classes with only blackboard partitions separating them. Classroom management was still a challenge for Participant 8 (PE); as she explained, "Classroom management is still a challenge for me, some students will shout answers across because they are so eager to answer and would forget the rules."

A teacher education program can impart foundational knowledge and strategies related to classroom management, equipping BTs with essential skills (Oliver & Reschly, 2007). However, the effectiveness of these teaching practices may be influenced by the specific context and policies of individual schools in which BTs are placed. Successful classroom management relies on teacher education programs and schools working together, ensuring that theoretical knowledge matches the practical needs of each educational institution's unique environment.

Furthermore, Participants 2 (ECE), 3 (SE), and 9 (PE) collectively expressed challenges concerning time management. Navigating within the designated time frame for lessons and ensuring timely completion of activities were commonly identified as hurdles. Participant 2 described a recurring difficulty in striking a balance between covering content comprehensively and adhering to the time constraints inherent in scheduling. Additionally, Participant 3 specifically highlighted the challenge of transitioning from one activity to another, underscoring the difficulty of maintaining flexibility in the classroom – an aspect not explicitly addressed by the other participants.

The second interview results highlighted a consistent theme of resource limitations, with participants emphasizing struggles in acquiring concrete objects and technology. Financial constraints emerged as a recurring hindrance, as obtaining necessary teaching aids proved challenging due to associated costs. Moreover, technology-related challenges were underscored by participants, in that due to lack of resources and finances, it was challenging to integrate technology into teaching mathematics. Classroom management difficulties added another layer of complexity, with noise disruptions, background distractions, and challenges in maintaining order identified by participants. The significance of ongoing professional development and mentorship is reiterated as crucial for helping BTs overcome these multifaceted challenges and enhance their teaching practices for better student outcomes.

The comparison of the first and second interviews reveals BTs on a dynamic and evolving journey. BTs moved from facing initial challenges and mixed feelings about readiness to teach mathematics to gaining a better understanding of effective teaching methods, ongoing challenges, and the importance of collaborative learning. The persistence of systemic issues, such as resource constraints and limited technology use, underscores the need for targeted support and continuous improvement from school administrators, educational institutions, mentor teachers, and educational policymakers. The commitment of BTs to meet student needs and promote equity remains a consistent theme, reflecting a moral dimension in the development of pedagogical knowledge.

Overall, the comparison highlights the complex and multifaceted nature of the teaching profession and the continuous growth and adaptation required for BTs to effectively teach mathematics. Shulman (1987) and his conceptualization of PCK theory emphasized the importance of adapting content knowledge for effective teaching, including using various strategies to make learning tangible and relatable for students. For example, participants described commonly using hands-on materials and real-life examples in their teaching. Participants' integration of real-life experiences and hands-on materials suggests they are working towards making mathematics accessible through the use of appropriate strategies.

Furthermore, there were indications of participants' efforts to implement principles of PBL. Some BTs infused real-life experiences into their instruction, offering students authentic problems linked to their contexts (Hmelo-Silver, 2004). While PBL does not explicitly address the use of manipulatives, I observed many participants attempting to make activities more hands-on by using manipulatives. The interactive nature of PBL naturally encourages the utilization of tangible materials or interactive tools to enrich the learning experience and foster practical understanding.

Moreover, participants, lacking formalized professional development, collectively voiced a shared aspiration to enhance their teaching experiences. This finding aligns with both PCK and PBL principles. PCK emphasizes the importance of continuous learning for effective teaching (Shing et al., 2018), while PBL's philosophy encourages educators to engage in continuous learning and development (Almulla, 2020). For instance, PBL emphasizes the continuous refinement and enhancement of problem-solving skills, and educators' commitment to ongoing professional development reflects a similar desire for improvement by refining instructional approaches, integrating new technologies, and enhancing effectiveness in the classroom (Darling-Hammond et al., 2017). These theories emphasize that teaching is more than just knowing the content to be taught. Therefore, BTs must be able to transform their mathematics content knowledge for teaching and learning (Shulman,1986). To evolve, participants need to engage in critical reflection and interpretation of the mathematics content and employ diverse representation methods (Grossman, 1990). They must learn to adapt materials to address students' developmental levels, abilities, gender, prior knowledge, and misconceptions (Aksu, 2019). Additionally, participants also must learn how to tailor materials to meet the specific needs of individual students or groups during the teaching process (Shulman, 1986). This implies that participants will require time, professional development, and support to enhance their PCK and PBL strategies (Lee et al., 2018). If these supports are not provided, there is a real possibility that they will learn to rely on traditional teaching methods and as a result, experience limited pedagogical growth.

Despite the diversity in teaching contexts, participants identified common challenges such as resource constraints and difficulties in time and classroom management. These shared challenges underscore the universal nature of certain aspects of teaching that educators grapple with across different settings and which are beyond the control of teacher education programs.

Although no participants had an organized induction program, some participants showed more confidence with their mathematics PCK because they had the support of their principals and more experienced teachers to rely on if they needed help (Hulme and Wood, 2022). In School C, I observed that those participants – 3 (SE), 4 (PE), and 5 (PE) – felt supported and were more confident with their classroom management, but their mathematics teaching and classroom organization practices remained very traditional. I did not see many student-centred approaches in their teaching. Both Participants 4 (PE) and 5 (PE) demonstrated evidence of employing some aspects of mathematics signature pedagogy during classroom observations; however, for each lesson, I observed inconsistencies in their lesson planning.

In School B, Participants 2 (ECE) and 9 (ECE), who were placed at the early childhood level, were highly motivated and incorporated many student-centred strategies in the teaching of mathematics. They both demonstrated growth and good development of their PCK, and the teaching strategies they selected promoted PBL. Participants 2 and 9 employed specialized techniques, strategies, and practices to teach mathematics effectively that were learned in their teacher education program. During my observations of their teaching, both asked thoughtful questions, used various mathematical representations, connected student thinking (National Council of Teachers of Mathematics [NCTM], 2014), consistently had well-prepared lesson plans that made use of manipulatives and teaching aids and were ready to commence class punctually. Participant 1 (PE) was also at school B and agreed that she had access to support but showed little evidence of growth in mathematics PCK; for example, she did little planning and there was little evidence of teaching aids or manipulatives. Her teaching methods were very traditional. This situation could stem from a lack of supervision by the administration; Participant 1 may have emulated what was demonstrated to her, and she seemed to not have a genuine passion for teaching mathematics.

Located at School A, Participants 6 (PE), 7 (TVET), and 8 (PE) had little formal support and struggled with classroom management. Wellner and Pierce-Friedman (2021) recommended that BTs require high-quality, structured support to begin the journey towards becoming experts. These BTs claimed they were highly monitored by their administration to ensure they had the required documents to submit to the Ministry of Education, yet there was little support to assist with the development of their teaching. Research shows that increased scrutiny and regulation of teachers' work has reduced space for professional judgment in the core areas of pedagogy, curriculum, and assessment (Oosterhoff et al., 2020; Worth and Van den Brande, 2020). Participants 7 (TVET) and 8 (PE) showed little evidence of growth in mathematics PCK. They tried to incorporate teaching aids, but the inadequate resources at the school made it difficult. They both struggled with implementing appropriate questioning techniques and meaningful activities when teaching mathematics. Yet, although Participant 6 was located at School A, she was the most innovative BT I saw; despite the noisy environment and limited support, she demonstrated growth and a good development of mathematics PCK. Her students were meaningfully engaged in the lessons, and she connected the mathematics content to students' everyday lives in a fun and exciting way. All participants at School A made great effort to apply their pedagogical knowledge as demonstrated by evidence of lesson planning, communicating expectations to students, and assessing student learning.

Participant 3 (SE) and Participant 7 (TVET) were designated to instruct elementary-level mathematics, even though their original training did not specifically prepare them for this level of teaching. The Ministry of Education is responsible for the placement of teachers, and despite having training in secondary and technical vocational education levels, Participants 3 and 7 were assigned to elementary-level teaching roles. According to the UNESCO Global Education Report (2021), when BTs are placed to teach a subject outside their expertise, it may have detrimental consequences on teaching and learning. Some studies have found that it negatively influences BTs' self-esteem, confidence, and relationships within the school community (Du Plessis et al., 2014), as well as job satisfaction and the likelihood of staying in the profession (Sharplin, 2014). Instructional practices may also differ. Out-of-field teachers tend to rely more on textbooks and pre-prepared material and are less likely to make connections across topics and engage in creative classroom activities (Napier et al., 2020; Van Overschelde & Piatt, 2020).

However, Participant 3 (SE) claimed that the support she received from her principal helped her greatly in teaching mathematics at the primary school. Positive experiences with teaching a subject outside one's expertise are usually a result of a combination of factors, including teachers' interests and a strong support system offered by the school community and school head (Campanini, 2019; Du Plessis et al., 2014). Therefore, not all out-of-field teachers are unhappy or uncomfortable with their positions. Those who are well-supported may see it as an important career development step (LaRue, 2017).

The findings imply a great need for targeted mentor support for BTs to help them enhance their practice and self-confidence. Simply having access to a mentor is not enough; it is the mentor's capacity to support new teachers that matters (Ingersoll & Strong, 2012). In this study, having a supportive headteacher was significantly and positively related to higher levels of confidence and development of PCK. These findings also show the need to place BTs in schools and grade levels they are trained to teach. According to McJames et al. (2023), BTs who enter a new school community feeling well-prepared appear less likely to report high development needs. However, BTs who enter the profession feeling ill-prepared appear more likely to report continuing high professional learning needs.

In conclusion, investigating and observing the accounts of nine BTs' classroom practices for over six months enabled me to identify variations in their evolving PCK (Shulman, 1986), their development of personal signature pedagogies (Shulman, 2005), and applications of PBL (Barrows, 1996). Through interviews and observations, I observed how placement and limited support, both in the form of lack of mentoring and inadequate classroom resources, were evident in BTs' discussions of their mathematics teaching practices. The analysis revealed three distinct clusters of BTs: those highly focused on improving their mathematics teaching practices (Participants 1 [PE], 2 [ECE], 4 [PE], 5 [PE], 9 [ECE]), those who wanted to be placed where they were trained to teach (Participants 3 [SE] and 7 [TVET]), and those who wanted formal support in terms of mentorship to teach the mathematics content (Participants 6 [PE] and 8 [PE]).

Chapter 9: Formal Structural Supports as PSTs Transition to BTs: Implications

Effective preparation of elementary mathematics teachers involves a comprehensive approach encompassing a focus on the development of content knowledge and pedagogical skills. As students, PSTs should develop a deep understanding of mathematical concepts and the ability to translate this understanding into engaging and developmentally appropriate lessons (NCTM, 2000). Hill et al. (2005) emphasize the importance of nurturing skilled PSTs who can not only calculate correctly but also use visual aids, provide explanations, and analyze a student's solutions. According to the AMTE (2017), PSTs should be equipped to instruct every student in their classrooms. While pedagogical skills will evolve, PSTs must possess an initial set of effective and fair mathematics teaching strategies (for example, explicit instruction and cooperative learning strategies). This also includes skills in task selection, orchestrating classroom discussions, building on prior knowledge, and linking conceptual understanding with procedural fluency, as emphasized by the NCTM in 2014.

Furthermore, the shift from being students to assuming the role of teachers poses a challenge for preservice educators in formulating their own objectives to become proficient professionals (Mustajab et al., 2023). Research indicates that not every preservice teacher can effectively apply theoretical knowledge during classroom instruction (Baier et al., 2021; Baker-Gardner, 2016; Mufidah, 2019). A significant number of preservice teachers have voiced concerns about these limitations, which impact their motivation, actions, and prospects (Nurzen et al., 2022). According to Lewin (2004), another challenge is the overreliance and modelling of poor practices at teacher education institutions, such as lecturing large groups of trainees despite having low staff-student ratios, implying that the endorsement of innovative teaching methods may be more of a nominal expression than a genuine belief.

Overall, participants found that the teacher education program they graduated from prepared them well for the classroom. In the first interview with BTs, they were specifically asked, on a scale of 1 to 10, how well participants felt prepared for the mathematics classroom, with 10 being exceptional.

No participants rated the program below six, and 93% of participants rated the program seven or above. Although they rated the program well, my observations of their teaching revealed that many participants struggled with classroom management, questioning techniques, applying differentiated instruction, and using a variety of assessment strategies.

Scholars agree that teachers' beliefs about their mathematics abilities can significantly impact their instructional decisions and, in turn, influence students' views of and experiences in learning mathematics (Geist, 2015; Latterell & Wilson, 2016). Latterell and Wilson (2016) noted that teachers' beliefs not only shape their instructional decisions but also impact their students' beliefs, potentially leading to math anxiety. They argued that if students do not perceive mathematics as useful or achievable, they may not invest the necessary effort to learn. Geist (2015) affirmed that teachers' confidence in this idea, stating that teachers' confidence in their math skills directly impacts how they prioritize math in the classroom. Arguably, the perspectives of preservice elementary teachers toward mathematics play a crucial role in shaping their teaching methods, ultimately affecting how elementary students approach and learn math.

This study aims to understand the early career experiences of BMTs using three theories, namely PCK (Shulman, 1987), signature pedagogies (Shulman 2005), and PBL (Barrows, 1996; Barrows & Tamblyn, 1980). PCK, based on Shulman's insights, underscores the integration of content and pedagogical knowledge, shaping effective teaching practices. Elements of PCK, including instructional strategies, knowledge of students' understanding, assessment, curriculum, and orientations toward teaching, contribute to skillful mathematics instruction. The sources of PCK development, such as PCK courses, observation apprenticeship, collaboration with colleagues, and teachers' reflective practices, play pivotal roles in shaping effective teaching.

According to Shulman (2005), signature pedagogies encompass surface, deep, and implicit structures, defining the fundamental ways future practitioners are educated within a profession. Gurung et al. (2009) identified specific pedagogical practices in mathematics aligned with signature pedagogy principles such as posing problems of interest, collaborative solutions, conceptual reasoning, and encouraging multiple approaches.

PBL is rooted in social constructivism and situated learning and emphasizes active, collaborative problem-solving for fostering critical thinking. PBL serves as a theoretical foundation for understanding how BMTs acquire knowledge and skills, encouraging collaborative learning through authentic scenarios and self-directed exploration over an extended period. Together, these theoretical perspectives offer a comprehensive framework for exploring and improving the early career experiences of BMTs in mathematics education.

BTs must be well-prepared professionals, skilled in both content and teaching methods (Darling-Hammond, 2000; Sharp et al., 2019). Shulman (1986) emphasized the importance of PCK, along with content knowledge and curriculum knowledge, in shaping teachers' practice. As PSTs undergo a transformative process from students to teachers, it becomes crucial for teacher educators to help them develop confidence and competence in their PCK (Mitton-Kükner & Murray-Orr, 2018). Traditional teaching methods involving repetitive drills and passive instruction have hindered students' access to effective mathematics education (Hattie & Zierer, 2017). Hattie and Zierer (2017) stress the need for PSTs to be exposed to transformative mathematics instruction, which incorporates collaborative learning, engaging discussions on mathematical concepts, enthusiasm for tackling challenging problem-solving tasks, and recognizing the relevance of ideas to real-world situations and problems. Furthermore, Van der Sandt and O'Brien (2017) stressed that prospective teachers should adopt PBL to help reduce math anxiety because this approach has proven to be more effective than direct teaching, which may worsen anxiety levels. The PBL style of teaching is defined by five important elements: unstructured problems, a student-centred approach in which students determine what they need to learn, teachers acting as facilitators in the learning process, authenticity forming the basis in the selection of cross-disciplinary problems, and an emphasis on group work (Barrows, 1996; Hmelo-Silver & Barrows, 2006). My observation of classroom practices revealed limited utilization of PBL among participants. This was evident in the minimal engagement of participants' students in actively solving real-world problems, limited instances of collaborative learning, and a scarcity of inquiry-based activities.

Additionally, Morales et al., (2021) discovered that a teacher education program incorporating hands-on activities and collaborative learning and promoting the teaching of mathematics as a blend of both pedagogy and content learning resulted in prospective teachers being more prepared to teach mathematics. The findings of this study align with the results of prior research. Each participant in the current study had varying experiences based on their background, grade level taught, and support provided within their school building. Kopkowski (2008) and Strauss (2015) found many new teachers report feeling overwhelmed, frustrated, stressed, and discouraged during their first year in the profession. Each of the participants in the current study expressed feeling at least one of these emotions during their first year. Knowing how to support teachers is essential to ensuring their success as they transition into the teaching profession. Participants who reported receiving administrative support expressed feeling happier and more content in their current teaching position. Ingersoll (2012) found one of the most impactful indicators of retention rates is new teachers' perceptions of administrative support and emphasized that often new teachers are provided with generalized rather than individualized support. As a result, many teachers early in their careers often feel unsupported by administrators. Although the BTs of this study described feeling well prepared for the classroom, their knowledge and skills did not always translate to adapting to its realities, given that there were structural constraints beyond their control.

Perceptions of Preparedness: Relationships with Teacher Education Training and Conflicts with School Placement

Overall, participants exhibited varied perceptions of their preparedness for teaching mathematics stemming from their teacher education program. Although many participants gave high ratings, they identified areas that needed improvements. These included the requirement for more exposure to teaching practices, additional instructional time, learning more mathematics content, and increased exposure to the curriculum. Despite these findings, it is important to acknowledge that the mathematics teaching actions align with the context in which BTs operate (Towers & Proulx, 2013).

Ensuring that teachers are placed where they receive training is essential for aligning their skills with the demands of their teaching roles, contributing to the overall success of both educators and students in the educational system. However, some BTs, like Participant 3 (SE) and Participant 7 (TVET), find themselves assigned to school contexts for which they were not originally trained. In contrast, participants 1 (PE), 2 (ECE), 4 (PE), 5 (PE), 6 (PE), 8 (PE), and 9 (ECE) were appropriately matched with schools based on their preservice training. In SVG, the Ministry of Education assigns new teachers based on demand, often overlooking the alignment with their specific training due to limited resources and job opportunities. This misalignment can lead to stress and dissatisfaction among BTs.

The school context is pivotal in shaping the experiences and success of beginning teachers, with a supportive environment contributing to their professional development, job satisfaction, and classroom effectiveness. The study's participants from various schools, including Schools A, B, and C, experienced different levels of support, highlighting the varying organizational measures in place for them. The study participants were distributed across three different schools. Participants 6 (PE), 7 (TVET), and 8 (PE) were placed in School A as BTs. They agreed that leadership support was limited, compounded by irregular check-ins and a lack of formal mentorship programs. Classrooms were open spaces divided by chalkboards or partitions made of thin plywood, creating a noisy environment. There were no structured induction programs for BTs, and from the findings, only one school attempted to pair them with mentors. At School B, BTs had individual classrooms and were paired with experienced teachers. Participants at School B included 1 (PE), 2 (ECE), and 9 (ECE); they noted that deliberate efforts were made to generate a supportive atmosphere. Similarly, School C had individual classes, and

BTs were placed with experienced teachers. Participants in this school, 3 (SE), 4 (PE), and 5 (PE), emphasized the importance of a principal's robust support and direct involvement in assisting BTs with content knowledge and teaching strategies.

Between the initial interview and classroom observations, participants exhibited varying degrees of development. In schools where tangible support was more apparent, participants gained elevated confidence and developed proficient classroom management skills. Self-motivated participants demonstrated a greater application of the teachings received in their mathematics teacher education program. For example, they used more hands-on manipulatives, connected their teaching to real-life situations; incorporated technology, and had students more engaged.

Additionally, participants' anxiety regarding mathematics contributed to shaping their perceived preparedness to teach the subject. Studies indicate that irrespective of the nature or effectiveness of the initial teacher training program, BTs are prone to encountering the most challenging phase of their teaching career when they transition into full-time teaching (Gainsburg, 2012; Moir et al., 2009; Podolsky et al., 2016; Towers, 2013).

Perceptions of Coursework and Participants' Ideas about How to Improve Training

Participants consistently expressed positive perceptions of their mathematics coursework when certain key elements were present. Participants seemed to appreciate opportunities to engage in relevant mathematics content that showcased real-world applications because it reportedly made mathematical concepts more meaningful. Participants underscored the importance of clear and effective instruction in shaping their growth. They particularly appreciated instructors who convey math concepts with care and empathy, especially for trainees facing challenges in both understanding the mathematical content and pedagogy. Participants were positive about the integration of technology, including educational software and online resources, that they experienced during different mathematics coursework. The findings revealed that participants appreciated learning in a supportive learning environment that encouraged open communication and collaboration. Participants reported that the above factors collectively contributed to the development of their confidence and their ability to grasp and apply mathematical concepts.

Despite the length of the 10-week teaching practicum, participants unanimously agreed on a greater need for microteaching activities to be embedded in all coursework. Engaging in microlessons exposes student teachers to authentic teaching sessions, providing a valuable opportunity to refine their teaching skills and enhance self-confidence (Punia et al., 2016). Throughout various phases of microlessons, student teachers practise and acquire diverse skills, leading to modifications in their teaching behaviour (Kumar et al., 2015). Scholars note that this practice positively impacts critical competency development among preservice teachers, including critical thinking, self-efficacy, apprehension, and disposition (Arsal, 2015). Microlessons contribute to the development of professional competence and confidence among student teachers, fostering planning skills, teamwork, and mastery of subject content (Herrera et al., 2017; Ralph, 2014). Additionally, self-training occurs as student teachers observe their peers presenting lessons (Remesh, 2013). Engaging in microlessons also cultivates the ability to provide and receive constructive feedback, leading to increased self-confidence (Banga, 2014). Notably, microlessons play a role in improving time management and classroom management skills, as well as helping student teachers overcome challenges encountered during the teaching process (Kilic, 2010).

The findings reveal that the BT participants of this study encountered various constraints that were beyond their control and for which they were not prepared. Participants identified a lack of resources, extremely large class sizes, and diverse student abilities. Adding to these challenges were few opportunities for technology integration and inevitable classroom management issues. The Ministry of Education and policymakers must comprehend and proactively formulate strategies to overcome these limitations, aiming to better prepare and place BTs to cultivate a positive and effective learning environment for their students in mathematics.

Bridging Gaps: A Global Look at Supporting Novice Teachers for Educational Excellence

Supporting the growth of novice teachers is crucial for fostering student achievement and educational improvement (Cochran-Smith, 2020; Darling-Hammond, 2000; Rivkin et al., 2005). In what follows, I discuss various international approaches to teacher induction, emphasizing the importance of tailored support for BTs to mitigate attrition and enhance professional development.

Several countries have implemented diverse induction programs for BTs. In China, induction initiatives have been in place since 1994, providing support with lesson preparation, implementation, and mentoring at both primary and secondary levels (Kutsyuruba et al., 2019; Lee & Feng, 2007). New Zealand offers state-funded reduced teaching commitments and various initiatives, including reflective writing and targeted professional development (Anthony et al., 2011; Haigh & Anthony, 2012). Singapore manages a centrally controlled induction support system for all BTs, emphasizing the transition from preservice to in-service learning (The National Center on Education and the Economy, 2016).

In Finland, Niemi (2017) described a unique approach where teacher recruitment and training minimize the importance of induction, assuming teachers are well-prepared. However, evidence suggests the need for standardized nationwide induction, leading to the "Osaava Verme" pilot program for fostering peer support and professional development. Scholars note that induction programs can also benefit experienced teachers. For example, in Scotland, Patrick et al. (2010) found that mentorship partnerships between new and experienced teachers enhanced informal collegial interactions and the revitalization of professional culture within schools. In the Caribbean, however, little attempt has been made to offer a formalized induction program to BTs. Baker-Gardner (2016) observed considerable variation in Caribbean teacher education programs, which necessitates, they argue, the implementation of induction to ensure early support for effective teacher performance; however, the OECS territories lack formal written policies for teacher induction, and this study reveals the need for comprehensive guidelines. Baker-Gardner (2016) further reported a request for information regarding induction policies and related documents was submitted to all territories through the Ministries of Education. While various information sources were received, there were no responses from SVG. Additionally, no online information regarding induction practices in this territory was found.

While each country has adopted unique strategies, common themes emerge, emphasizing the importance of tailored support, mentoring, and professional development for BTs. Discrepancies and challenges highlight the need for standardized policies and comprehensive guidelines to ensure the effectiveness of teacher induction programs globally.

Induction Programs, Ongoing Mentoring, and BT Mathematics Teachers

Several scholars in mathematics education investigated induction programs for BTs. For example, Cross et al. (2020) focused on the impact of a mentoring network for preservice mathematics teachers embedded in an educator preparation program and continuing after graduation from a rural university in Texas. They found that, while many educator preparation programs offer mentoring for preservice teachers, few extend this support post-graduation for mathematics teachers. Their research aimed to assess the mentoring network's influence on instructional methods chosen by novice mathematics teachers in their classrooms. Both Ingersoll and Strong (2011) emphasized the need for a mentoring network, especially in the context of learning mathematics as a social and experiential phenomenon. The goal of the program was to facilitate the paradigm shift from student to teacher and enable the selection of research-based instructional methods. Their findings are aligned with those of Lofthouse (2018), who asserted that mentoring in teacher education should result in broad and transferable professional learning for student teachers.

With the advancement of technology, scholars are beginning to explore its impact on the mentoring of new teachers. For example, Guler et al. (2023) explored the use of e-mentoring as a professional development tool for novice mathematics teachers. The study involved 17 mentees, novice middle school mathematics teachers, in a single-group pre-and post-test design. The e-mentoring program, enriched with videos, focused on improving novice teachers' observational skills. The assessment, conducted through a whole class teaching video, measured participants' observational skills in attending, interpreting, and decision-making dimensions. Results revealed a significant enhancement in the novice mathematics teachers' observational skills across all assessed dimensions as a result of the e-mentoring program.

Other scholars have noted the promise of group mentoring. Leonard et al. (2019) advocated for the "Two-Way Mentoring Model" to revolutionize the conventional approach to mentoring beginning teachers. This model introduces two key changes: a shift from individualized mentoring to a team-based approach and a transition in mentor selection criteria towards individuals with expertise in mathematics and experience as mathematics teachers. Drawing on the concept that a team of individuals with diverse skills can offer more substantial support than a single mentor, the model aligns with the research of Katzenbach and Smith (2005). Furthermore, the study emphasizes the critical role of content mentoring in shaping beginning teachers' content knowledge and pedagogical skills, (Richter et al., 2013; Simonsen et al., 2009). Participants in Leonard et al.'s (2019) study affirmed that the focus on mathematics content and a shared passion for mathematics in the mentoring relationship contributed significantly to BTs' professional growth, suggesting the model's potential applicability to similar programs.

Recommendations: Future Work Required

This study aimed to understand the perspectives of Vincentian elementary mathematics BTs and how well they were prepared for a career of teaching as they transitioned from preservice teachers to full-time classroom educators. The research questions framing this study are the following:

1. What are beginning Vincentian elementary teachers' perceptions about their own preparation to teach mathematics?

2. What do beginning Vincentian elementary teachers identify as key factors influencing their early career mathematics regarding their content knowledge?
3. What do beginning Vincentian elementary teachers identify as key factors influencing their early career mathematics regarding pedagogical knowledge?
4. What do beginning Vincentian elementary teachers identify as schooling context constraints that shape how they teach mathematics?
5. What do beginning Vincentian elementary teachers identify as personal constraints that shape how they teach mathematics?

In addressing these research questions, I utilized diverse perspectives to both reinforce and challenge my assumptions during the analysis. The theoretical framework incorporated PBL (Barrows,1996), PCK (Shulman, 1987), and signature pedagogies (Shulman, 2005), aiding in the interpretation of beginning mathematics teachers' (BMTs) beliefs and practices about their preparation for full-time teaching. Through analysis, three distinct groups of BTs emerged: those focused on improving their teaching practices no matter the constraints, those preferring placement in the areas in which they were trained, and those seeking formal mentorship for teaching mathematics content.

Investigation into the classroom practices of nine BTs over six months revealed variations in their PCK, development of personal signature pedagogies, and applications of PBL. Additionally, I observed diverse perceptions regarding their readiness to teach mathematics, with many BTs identifying areas in which the teacher education program needs improvement, such as increased opportunities for teaching practice (i.e., microlessons) and learning mathematics content. I also identified several constraints influencing BTs' approach to teaching elementary mathematics, including schooling constraints like resource limitations and crowded classrooms, as well as personal challenges such as classroom management difficulties. The significance of supportive headteachers in fostering confidence and PCK development was noted, emphasizing the importance of appropriate placement and tangible support for BTs.

Furthermore, self-motivated participants (these include Participants 2, 4, 6, and 9) demonstrated enhanced mathematics teaching practices: incorporating hands-on manipulatives, real-life connections, technology, and student engagement strategies. These participants' success can often be attributed to their genuine passion and enthusiasm for teaching and mathematics. This internal drive compels them to invest additional effort and zeal into their work. However, participants advocated for increased microteaching activities throughout their teacher education program coursework to refine teaching skills and boost self-confidence, despite the 10-week duration of the teaching practicum.

The Importance of Induction Programs

Insights from various scholars highlight the positive influence of induction programs on BTs in elementary mathematics. This information is particularly valuable for understanding the potential impact of induction on BTs in the OECS, especially in SVG. There is a significant demand to enhance research capabilities in teacher education, particularly in the realm of induction. This is crucial for assessing the effectiveness of existing induction programs in other Caribbean Islands, gaining insights into what works and what does not work in our context, and creating a body of literature on induction tailored to the diverse challenges of the OECS region. Areas that merit investigation include

- the effects of mentoring on new teachers,
- the training mentors require to provide adequate support,
- the knowledge and skills principals require for successful induction programs,
- characteristics of effective schools supporting new teacher growth,
- models fostering collaboration between mentors and BTs.

Ministries of Education should evaluate how BTs enter the teaching profession to address the unique needs of mathematics in the Caribbean.

The results of this study underscore the importance of incorporating an internship period with a mandatory induction program for BTs as they enter the teaching profession. Based on my research, the inadequacies identified by participants, and by me during observations of BTs' teaching, were a lack of mathematical content knowledge, a lack of time for microlessons, inappropriate placements of BTs, a lack of a formalized induction program, a lack of policies regarding teacher certification/licensing, and no guidelines for principals as they engage with BTs. Based on these factors, in what follows I make specific recommendations for the effective transition of BTs from students to teachers.

Recommendations for OECS Teacher Education Programs

The participants in this study emphasized prevalent challenges, notably citing inadequate teacher training (i.e., a lack of microteaching opportunities) and a lack of sufficient classroom support upon transitioning into full-time teaching roles. BTs asserted that more practical classroom experiences were needed while they were students in their teacher education program. A first potential solution is for teacher education programs to partner with schools in their district, allowing candidates to gain experiential learning opportunities in classrooms. This does mean a rethinking of teacher education programming in relationship with schools. This arrangement would provide preservice teachers with more hands-on classroom experiences and opportunities for mentoring during their teacher education coursework. Schools would also benefit from the presence of preservice teachers at schools at no extra cost to districts, as schools would have the support of their classroom assistance and students would encounter new and emerging practices in the teaching of mathematics. Having experience in the classroom and a strong mentor during student teaching may be more important than an advanced degree in teaching (Clotfelter et al., 2007). Second, the support of BTs may happen by offering professional development courses through local teacher education programs. Third, teacher education programs could engage in follow-up research studies on their past students and use this data to guide revision and improvement of their programs. This kind of research could also include inquiry into how well new teachers are managing in their first year in the classroom. As Putman and Walsh (2021) found, the quality of teacher preparation reveals the quality of their teacher education program.

Recommendations for OECS Beginning Teachers

To address personal inadequacies, BTs must endeavour to put the theories and pedagogical knowledge gained during their teacher education program into practice. The practical experience they gain by practising what was learned in the classroom may help them to develop their skills. They should also work with a mentor-teacher and allow them to provide guidance. BTs should embrace advice and constructive criticism to enhance their abilities and practise recording themselves while teaching to get valuable feedback for self-improvement and future development. Fostering this mindset is something that can be encouraged while they are students.

Recommendations for the Ministry of Education

BTs recognized the structural constraints that hindered their classroom practices. As previously identified, I noted constraints such as improper placement of BTs, scarce school resources, insufficient professional development opportunities, and a lack of mentoring and induction programs. Based on these findings, recommended actions for the Ministry entail ensuring BTs are placed in the school and grade levels in which they are trained. To address the specific needs of BTs, the following recommendations are proposed:

1. Reducing the number of teaching hours for BTs during their initial period in the profession.
2. Involving BTs in a diverse array of professional development activities that support their understanding of mathematics pedagogy (instruction and assessment): for example, engaging in regular observation of experienced educators and having their teaching regularly supervised.
3. Establishing an induction period, which could span one to three years depending upon BTs' development.
4. Designating mentors to beginner teachers (BTs) for both mathematics content expertise and pedagogical guidance and support.

5. Implementing a mathematics community mentorship initiative within each school, fostering a reciprocal relationship among mentors and mentees.

Research Considerations: Possible Next Steps

In recent years, there has been significant advancement in research on elementary mathematics (Letwinsky & Berry, 2021; Manizade et al., 2023; Penfold, 2023). I suggest that future research should focus on examining the support elementary educators receive in mathematics instruction, with attention to BTs in the Caribbean. This inquiry should aim to determine if substantial changes are needed in preservice programs and/or in the support provided to employed educators. This recommendation aims to enhance support for elementary educators who face challenges delivering high-level instruction in mathematics, especially those in which elementary educators may feel less confident.

The need for effective, well-designed, and successfully implemented beginning teacher induction is critical for schools today. Feiman-Nemser (2012) advocates for an enhanced approach to new teacher induction, emphasizing a transformative view that embeds new teachers' development within a supportive professional teaching community and school culture. This model promotes teaching as an interdependent practice rather than an independent one. For the OECS islands, it is essential and highly recommended to establish a well-defined induction program and a clear timeline for its implementation. As outlined by the Massachusetts Department of Elementary and Secondary Education (2020), a teacher induction program is designed to offer systematic support for BTs and usually includes the following components:

- New Teacher Orientation: An initial orientation program that introduces new teachers to essential information about the district and school.
- Mentoring Relationships: Pairing new teachers with experienced mentors who facilitate close guidance and learning opportunities. Release time is essential for mentoring activities like observation, co-teaching, and lesson planning.

- Support Teams: These teams connect new teachers with networks of veteran educators beyond their mentors, offering additional assistance and guidance.
- Workshops and Training for Beginning Teachers: Specialized professional development workshops to equip new teachers with relevant knowledge and skills for their first year in the classroom.
- Workshops and Training for Mentors: Before mentoring assignments, mentors must undergo training in effective mentoring techniques. Mentors should also hold regular meetings to facilitate the sharing of successful strategies and troubleshooting.
- Evaluation: Formal evaluations conducted by supervisors, who consult with a BT's mentor, to provide new teachers with insights about their strengths and areas for improvement. Standards and processes for evaluation serve as a framework for collaborative work between mentors and new teachers throughout the school year.

I propose that the Ministry of Education implement an orientation program for new teachers within their first two weeks of employment. BTs should be paired with trained mentors, and a support team, including the mentor and an evaluating administrator, should be established. This mentoring should last no less than one year. Release time should be provided for regular classroom observations and mentoring activities.

Furthermore, future research could explore student achievement when taught by BTs and administrators' perceptions of BTs' preparedness to teach elementary mathematics. Additionally, a cross-case analysis of mathematics teacher education programs across the OECS could investigate consistencies, inconsistencies, perceived preparedness levels, and their impact on student achievement.

Reiteration of Significance of Study

Recognizing the critical role of well-prepared and supported teachers in enhancing student learning, the study addresses the need for significant changes in teacher preparation and support systems. The study underscores the pivotal role of high-quality PSTE programs in the Eastern

Caribbean to help candidates – particularly BTs – teach deeply, personalize learning, solve real-life problems, and create fair, inclusive learning communities, preparing BTs for effective and equitable mathematics education. Emphasizing the direct impact of PSTE program quality on teachers' practices and commitment, the research highlights the necessity of continuous development to enhance overall educational outcomes. Focusing on Vincentian BMTs, the research aims to contribute insights that will assist teacher-educators in the rigorous preparation of PSTs, tailored to the unique challenges of Vincentian schools and ultimately improving the quality of education in the region.

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Appendix A

Developing Number Concepts and Operations at the Primary Level

REVISED NOVEMBER 2015

COURSE CODE: JBTE/MAT 101

COURSE TITLE: Developing Number Concepts and Operations at the Primary Level

CREDITS: 3

DURATION: 45 Hours

PREREQUISITES: None

OVERVIEW

The main purpose of this course is to present participants with practical strategies for helping students in the primary grades to develop number sense as well as a conceptual understanding of the four operations. It is however recognised that teachers who have a sound understanding of the concepts that they are required to teach approach their task with confidence. In harmony with this, the course will be delivered in such a way as to help the teachers to themselves develop an understanding of the concepts.

OBJECTIVES

1. To raise participants' awareness of some contemporary issues relating to teaching and learning mathematics at the primary level.

2. To expose participants to instructional approaches appropriate to students in the primary grades.

3. To expose participants to strategies which promote understanding of mathematical ideas.

CONTENT

1. Contemporary Issues in Mathematics Education
2. Early Number & Number Sense in the Primary Grades
3. Fraction Concepts in the Primary Grades
4. Decimal Concepts in the Primary Grades
5. Proportional Reasoning

DETAILED OUTLINE

Unit 1: Contemporary Issues in Mathematics Education

There are many factors that influence the teaching and learning if mathematics at all levels. These include the nature of the subject itself, various theories of learning mathematics, resources available and the characteristics of the learners. This unit raises the students' awareness of such issues. It should also help them to link general learning theories that they would have explored in educational foundation courses to the teaching and learning of mathematics.

- The nature of mathematics
- Theoretical foundations for contemporary mathematics education

- The influence of Piaget, Bruner, Dienes, Skemp
- Constructivism in mathematics classrooms
- Levels of representation of knowledge (concrete, pictorial, symbolic)

- Language and mathematics
- The effective use of instructional resources (e.g. manipulatives, textbooks, technology)
- Dealing with diversity in the mathematics classroom
- Effective use of assessment in primary mathematics classrooms

Unit 2: Number & Number Sense in the Primary Grades

- Developing early number concepts
- Developing place value and numeration concepts
- Developing concepts and operations of addition and subtraction of whole numbers
- Developing concepts and operations of multiplication and division of whole numbers

- Using technology to develop early number concepts and number sense

Unit 3: Fraction Concepts in the Primary Grades

- Developing the concept of a fraction

  - Part of a whole; part of a set

  - Notation for fractions

  - Equivalence of fractions

  - Mixed numbers and improper fractions

- Developing concepts and operations of addition and subtraction of fractions

- Developing concepts and operations of multiplication and division of fractions

- Using technology to develop concepts of fractions

Unit 4: Decimal and Percent Concepts in the Primary Grades

- Developing understanding of the link between decimals and fractions
- Developing concepts of place value and decimals
- Computations with decimals
- Developing concepts of percents

Unit 5: Proportional Reasoning

- Developing understanding of ratio and proportion
- Developing proportional reasoning: Useful activities
- Using technology to develop concepts proportional reasoning

METHODOLOGY

Lecture / Discussion

Demonstration / Simulation

Presentations

Peer Teaching

ASSESSMENT

Coursework ONLY 100% of course grade

Coursework will include:

1. Creation of a teaching aid 30% of grade

2. Two class tests 30% of grade

3. An investigation or problem solving activity 25% of grade

4. Discretionary activities (Instructor devised) 15% of grade

Details of the course work activities are given below.

COURSE TEXTS

Van de Walle, J. A. (2007). *Elementary and middle school mathematics: Teaching developmentally*, 6th ed. Boston, MA: Pearson.

Reys, R. E., Lindquist, M., Lambdin, D. V., & Smith, N. L. (2014). *Helping children learn mathematics*, 11th ed. Hoboken, NJ: Wiley.

Cathcart, G. S., Pothier, Y. M., Vance, J. H., & Bezuk, N. S. (2010). *Learning mathematics in elementary and middle schools: A learner-centered approach*, 5th ed. Upper Saddle River, NJ: Pearson.

OTHER USEFUL RESOURCES

Schwartz, J. E. (2008). *Elementary mathematics pedagogical content knowledge: Powerful ideas for teachers*. Boston, MA: Pearson/ Allyn & Bacon.

Pratt, N. (2006). *Interactive maths teaching in the primary school*. London, UK: Paul Chapman.

Haylock, D. (2006). *Mathematics explained for primary teachers*, 3rd ed. London, UK:SAGE.

Burris, A. C. (2005). *Understanding the math you teach: Content and methods for prekindergarten through grade 4*. Upper Saddle River, NJ: Pearson.

Tucker, B. F., Singleton, A. H. & Weaver, T. L. (2006). *Teaching mathematics to all children: Designing and adapting instruction to meet the needs of diverse learners*, 2nd ed. Upper Saddle River, NJ: Pearson.

Note: Students are encouraged to locate and make use of other useful resources (e.g. videos, websites) that can support their learning and development during this course.

DETAILS OF ASSESSMENT ACTIVITIES

Assignment 1 (30% of course grade)

a) Create teaching aids (manipulative materials) to be used in the teaching of any of the concepts in this course.

b) Develop a handbook to accompany the created teaching aids.

Assignment 2 (15% of course grade)

Discretionary assessment – Primarily to address the **CONTENT** needs of the students

This may be in the form of, for example, worksheets, journals, quizzes, and participation.

The actual students' work done need not be submitted for moderation. However, there should be a **brief** report for moderation purposes, indicating how the discretionary mark was distributed and the rationale for the distribution.

Assignment 3 (30% of course grade)

a) Two tests (content & methods) (15% each)

Assignment 4 (25% of course grade)

Investigation /Problem Solving

Choose an investigation /problem solving

Carry out the investigation (individually)

Choose a student (age group)

- Report on student behaviour (factual account of what happened)

- Interpretation of what happened

- Strength and weakness of students in relation to the emerging math

- Identify the mathematical concepts/issues that emerged

[Analysis of student's work/approach/responses]

- Possible follow up action?

- Brief Reflection [What you learn from the process? What you might do differently next time? What went well/did not go well?]

Possible variations in administering this assignment

Report on the investigation (individually)

Choose a student (age appropriate). This may be done in pairs and report on what transpired individually or as a group, IF done as a group, there should be a component of **personal reflection** that should be completed individually by each member of the group.

REVISED NOVEMBER 2015

COURSE CODE: JBTE/MAT 102:

COURSE TITLE: Promoting Understanding of Key Concepts in Primary Mathematics

CREDITS: 3

DURATION: 45 Hours

PREREQUISITES: None

OVERVIEW

The main purpose of this course is to present participants with practical strategies for helping students in the primary grades to develop a sound understanding of concepts that they must learn at this level. It is however recognised that teachers who have a sound understanding of the concepts that they are required to teach approach their task with confidence. In harmony with this, the course will be delivered in such a way as to help the participants to themselves develop an understanding of the concepts.

Assessing children's mathematical knowledge and understanding is vital to their development of mathematics concepts. Teachers need to know when students are not "getting it" or when they are developing misconceptions so that corrective action can be taken. Thus, through the course, course participants will be exposed to a variety of approaches to assessing their students. These will include interviewing, observing, writing and of course, testing.

OBJECTIVES

1. To expose participants to instructional approaches appropriate to students in the primary grades.

2. To expose participants to strategies which promote understanding of mathematical ideas related to strand taught at the primary level.

CONTENT

1. Planning for instruction in primary mathematics

2. Promoting understanding through problem solving

3. Developing Algebraic Thinking

4. Concepts and Skills of Measurement

5. Geometry Concepts and Geometric Thinking

6. Concepts of Data Management and Analysis

DETAILED OUTLINE

Unit 1: Planning for Instruction in Primary Mathematics

- Developing unit and lesson plans for topics in primary mathematics

- Planning for student–sensitive instruction at the primary level

- Using Inductive and deductive teaching approaches

- Using discovery learning

- Using co-operative learning strategies in the primary school

- Linking mathematics to other areas in the curriculum
- Using games in mathematics instruction at the primary level
- Using assessment results for planning purposes

Unit 2: Promoting Understanding through Problem Solving

- Understanding problem solving as a means of instruction
- Teaching mathematics through problem solving
- Designing and selecting problem solving tasks
- Teaching about problem solving: Process and strategies
- Assessment and problem solving

Unit 3: Developing Algebraic Thinking

- Exploring pattern and relationships in mathematics
- Exploring variables: encounters with the unknown
- All things being equal: Exploring concepts of equations
- Go with the flow: sequencing events
- Assessing children’s algebraic thinking

Unit 4: Concepts and Skills of Measurement

- The meaning and process of measuring

- Developing measurement concepts and skills (including concepts of standard units)
- Measuring length and area (including developing formulae)
- Measuring volume and capacity
- Measuring weight and mass
- Measuring time
- Developing formulae for area and volume

Unit 5: Geometry Concepts and Geometric Thinking

- The development of geometric thinking
- Learning and teaching about shapes and properties
- Learning and teaching about transformations
- Learning and teaching about location
- Assessing student's geometric thinking

Unit 6: Concepts of Data Management and Analysis

- Questions and answers: finding evidence
- Classification and data analysis
- Learning and teaching about graphical representations
- Learning and teaching about descriptive statistics
- Using technology for data management and analysis

METHODOLOGY

Lecture / Discussion

Demonstration / Simulation

Presentations

Peer Teaching

ASSESSMENT

Coursework ONLY 100% of course grade

Assessment for this course will be by course work ONLY. Assessment structure is as follows:

- **A Project** designed to help students to reflect on mathematics content and on pedagogy [20%]
- **Instructional Design**: Create a Unit of Work (unit plan) with associated lesson plans [40%]
- **A Class test** (Content and/or pedagogy) [30%]
- **Discretionary Assessment** (Lecturer selected assessment exercises; e.g. short quizzes) [10%]

Details for the assignments will be sent in a separate document.

COURSE TEXTS

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2012). *Elementary and middle school mathematics: Teaching developmentally*, 8th ed. Boston, MA: Pearson.

Haylock, D. & Manning, R. (2014). *Mathematics explained for primary teachers*, 5th ed. London, UK: SAGE.

Burris, A. C. (2005). Understanding the math you teach: Content and methods for prekindergarten through grade 4. Upper Saddle River, NJ: Pearson.

Tucker, B. F., Singleton, A. H. & Weaver, T. L. (2006). Teaching mathematics to all children: Designing and adapting instruction to meet the needs of diverse learners, 2nd ed. Upper Saddle River, NJ: Pearson.

COURSE CODE: JBTE/MAT 102:

COURSE TITLE: Promoting Understanding of Key Concepts in Primary Mathematics

NOTES TO LECTURERS

The following are notes to provide further guidance for those charged with delivering this course to student-teachers.

1. Issues of planning and problem solving (Units 1 and 2) can be introduced at the start of the course, but can also be interwoven with the other units where appropriate as a means of consolidation. This is to help the student-teachers to make practical application of the concepts involved. For example, though a general introduction to problem-solving and how to teach problem-solving can be taught in the mathematics classroom, throughout the course, the lecturer can provide opportunities for the students to see how it can be done and to practice problem solving themselves.

2. The ADE programme contains a non-credit course in which student-teachers are trained to use whatever technology is available to them in the schools in their country. Lecturers in this course should take the opportunity to demonstrate to the student-teachers how this technology can be used to help

learners of mathematics to engage with mathematics concepts. For example, rather than just use the technology to make presentations, the students should be exposed to mathematics-specific software and websites and should explore how to use more generic software (e.g. EXCEL) in mathematics instruction. This should help to build the confidence of the student-teachers to put the technology in the hands of their students to enhance their learning.

3. There are no examinations for this course, but lecturers are encouraged to assess their students regularly. The assessment structure assigns a proportion of the course grade for discretionary activities by the lecturer. These activities can take whatever form the lecturer deems necessary to ensure that the student-teachers engage with and benefit from the course content. It can include short in-class activities (individual or group) that are graded

4. A portion of the course grade (10%) has been allotted to discretionary Assessment. This provides the lecturer with leeway to assess their students in areas deemed necessary for their development. For example, the lecturer may decide to give short quizzes on content; or may ask the student to produce a paragraph on some issue covered in the class; or for solving a non-routine problem.

5. To be deemed to have passed the course, student-teachers taking the course MUST obtain a minimum passing grade (50%) for each of the four assessment components. If an assessment component comprises more than one exercise, then the students will be deemed to have passed the component if the combined grades for all of the exercises reach the criterion of a minimum passing grade (50%).

Appendix B

LETTER REQUESTING PERMISSION TO CONDUCT RESEARCH

31st October 2022

Mrs. Kay Martin-

Jack
Chief Education Officer
Ministry of Education
Kingstown

Dear Mrs. Martin-Jack

I am presently pursuing a Doctor of Education in Educational Studies, at St. Francis Xavier University, Canada. As part of the requirements for the degree, it is necessary to complete a dissertation. The purpose of this study is to explore elementary Beginning Mathematics Teachers' (BMTs') perceptions of an OECS teacher education program on their mathematicspedagogy and teaching practices as they relate to preparedness to teach in the reality of SVG.My research is entitled: Beginning Mathematics Teachers' Perceptions of Preparedness: An OECS Teacher Education Program.

I am therefore seeking permission to conduct the data collection process at three primary schools. I am hoping to conduct this research in three primary schools, one in the East St. George constituency, West St. George, and West Kingstown constituencies of St. Vincent and the Grenadines. The schools will be referred to as School A, School B., and School C. They include the Brighton Methodist, Lowmans Hill Anglican, Belair Government school. This process will involve gathering data from teachers. Data will consist of interviews (bothpre-and post-interviews), in-school observations (between November 2022 and February 2023), and teacher-generated artifacts in the form of lesson plans, and BMTs' reflections of their taught lessons.

Please note that any information gathered from the investigation will only be utilized for the intended purpose and measures will be taken to ensure that anonymity and confidentiality aremaintained. In addition, I would be willing to discuss any important issue arising out of the research with the relevant officials at the Ministry.

I can be contacted at x2018vmr@stfx.ca or at if there is a need for furtherclarification.

Thank you for your kind co-operation and I am looking forward to a speedy and favourableresponse.

Yours sincerely

....

Samantha Porter (Ms.)

Senior Mathematics

Educator

Appendix C

INFORMED CONSENT FORM for RESEARCH

Researcher's Name: Samantha Porter

Principal Investigator: Samantha Porter

Academic Adviser: Dr. Jennifer Mitton

What are some general things you should know about research studies?

You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Research studies also may pose risks to those that participate. In this consent form, you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form, it is your right to ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researcher named above.

What is the purpose of the study?

The purpose of this study is to explore elementary Beginning Mathematics Teachers' (BMTs') perceptions of an OECS teacher education program on their mathematics pedagogy and teaching practices as they relate to preparedness to teach in the reality of St. Vincent and the Grenadines.

What will happen if you take part in the study?

If you agree to participate in this study you will be asked to participate in interviews (both pre- and post-interviews), in-school observations (between November 2022 and February 2023),and teacher-generated artifacts in the form of lesson plans and reflections of your taught lessons, To protect your identity you will be assigned a random number and all work will be kept according to that number. It may be necessary, however, to connect your work with your personal experiences. In this case, a pseudonym will be used in all research analysis and reporting. Your image on the video may be used in research analysis, but your name will not appear in any reporting.

No additional commitments of time or work are required beyond your usual time and work required for your participation in this study.

You are free to withdraw from participation in this study and free to continue to take in this research, without penalty. If you choose to withdraw from the research at any time, we will remove all your work from our research data. We will not use their image or the words they said. From that time on, you will be placed with your back to the data collection or where you are not taped at all. If we use groups in the taping, your group will not be used.

Risks

There are no foreseen risks to this research, although as stated, the researchers of this studywill also be the observer of the lessons of this study.

Benefits

The direct benefits will be as you engage in the reflection of your lessons, you may learn mathematics at a deeper level for teaching it in the future. Additionally, the research will directly benefit the body of knowledge in mathematics education since the finding of this research can result in substantial, large-scale changes in how teachers are prepared and supported to teach which will in turn cause improvements in students' learning. This researchwill provide the necessary stakeholders with information about the currency of the Joint Board of Teacher Education Primary program that is being offered in the Organization of the Eastern Caribbean States (OECS).

Confidentiality

The information in the study records will be kept strictly confidential. Video recordings and work products from this research will be stored on a secure external hard drive protected by a password that is only accessible by the researcher and will be stored in a locked drawer in the researcher's office at St. Vincent Community College. With your consent (signature below), particular clips from the video recordings may be shared with people beyond our project team. You will not be identified by name in such presentations or materials, or in any written or oral reports of the research. The video and audio tapes will be destroyed two years after the completion of the project.

Compensation

None

What if you have questions about this study?

If you have questions at any time about the study or the procedures, you may contact the researcher, Samantha Porter,

Email x2018vmr@stfx.ca.

What if you have questions about your rights as a research participant?

If you feel you have not been treated according to the descriptions in this form or your rights as a participant in research have been violated during this project, you may contact JacquelineBeaton, Research Administrative Coordinator, Research Ethics Board, St. Francis Xavier University, PO Box 5000, Antigonish, Nova Scotia, Canada, B2G 2W5. Phone 902- 867- 2393. Email: reb@stfx.ca.

Content to Participate

I have read and understand the above information. I have received a copy of this form. I agreeto participate in this study with the understanding that I may withdraw at any time by tellingthe researcher. I understand that the researchers may use pieces of the videotapes for research purposes, or possibly during presentations at conferences. They may use my work as well. My name will not be used.

______________________________	______________________________
Participant Signature	Participant Name (please print)
______________________________	______________________________
Interviewer Signature	Interviewer Name (please print)

____

Date

Appendix D

FIRST
INTERVIEW

Perception of the mathematics education program

1. Tell me a little about yourself (for example, how long you have been teaching)

2. Describe your current role at this school.

3. Why did you decide to become a teacher?

4. As you reflect on your courses and experiences in the mathematics education program, what specific classes would you point to that really helped prepare you forthe classroom?

5. Again, reflecting on your courses and experiences in the mathematics educationprogram, what specific projects, theories, or experiences do you frequently incorporate into your classroom?

6. Do you feel your teaching experience has influenced how you understand and incorporate aspects of the mathematics program in your class? If so, could you givean example?

7. On a scale from 1 to 10, with 10 being defined as exceptional, how well did the mathematics education program prepare you for the mathematics classroom? Can youthink of ways you could have been better prepared? Please explain your answer.

8. What has been the most positive aspect of teaching mathematics that you havediscovered?

9. What has been the most surprising aspect of teaching Mathematics that you havediscovered?

10. What are a few obstacles or dilemmas you‘ve faced as a beginning Mathematicsteacher?

11. What could the Mathematics Education program have done to help you better handlethese obstacles or deal with these dilemmas? What suggestions would you offer?

12. If you could change anything about or add anything to the mathematics educationprogram, what would you change or add? Why?

13. In what ways does the college provide support for new teachers as they

transition intothe classroom? Do they stay in touch with you, or do you stay in touch with your lecturers?

Mathematics Concepts, Practices, and Curriculum

1. What Mathematics content areas have you been teaching? How comfortable have youbeen with the content?

2. Was there a particular curriculum area in which you felt well prepared? Tell mehow you are using this knowledge in the classroom.

3. Was there a curriculum area for which you felt least prepared? How has this impactedyour experience in the classroom?
4. If underprepared, how have you acquired the new knowledge to teach the unfamiliarcurriculum?

5. Describe the support that you received so far in teaching the content. Was it adequate?What else would you need or want?
6. Can you tell me about some of the unexpected things that happened since you havebeen teaching mathematics?

Pedagogical Knowledge and Practices for Teaching Mathematics

1. Explain your method for writing (designing?) and maintaining lesson plans. What resources have you used in planning your lessons? (textbook, team members, readingspecialist, media specialist, Internet).

2. Can you give me some examples of how you differentiate to meet the needs of allstudents?
3. What are you most confident about in your teaching practice?
4. Tell me about some of the challenges you faced in using varying strategies in theteaching of mathematics? How did you address them?

5. Talk about how you demonstrate caring and commitment to your students. Talk abouta student who may be a particular challenge behaviorally or academically

6. What are some of the methods you use to assess students? What informed yourchoice?

7. What are some of the things you learned since you have been teaching? How did youlearn them? What is your reflection process like after a lesson, or at the end of the day?
8. Do you have peers that you process with? Do you do it alone in the car on the wayhome?
9. What kinds of things do you think about that are related to the school day?
10. Describe how you incorporate technology in your planning, instruction, and recordkeeping. Discuss your preparation to use school-related technology. Were the methods acquired through your teacher preparation program, here at school, or on your own?

11. Describe the diversity in your classroom – by diversity I mean matters of race, gender,individual differences, or ethnic and cultural diversity. Discuss an occasion when you felt unsure of how to handle a situation. How did you overcome this?

12. What are any unique challenges that you have faced this year that we have notdiscussed?
13. Probes: professional challenges, challenges with team members, challenges with admin., challenges with parents and students, classroom management / organizationalchallenges

14. How do you accommodate multiple points of view or experiences in your classroom?
15. Describe the level and type of collaboration that you are involved in at school as wellas at the team level.

16. Have you had opportunities to team teach or observe other teachers modelling anactivity?
17. Describe any mentoring that you have received? Was it effective? Describe your interactions with your mentor(s). Is there a teacher who has not been assigned as amentor to you but has taken that role

18. Have you sought out other teachers or specialists at the school

SECOND INTERVIEW

Reflection
questions

Second-Interview Reflective Questions

1. What are some things that you learned from your mathematics education program that you find yourself using most in your teaching practice?

2. What things did you learn from your mathematics education program that you wish you could use more in your teaching but find yourself unable? What prevents you?

3. What things did you learn from your mathematics education program that you find inappropriate or unhelpful in your current teaching situation? Why?

4. What is or was the most difficult part of your role as a teacher as your lesson was being observed?
5. If you could change one thing about your personal teaching experience, what would it be?
6. As you reflect on this observation cycle, what ideas or insights are you discovering about your teaching?
7. What do you feel worked well in your teaching practice and what would you refine if you were to redo this observational cycle again to the same class?
8. How did you feel being observed again by a teacher educator? And why?

Appendix E

<table>
<tr><th colspan="2">Standards-Based Lesson Plan</th></tr>
<tr><td>Teacher:</td><td>Date:</td></tr>
<tr><td>Grade Level:</td><td>Class Name:</td></tr>
<tr><td>Subject:</td><td>Unit Title:</td></tr>
<tr><td>Lesson Title:</td><td>Duration:</td></tr>
<tr><td>Standards Addressed</td><td></td></tr>
<tr><td>Learning Outcomes</td><td></td></tr>
<tr><td>Lesson Objectives</td><td></td></tr>
<tr><td>Focus/Essential Question(s)</td><td></td></tr>
<tr><td>Content</td><td></td></tr>
<tr><td>Vocabulary</td><td></td></tr>
<tr><td>Previous Knowledge</td><td></td></tr>
<tr><td>Materials/Resources/Technology</td><td></td></tr>
<tr><td>Differentiated Instruction
(Planned Supports)</td><td>Whole class:

Small groups:

Individual students:</td></tr>
<tr><td>Assessment Strategies:
Formative/Summative
(formal and informal assessment)
Include HOT questions</td><td></td></tr>
</table>

Starter/Bell ringer	
Introduction	
Procedure	Instructional activities: Guided practice: Independent practice:
Closure	
Enrichment	

Appendix F

Teacher perceptions of their preparedness themes

Transfer learning	Confidence	Obstacles	Changes
Projects *Unit 4 in the course ECMT101, using Literature to Explore Mathematics was most helpful. The participant said "I remember vividly when we did, it was Literature in Mathematics where we did it. We did an assignment where we had to make big books and so on. And that is something that I carried with me in the classroom. So even when we're doing Math. I would do stories. I would write little, short stories and the children really enjoyed that. So, I would say it would have to be that aspect of Literature and Math (Pre-interview2, November 16th, 2023)* *I remember in teachers' college when we did a project with 3D shapes. We had to use the shape and come up with a real-life project and create an entire village where we built roads, I really enjoyed it, I'm not sure if it will be suitable for grade 1, but I always wanted to try to it out with my students (Pre-interview 8, January 9th, 2023).* *I can recall that in our math course at teachers' college, we were supposed to create a dog home as a group project using specific measurements and 3D shapes. So, I had my students build a doghouse while we looked at different 3D shapes. So, they were able to build the doghouse while learning about the concept (Pre-interview 6, December 23rd, 2022)* *When I was at Teachers' College, I had to do a project for my final assessment in Math, in the course (MAT 101). That's where we had to create a visual aid for any concept, and I built what I remember to be an addition machine that was something that I enjoyed building. I had it after*	***Using math manipulative, Making mathematics connection and Engaging students*** *When I'm doing hands-on stuff, you know, using concrete objects. Like last week I was doing measurements, mass and you know, students were really excited to be using the scales and all of those things and I believe they grasp the concept more when they are using hands-on manipulatives. … I am able to make math more relevant to the real world. So, I feel confident connecting math to real life for them. And I think that they get more interested in learning. I Don't think I have any child in my class who doesn't like math (Pre-interview 3, November 21st, 2023),* *I was teaching skip counting and the student had difficulty understanding the concept. So, I had to create a game on the floor similar to hopscotch, so they had to skip numbers in the hopscotch game. Once the students played the game, they had fun became more engaging, and started to understand the concept I was teaching (Pre-interview 6, December 23rd, 2022).* ***Not fearful*** *Well, I discovered that I was not as fearful as I thought I was of the subject. Honestly, …I find that my most positive aspect of teaching is that I could get my job done and I don't have to be using the chalk and talk. I could get it done using technology, I could get it done using manipulatives and the children understand (Pre-interview 4, November 26th, 2022).* *I can actually do the math and teach it (Pre-interview 1, November 16th, 2023).* .	***Lack of tools and resources*** *My number one obstacle is resources, so at teachers' college, I know we were encouraged to use what we have and take it into the classroom and so on. But sometimes we just don't have the tools or resources and I would tell children to bring. Then I am really looking forward to starting to teach a concept or a topic. And then the children don't bring these resources, it is a big problem (Pre-interview 1, November 16th, 2023).* *My main obstacle. Well, as I would have to say um, we have to go back to lack of resources. Right. Because sometimes, you know, yes, we do have some, but of course, there are others that would make the lessons better or more engaging. I do use what we have, but I think if I had some other resources, my lessons would be much better (Pre-Interview 2, November 17th, 2022).* ***Limited knowledge of teaching math content*** *I had a lack of math content knowledge. I mean, I wasn't exposed to the mathematics contents at teachers' college. This was one of the challenges I had, and I did not like Math. So, I think that was a barrier in the beginning. but now it's much better. Because I have a friend who is a mathematics teacher, she used to encourage me and I did lots of research (Pre-Interview3, November 21st, 2022).* ***Classroom management*** *Yes, I did encounter obstacles, mostly with classroom management and behavioral problems. I had some issues because the classroom, the environment of the school, is so noisy so it is difficult to keep the students' attention as noise*	***More micro-teaching activities*** *I will recommend more micro-teaching activities meaning for students to get the opportunity to actually teach the math subject in front of the lecturer you know, and getting much feedback and you know, we have to wait until we do go to practicum. So, I think there should be more micro-teaching sessions within the program(Pre-interview 9, April 24th, 2023).* *I would add the micro-teaching a little bit more … We won't shy away from practical experience and think that we are not capable. Giving teachers and students the opportunity to do micro-teaching activities at different levels so that they can have an idea before they go into the classroom (Pre-Interview 4, November 26th, 2023).* ***Adding a math content course or offer subject seminars for all students*** *Yeah, well, the only thing I was thinking of is adding the math content courses. So like novice teachers, if they are not familiar with the content they can at least have and get an idea of what they are supposed to teach. So, if it is not an entire course, we can offer Seminars with different aspects of the Math content (Pre-interview 5, November 29th, 2023).* *We are all quite aware that sometimes teachers, teachers may end up in the primary school to teach and did not complete the primary program. So, I'm thinking if we, let's say for example, could have offered a math seminar or content course for students. An open class and maybe past students could also take it. So, like, you know, students who didn't do the primary program, if you want to learn more math strategies or a particular*

teachers' college and I kept it at home all that time because I felt so proud of myself for doing this. Never did I know you could do things like that. And then when I was placed in kindergarten, that machine became a part of me where I was able to use it to show the children how to actually add 1-digit numbers and I think it was something that I brought from Teachers' College that I was able to implement into my classroom (Pre-interview 4, November 26th, 2022). ***Theories*** *I frequently do adapt the behaviorist theory as it pertains to using reinforcement, incentives, and so on to motivate my children or to get them to desist from certain behavior (Pre-interview2, November 16th, 2023).* *Bruner's theory stood out to me: using the Concrete, Pictorial, and Abstract approach to teaching math. Using manipulatives, like based ten blocks, fraction circles, number lines, and so forth, I have implemented this theory when I'm doing my math sessions (Interview 9, April 24th, 2023).* ***Experience*** *Being in a mathematics class and using manipulatives was a novelty that I now use to engage students and help with understand concepts (Interview 9, April 24th, 2023).* *I learned to make manipulatives and I am now using that knowledge in the classroom (Pre-interview 4, November 26th, 2022).* *Mostly the Practical teaching prepared me more for the classroom and becoming a quality teacher. We were exposed to lesson planning. Um, professionalism, time management. Time management was a big problem for me because before I went to teachers' college, I had a problem with time management. Not having enough time during my activities. For example, I would*	***Planning lessons*** *I am confident in planning my lessons, I always like lesson planning. I believe you should always plan before you go into the classroom. Yes, because if you don't plan, and you go in front of the classroom, you don't know what to do (Pre-interview 8, January 9th, 2023).* ***Feeling supported*** *Over the years I have seen myself grow because when I just entered the classroom, especially when teaching mathematics, I had no clue, you know, what I was getting into, especially when I finished, teachers' college, and I was told that I was placed at a primary school. It was strange although I had the experience before, but as time goes by, you know, with guidance from my principal and others, I was able to, you know, teach the concepts in a more structured way (Pre-interview 3, November 21st, 2023).* *So, when I was unsure about how to go about teaching a topic or whatever, I would go to the Math coordinator in the school and another experienced teacher and they would give me ideas and so on, yeah, and develop my confidence (Pre-interview 1, November 16th, 2023).*	*would distract them…classrooms are just separated by a piece of board, so all the students are close by (Pre-interview 6, December 23rd, 2022).* *One obstacle was classroom control. That was one of my biggest challenges because going into the classroom as a new teacher and to children had never seen me before. They figured out, OK, I could do what I wanted, so classroom control was my number one (Pre-interview 5, November 25th, 2022).* ***Limited knowledge of the curriculum*** *My obstacle is with the curriculum. I am having difficulty understanding the curriculum and getting the right content and age-appropriateness. The curriculum has a path to do with a bit of my challenges at the moment as well (Participant 9, April 24th, 2023).*	*content it can probably be offered to them so they could take the course and learn the content and feel more confident (Pre-Interview 3, November 21st, 2022).*

spend too much time on an activity and too little time on another activity, and sometimes the class would go longer than I planned; it was very helpful for me (Pre-interview 3, November 21st, 2023). *During my teaching practicum, I taught the topic 2D shapes and I remembered, I did a chart and I cut the shapes out and I put them on it. I had an assessor; he came to listen to my lesson, and he told me my chart was incorrect and I should take it down. He explained to me that what I have on the chart are 3D shapes because 2D shapes…if I take the shapes off the chart, I will see that there are faces and so on the other side. So, he was saying those are 3D… so now I always tell my students we can't cut out 2D shapes but they have to draw it (Pre-interview 1, November 16th, 2023).* *One of the things that stood out to me was that I had a math lecturer and that was really, really calm. The lecturer who I thought was very caring and very concerned about how we get things done. And what helped me most was always the fact that we had to do something hands-on. I think that is what really pulled me into it (Pre-interview 4, November 26th, 2022).*			