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Teacher Efficacy in Bermuda Middle School Geometry Classrooms

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This is to certify that the doctoral study by

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Abstract

Geometry is a complex subject to teach and learn at all levels in education. Poor performance in geometry in Bermuda has raised concerns about whether teachers are fully prepared to deliver content effectively. The purpose of this research was to examine teachers' efficacy in the geometry classroom using a basic qualitative study design. The study is grounded in Bandura's social cognitive theory and involved middle school mathematics teachers' self-efficacy in terms of teaching geometry. A purposeful sample of five middle school mathematics teachers volunteered and participated in semi-structured zoom interviews. Data were analyzed using a basic qualitative methodology approach led to the following themed categories: pedagogical strength, content knowledge, concerns, and professional development (PD). Results indicated that mathematics teachers need support in terms of PD in geometry. Based on the findings, a 3-day PD session via Zoom was developed to address teaching middle school geometry. This may contribute to positive social change by providing middle school mathematics teachers with learner-centered strategies through collaborative and flexible blended learning PD aimed at addressing teachers' self-efficacy and gaps in terms of teaching and learning geometry among middle schools in Bermuda.

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Dedication

This doctoral study is dedicated to my parents Mr. Sugrim Budhu and Mrs. Srimati Budhu who are my inspiration and to the staff and students of Whitney Institute Middle School of Bermuda.

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Section 1: The Problem

There are many challenges facing geometry teachers at the middle school level. These challenges range from lack of content knowledge and use of appropriate pedagogical techniques to engage students in making real-world connections to their learning to lack of self-efficacy when planning meaningful learning tasks (Carrillo-Yañez et al., 2018). Adequate professional development (PD) and support for middle school mathematics is a challenge facing teachers in the island nation of Bermuda, as there is currently no education officer for mathematics in the Department of Education. PD and coaching is left directly to school administration and content leaders within school buildings. When teachers feel supported, they tend to have a better sense of security in terms of content and pedagogy practice in the classroom (Sanders, 2016).

In addition to the issue of their level of self-efficacy, middle school teachers in Bermuda also have to contend with varying levels of mathematical readiness of learners who come from primary school. Many students coming to middle school scored below a 2.0 on the Cambridge Checkpoint Examination, which is administered during primary grade six. The Cambridge Checkpoint Examination measures students' ability in number sense, algebra, statistics, and geometry. Mathematics skills are building blocks from primary to middle schools; therefore, students lacking basic skills encounter frustration when they are exposed to higher-order learning of geometry during middle school. Students' lack of basic mathematics skills can also lead to teacher frustration when teaching geometry because in the classroom environment, there are learners with varying

abilities; hence, the teacher has to plan for the needs of the individual learners (Gökkurt et al., 2015).

In the field of mathematics education, teachers with strong content knowledge and good pedagogical skills plan and deliver effective lessons to learners under their charge (Gagani & Misa, 2017). Taylor (2017) said teachers with solid content knowledge of mathematics can effectively communicate the jargon of mathematics to students. Geometry is one branch of mathematics that requires students to demonstrate their understanding by justifying their answers using mathematical jargon or theories. The geometry classroom also involves integrating students' number sense skills in terms of calculation, estimation, measurements, and use of correct mathematical symbols. Students' algebra skills are also integrated into the geometry classroom via substitution into formulas or changing formulas to solve for the unknown values. For students to develop solid geometry skills, teachers must be able to demonstrate a solid understanding of both number sense and algebra (Taylor, 2017).

Geometry should be taught with a link to previous knowledge and real-world connections (Tutak & Adams, 2017). When teacher content knowledge of geometry is strong, the teacher allows students to construct their learning through interaction with the environment (Taylor, 2017). Students should be allowed to reflect on processes they use to solve geometry problems and discuss their answers with their peers, which allows students to feel a sense of ownership in terms of their learning process and self-correction for any errors made (Sanders, 2016). To achieve structural learning and facilitate geometrical thinking in the mathematics classroom, teachers must possess solid content

knowledge and pedagogical skills in geometry as well as in mathematics in general (Tutak & Adams, 2017). Teachers with solid content knowledge who lack pedagogical skills to effectively deliver content and concepts to learners have theoretical knowledge but no practical application, and this can lead to poor classroom management and poor planning (Taylor, 2017).

Several factors affect the teaching and learning of geometry in schools, and this study specifically focuses on teacher self-efficacy and perceptions of middle school geometry. I also examine how students' achievements are affected by teachers' lack of self-efficacy and if PD serves as an effective support mechanism to help build teacher self-efficacy in the mathematics classroom. Mathematics teachers must demonstrate knowledge of the entire mathematics curriculum if they are to effectively deliver lessons in the classroom (Tutak & Adams, 2017). Knowledge of mathematics throughout the curriculum allows mathematics teachers to make connections and integrate other areas of mathematics into geometry (Soldano & Sabena, 2019). Teachers who demonstrate an adequate understanding of the mathematics curriculum can plan achievable learning goals and outcomes for students. Content knowledge of teachers is important in every aspect of the mathematics curriculum, especially geometry, which is one of the most applicable topics in daily life but is sometimes overlooked because of perceptions of teachers regarding their inability to effectively deliver concepts to learners.

To support mathematics teachers' growth and development in classroom PD, mentoring and coaching are key elements. PD is one of the pillars of best practices in education because it provides a safe space for teachers to grow and develop as they get

better at their craft (Darling-Hammond et al., 2017). Many new initiatives, programs, interventions, and innovations in education are done through the use of PD because of its nature to build capacity and collaboration (Sanders, 2016).

The Local Problem

The research problem under investigation in this study is that middle school teachers recognized low achievement in students' geometry performance despite support and initiatives to improve student learning. Analyses of Bermuda Common Assessment Examinations for 2015, 2016, and 2017 show students are performing poorly in the geometry section of the test (Ministry of Education, 2017). Analysis of the Cambridge Checkpoint Examination for middle school year three (M3) shows 53% of students scored 2.0 and above and 27% of students achieved 3.0 and above in mathematics (Ministry of Education, 2017). The maximum score on the Cambridge Checkpoint Examination that a student can achieve is 6.0, and the minimum is 0 (Ministry of Education, 2017). This means 73% of the population is scoring less than 50% on the Cambridge Checkpoint Examination at the M3 level. Wang and Su (2015) said a constraint in students learning geometry is that geometry requires proof and is a deductive approach to teaching and learning; hence, students have challenges deducing reasoning for their answers. Teachers with higher self-efficacy tend to exert more effort and persistence with students, are more open to new ideas and methods, and take greater responsibility for students' success, as compared with teachers with low self-efficacy (Carrillo-Yañez et al., 2018). One administrator at the school being studied said, "teachers need to improve their instructions to better engage students in the practical

application of geometry." It was observed by a senior staff member that teachers are teaching geometrical concepts abstractly, and students are unable to answer geometrical problems correctly, which is a reason for concerns among mathematics teachers, curriculum planners, parents, school principal, and stakeholders at this school.

Once students have a chance to work out their solutions to geometry problems, teachers should encourage them to share their solutions and explain the justification of their answers with their classmates. This promotes critical and analytical thinking in the mathematics classroom (Soldano & Sabena, 2019). Educators and principals of schools in Bermuda said students in many cases were producing answers to geometrical problems without being able to explain reasons or provide a proper justification for their answers. This led to lower-level cognitive thinking in mathematics.

It was also observed by educators and curriculum officers that mathematics teachers are teaching concepts they feel comfortable with, creating a gap in student learning, and this was evident in terms of mathematics performance across the island. For students to effectively learn geometry in middle school, a solid foundation must be established in terms of teaching and exposing students to all supporting standards in the geometry syllabus. A school principal explained in-depth PD is needed in both content and pedagogy for meaningful mathematics teaching to be inculcated in middle school classrooms.

In addition to being a local concern on the island of Bermuda, student success in geometry is also a concern in other educational jurisdictions as well. Students achieve low scores in geometry because it is a difficult content area to learn in the mathematics

curriculum. The main reason is that students tend to demonstrate inadequate mathematical knowledge when justifying the solution to the problem. Teachers need to improve their teaching of geometry by widening their content knowledge and developing pedagogical skills that will help them transfer both content and knowledge effectively in the mathematics classroom (Tutak & Adams, 2017). According to Gökkurt et al. (2015), for students to develop a conceptual understanding of geometry and show academic growth, teachers must possess a strong content knowledge in geometry.

Moreover, teacher attitudes can also influence their confidence level, the instructional decisions they make, and how they teach lessons (Kanadlı, 2017). Therefore, teachers need to have a positive disposition towards the subject and content area they are teaching in the mathematics classroom (Ingram et al., 2020; Kanadlı, 2017; Tutak & Adams, 2017).

The 21st century has seen mathematics as the driving force for solving complex and complicated problems in the workplace. Therefore, there is a need for students to develop a conceptual understanding of how mathematics is used in everyday life. For students to develop that conceptual understanding, mathematics teachers must demonstrate a strong command of the subject matter (Tanujaya et al., 2017). Many modern buildings depend on geometric concepts of space and shapes, hence the importance of helping students develop a solid foundation in geometry .

Effective mathematics instruction not only serves as a tool for young learners to make real-world connections with geometry and mathematics, but also helps them to develop critical thinking skills when problem-solving (Tanujaya et al., 2017). A strong

mathematical foundation is vital for job opportunities in job markets such as business, education, engineering, aeronautics, genetics finances, statistics, and technology (Rocchetta & Mina, 2019). Bermuda's economy is based on international business, tourism, and financial marketing. A solid foundation of mathematics is needed to enter the job market.

At the middle school level, K-9 mathematics teachers are expected to help students develop fundamental concepts in geometrical thinking. This can be overwhelming as it involves a large responsibility on middle school mathematics teachers. Mathematics teachers at middle school are expected to master the content and pedagogy of mathematics in all areas, whether they enjoy teaching it or not (Minshew & Anderson, 2015). Speer et al. (2015) said middle school mathematics teachers teach geometry based on how they were taught in school or previously exposed. Greefrath et al. (2018) said in-service teachers studying geometry have displayed a lower level of efficacy in the mathematics program. Many teachers are unable to effectively explain reasons for solutions to-geometry problems, thus creating a void in terms of geometric content knowledge in the mathematics classroom.

While a high level of self-efficacy can be used to promote, expand, and extend the scope and depth of teaching geometry at the middle school level, teacher PD is the most important step to support teachers in integrating new and advanced pedagogical approaches (Kandil & Işıksal-Bostan, 2019). This will in turn promote critical thinking and problem-solving in the mathematics classroom (Kandil & Işıksal-Bostan, 2019). Carney et al. (2016) found that PD helps mathematics teachers boost their knowledge and

pedagogical skills. It promotes a greater level of teacher self-efficacy in the mathematics classroom, and therefore improves students' overall achievement in mathematics (Carney et al., 2016).

Depending on level of teacher self-efficacy, PD can affect students' mathematics experiences either positively or negatively because it is communicated through instruction and actions of teachers in the classroom (Wyatt, 2016; Zee & Koomen, 2016). Teachers' perceptions and efficacy influence teaching practices via instructional decisions they make, including goals for lessons, time used for tasks, and approaches that are used for teaching the mathematics content (Zee & Koomen, 2016). Güler and Çelik (2018) said student achievement is linked to teachers' efficacy in terms of effectively delivering lessons using effective mathematics instructions. Karatas et al. (2017) said one of the factors that affects teachers' self-efficacy in mathematics instructions and content knowledge is prior experiences with mathematics. If teachers have adequate skills and motivation, they are likely to more easily get through mathematics content and therefore raise students' achievement levels in the mathematics classroom (Pepin et al., 2017).

Teachers with high self-efficacy are more likely to set high goals for themselves and put extra effort into performing a specific task and persist in getting it done (Schunk & DiBenedetto, 2020). Teachers with self-efficacy can effectively support positive learning outcomes in the classroom (Schunk & DiBenedetto, 2020). Teachers with high efficacy are likely to use effective instructional strategies and seek ways to improve their current practice, whereas teachers with a low level of efficacy tend to operate in their comfort zone (Sun et al., 2016).

Teachers who have a negative relationship with mathematics tend to use instructional strategies and practices that are focused on skill-building rather than concepts; consequently, students are less involved in problem-solving in the mathematics classroom (Carney et al., 2016). Geometry by its very nature involves critical thinking, and teachers with positive relationships with mathematics use instructional strategies to encourage more students' participation and independent thinking in the classroom (Carney et al., 2016). Rhew et al. (2018) said teachers' efficacy has a direct influence on classroom behaviors in which interns affect the quality of instruction provided by the teacher. Rhew et al. said that the degree of self-efficacy directly influences teachers' dedication, motivation, instructional strategies, commitment, and willingness to experience and try new methods.

Rationale

Self -efficacy the extent to which a person believes they can do something, feel, think, make decisions, and influence how a person behaves in a situation. Self-efficacy influences the quality of human functioning through motivation, affective, cognitive, and decision processes (Bandura, 1977). Self-efficacy is associated with behavior, achievement, attributions, and motivation. Self-efficacy involves students' academic achievement across all ability levels and subject areas (Sharp et al., 2016). Self- efficacy for teachers forecasts stress, burnout, and job satisfaction (Kim & Burić, 2019). The intensity of one's efficacy can influence whether a person knows how to seek to manage a situation and preference of activities (Bandura, 1977). If the level of expectation is increased in mathematics, teachers' mathematical ability will increase.

Self-efficacy in teaching mathematics and geometry are also related to mathematics motivation, performance, and intention to justify solutions to geometry problems (Aguirre-Muñoz et al., 2018). Self-efficacy influences the manner in which teachers think and the ways they teach, as well as effectiveness or ineffectiveness of delivery of lessons in the classroom. Self- efficacy also influences goals teachers set for themselves and their students and their resiliency in terms of working out complexities they may face in the profession (Zee & Koomen, 2016). Zee and Koomen (2016) said heightened self-efficacy sustains motivation and improves skills development. The content knowledge dimension of mathematics teaching anxiety has a negative effect on the efficacy of teaching and motivation in the mathematics classroom (Basso, 2019). The teaching knowledge element of mathematics instruction concern has a negative impact on the successful teaching dimension of self-efficacy beliefs regarding the teaching of mathematics (Basso, 2019). Self-confidence in the content area of mathematics allows teachers to set achievable goals for both themselves and students in the teaching and learning process. Setting achievable goal in the mathematics classroom creates an atmosphere for productive teaching and learning of mathematics.

Teachers with a higher level of self-efficacy tend to be more open to new ideas and take chances to try out different pedagogical approaches and promote effective learning in the classroom (Woodward et al., 2018). Conversely, teachers with low self-efficacy tend to work in their comfort zone and do not set high expectations for themselves or their students. Teachers with a low level of self-efficacy are not willing to try out new ideas and pedagogical approaches (Irvine, 2017; Woodward et al., 2018).

Many mathematics teachers in middle school in Bermuda provide students with answers and do not allow for mathematical discovery. It was observed that some mathematics teachers lack confidence in terms of their abilities to teach and explain many concepts in geometry, so they struggle to answer questions posed by students. If teachers' self - efficacy in geometry is influencing their instructional practices involving setting goals, time on tasks, and ability to effectively answer questions, then students are not receiving exposure to mathematics concepts in geometry and may not have sufficient practice of skills needed for mastery of the concept (Schunk & DiBenedetto, 2020). For students to learn geometry, they need consistent exposure to concepts and sufficient time to practice mathematical concepts and skills, and this can only happen when the teacher has a high level of self-efficacy and confidence in topics and concepts (Sun et al., 2016).

School administrators in the middle school system in Bermuda have observed that some mathematics teachers lack confidence in their abilities to teach geometrical concepts, and in some cases struggle to answer students' questions. In many cases, teachers are reliant on textbook solutions to provide answers to students' questions rather than understanding the concept they are teaching. In Bermuda, mathematics is a national priority, and it is important to understand how teachers feel about their abilities to teach certain mathematical concepts in middle school classrooms. To improve the quality of mathematics education in the classroom, there must be an environment that fosters support for teachers who create an environment for creativity, collaboration, and critical thinking. Teachers' attitudes towards a subject can influence how they teach, instructional decisions they make, motivation levels, and levels of confidence in terms of

delivering content and concepts to students (Kanadlı, 2017). Students' achievement and their attitudes towards a subject they are learning can be influenced by teachers' attitudes towards that subject or content area. Attitude is an affective domain and therefore can affect the learner beyond the cognitive domain as it contains key dimensions of values, attitudes, emotions, and beliefs (Wu et al., 2019). A person's affective domain in terms of teaching mathematics is identified as the person's relationship with the subject(Wu et al., 2019).

The affective domain can affect how the person feels and connects in terms of teaching and learning of mathematics. It encompasses the person or teacher's general attitudes towards his or her beliefs and confidence level in her or her mathematical ability and ability to communicate the same to others (Yuanita et al., 2018). Yuanita et al. posited that teachers' affective relationship with mathematics can influence their teaching practices in terms of pedagogical decisions they make. Unless confidence level or efficacy in mathematics is addressed during the delivery of mathematics concepts, especially geometry, there will continue to be a gap in teachers' instructional decisions and practices which will hinder student achievements.

The purpose of this basic qualitative study is to explore teacher efficacy regarding instructional practices in the geometry classroom. A basic qualitative research study was used to better understand teacher experiences and confidence in terms of teaching geometry, which may lead to an understanding of what support or resources teachers need to help them succeed in their teaching. In this study, I investigated the efficacy of teachers' geometry instructional practices and determined support and resources needed

to improve content teaching of geometry. Mathematics lessons at the middle school level were planned to provide the essential foundation for mathematical thinking and reasoning. However, if teachers do not feel confident regarding their teaching practices, they may not be creating learning experiences that benefit students. Modeling through social learning has helped students' test scores rise considerably in geometry, which would be a positive outcome in teaching practices (Aktaş & Ünlü, 2017). Teachers' self-efficacy also has an impact on students' motivation, engagement, and overall academic success (Aktaş & Ünlü, 2017). Teachers with low self-efficacy tend to avoid challenging tasks (Bandura, 1977). The objective of this basic qualitative study was to assist curriculum planners, administrators, and mathematics teachers to determine pedagogical practices, support, and resources that are needed to help teachers when improving their pedagogical techniques and practices in the geometry classroom.

Definitions of Terms

Content Knowledge: Content knowledge refers to knowledge of the subject matter and the ability to relate skills, facts, concepts, theories, and principles that give meaning to the subject matter (Rollnick & Mavhunga, 2016).

Geometric thinking: Geometric thinking occurs when people use properties of geometric figures and spatial relationships to make meaningful geometrical concepts (Armah et al., 2018).

Geometry: Geometry is a branch of mathematics that deals with learning of space and shapes. It also involves spatial visualization of two, three, and n dimensions (Fabiyi, 2017).

Instructional practice: The skill to effectively use pedagogical approaches to deliver a lesson of high quality in the classroom (Üstünlüoğlu, 2017).

Mathematics Instruction: Mathematics instruction is the process used to deliver mathematical concepts and skills to students so they can make meaning of the subject matter (Widodo, 2018).

Pedagogical Content knowledge (PCK): PCK is knowledge of teaching materials as well as how to transfer subject content and concept matter effectively to learners (Livy et al., 2016).

Problem-solving: Problem-solving is the ability to solve problems in an efficient and timely manner by following a process. It involves the ability to identify and define the problem, look at alternative paths, and evaluate and select the approach to solve the problem (Von Hippel & Von Krogh, 2016).

Professional Development (PD): Specialized training or advances in professional learning which are intended to provide professional knowledge and support for teachers, educators, and administrations (Darling-Hammond, 2017).

Teacher self-efficacy: Teacher self-efficacy is the ability of the teacher to believe in his or her ability to guide students to success (Bandura, 1977; Sharp et al., 2016).

Significance of the Study

Improving the instructional practices of geometry teachers at the middle school level is one of the foci of educators and government in Bermuda who hope to positively influence the learning of students in mathematics. Geometry aids in the development of foundational skills and building of critical thinking skills such as logical, deductive, and

analytical reasoning, as well as problem-solving skills (Tong et al., 2020). Traditionally, teachers have had few opportunities to engage students in content learning involving topics of measurement and geometry (Pane et al., 2010). Oleson and Hora (2014) said teachers' content and pedagogical knowledge play a fundamental role in the teaching of mathematics across all school levels. Engaging in research regarding instructional practices in geometry at the middle school level in Bermuda will help identify ways to support teachers and promote growth in their pedagogy to improve instructions in the geometry classroom.

The findings of this study will contribute to educators and curriculum developers to develop programs and deliver support, resources, and materials that can improve the teaching and learning of geometry. Depending on the findings of this study, a proposed project would involve a PD training session that can be used to help mathematics teachers develop effective instructional, pedagogical, and assessment practices to promote geometric thinking in Bermudian schools. The goal of this study is to help middle school mathematics teachers raise their level of self-efficacy regarding the teaching of geometry through PD and training in geometrical thinking at the middle school level.

Research Questions

To identify teachers' concerns, the research questions are as follows:

RQ1: What is middle school teachers' self-efficacy in terms of teaching geometry and their ability to challenge students to solve problems and justify solutions?

RQ2: What resources or supports do teachers need to improve their self-efficacy when teaching geometry at the middle school level?

Review of the Literature

This chapter includes related literature regarding teachers' efficacy in middle school geometry classrooms. I reviewed journals, papers, and academic articles that address the topic of teachers' efficacy in middle school geometry classrooms. Journal articles were sourced from Google Scholar and the Walden University Library.

Conceptual Framework

The conceptual framework that guides this study is Bandura's social cognitive theory Bandura (1977) said that the psychological process plays a big part in how people create and strengthen their perceptions of their personal efficacy in completing a task. To better understand how teachers are teaching geometry in the classrooms, it is helpful to understand their efficacy in doing so. Bandura (1995) said the theory was, "the belief in one's capabilities to execute and organize a course of actions that require one to manage the prospective situation" (p. 2). There are several elements of this framework which determine efficacy, including personal characteristics, behavioral actions, environmental events, and processing (Bandura, 2008).

Therefore, self-efficacy can be a predictor of a person's failure or success, as it can indicate whether he or she can self-regulate and be self-motivated and successful even in difficult times (Bandura, 2012). Participants may indicate areas of difficulty when teaching geometry, which could have a negative effect on their teaching but can offer administrators ideas or solutions to help teachers succeed. Pepin et al. (2017) said teachers with low self-efficacy are not open to new ideas, teaching strategies, and

methods, and this will affect their students' performances negatively. Research questions examined the efficacy of middle school teachers tasked with teaching geometry. Data were collected via individual and small group interviews. Interview transcripts were coded and categorized to identify areas of concern that require support or resources from administrators and support staff.

There are four sources of efficacy: performance accomplishments, vicarious occurrences, verbal persuasion, and physiological conditions (Bandura, 1977; Doble, 2018). Bandura (1977) said self-efficacy was people's beliefs about the extent to which they can organize a task or course of actions. According to Bandura (1977), "successes help to raise mastery of expectation and repeated failures to lower them" (p. 195) and vicarious experiences help to build self-efficacy through observing or watching others complete tasks with success. The more people observe someone being successful at a task, the more likely their self-efficacy will increase for the same task (Bandura, 1977).

Self- efficacy involves one's ability to effectively perform a task, which impacts engagement and successful completion of tasks because it hinges on one's belief system (Jaffe, 2020). Teachers with high self-efficacy beliefs are more willing to participate or try new strategies and pedagogical approaches to improve their skills during teaching and learning processes in the classroom (Granziera & Perera, 2019; White, 2017). Jaffe (2020) said teachers who possess high self-efficacy recognize the importance of setting high goals and expectations for both themselves and their students, embracing new experiences, and diligently working to achieve those goals and expectations. Bandura (1977) said individuals form self-efficacy beliefs based on interpretation the information

from the environment, specifically via four essential sources (mastery experiences, social experiences, vicarious experiences, and physiological experiences). This study is guided by Bandura's cognitive theory of self-efficacy and other bodies of research.

Teachers' self-efficacy as it relates to their years of experience and teaching of geometry at the middle school level differ in general for each teacher and situation. One's beliefs can affect one's ability to effectively complete a task and its degree of efficiency. It is important to examine pedagogical and instructional practices because self-efficacy is a factor that can or may influence pedagogical or instructional practices of classroom teachers.

According to Sinclair et al. (2016), quality of instruction is one of the greatest influences on students' ability to acquire geometry knowledge in the mathematics classroom. Carney et al. (2016) said teachers' level of content knowledge also impacts their level of confidence in terms of teaching and promoting geometrical thinking in the classroom.

Teachers with strong content knowledge in mathematics have higher self-efficacy, and they can teach geometry with confidence in the mathematics classroom (Blazar & Kraft, 2017). For teachers to bridge the achievement gap in terms of teaching and learning geometry in the mathematics classroom, teachers need to have insight into how students think and difficulties they face when learning geometry concepts (Blazar & Kraft, 2017). Aktaş and Ünlü (2017) said for teachers to create a positive learning environment when teaching geometry at the middle school level, they must have a high level of confidence in the content area. The primary purpose of learning geometry is to

develop the ability to think logically and develop a sense of spatial intuition in terms of making connections and interpreting mathematical arguments (Aziz et al., 2020). Thus, teachers must create a learning environment that stimulates and motivates creative thinking of students. This can only be done if teachers have a high level of self-efficacy in the content area (Pepin et al., 2017). According to Burić and Kim (2020), teachers' self-efficacy is crucial and shapes teacher effectiveness and motivation in terms of success in the classroom.

A Review of The Broader Problem

Databases searched were Ebscohost, Academic Search Premier, Google Scholar and ERIC. Search terms used were *teacher efficacy and middle school geometry*, *teacher efficacy and middle school mathematics*, and *teacher efficacy and professional development in mathematics*. Articles addressed teachers' attitudes regarding teaching and learning of geometry at the middle school level. This chapter includes academic work that supports research questions by providing insight into self-efficacy, student achievement, and PD.

Student Achievement in Mathematics and Teacher Self-Efficacy

Achievement is the measure of students' learning over a given period of time (Glackin & Hohenstein, 2018). Students' achievement can be affected by lacking self-motivation and interest in the subject. Achievement in the classroom can also be hindered by teachers' inability to help students develop critical and analytical thinking skills (Lazarides et al., 2018). Students' levels of self-efficacy, self-control, and attitude also impact level of achievement in the mathematics classroom (Glackin & Hohenstein,

2018). The four factors that impact student achievement are classroom management, teaching for learning, teachers believing all students can learn, and attitudes of learners (Lazarides et al., 2018). Home and parental involvement play an important role in how students learn and excel academically.

Teachers with good content knowledge are more flexible in terms of their teaching and have the potential to help all students grow academically (Glackin & Hohenstein, 2018). Teachers with low content knowledge will never strive to help all students meet their learning needs in the classroom (Wyatt, 2016; Zee & Koomen, 2016). A teacher who lacks basic knowledge in geometry will most probably fail to create a conducive classroom atmosphere for students to construct their learning (Alhassan, 2017; Wyatt, 2016). According to Lazarides et al. (2018), there exists a close relationship between effective teaching of mathematics and beliefs, perceptions, and content knowledge levels of teachers in terms of their ability to teach mathematics in the middle school classroom.

Teachers who believe that their level of content knowledge in mathematics is imperative in terms of promoting effective teaching and learning processes for students' achievement are more likely to be successful than teachers who believe they cannot affect students' achievement (Güler & Çelik, 2018). Students' ability to learn is based on their past performances, vicarious experiences involving observing others, verbal persuasion and physiological states. Teachers who capitalize on past performances, observations of others as models, and verbal persuasion produce more confident students.

There exists a close relationship between teachers' ability to teach mathematics and student attitudes towards their learning of mathematics (Blazar & Kraft, 2017). Teachers' content knowledge and attitudes regarding the teaching and learning of mathematics are a crucial variable in terms of increasing quality of education, students' achievement, and use of methods and strategies to motivate students towards success (Taştan et al., 2018). According to Taştan et al. (2018), a well-trained mathematics teacher is expected to have high content knowledge and skills when delivering mathematics lessons in the classroom.

According to Skaalvik and Skaalvik (2016), mathematics achievement and personal judgment shows that motivation is key for students to learn mathematics. This leaves a gap in terms of quality of classroom instruction for mathematics in the middle school classroom (Skaalvik & Skaalvik, 2016). According to Skaalvik and Skaalvik (2016), students' perceptions of teachers are supported by their academic achievements in the subject area. Students with better mathematics performance tend to have a better perception of their mathematics teachers as opposed to students with poor mathematics performance.

In addition, it is at the middle school level that students find themselves at important junctions in their mathematics education. It is during this stage that students begin to form their conclusions about their mathematical abilities, interest, and motivation (Petersen & Hyde, 2017). It is these same factors that influence how students approach mathematics in later years. Therefore, it is imperative that mathematics teachers create an atmosphere in the classroom to allow for instructions to be presented in a

manner that builds on students' emerging capabilities to engage in abstract reasoning (Weintrop et al., 2016). Moreover, it is incumbent upon mathematics teachers to comprehend the three critical components of effective mathematics instruction. These are: teaching for conceptual understanding, developing children's procedural literacy, and promoting strategic proficiency through meaningful problem-solving investigations (Chapman, 2015; Dorouka et al., 2020).

Further, to ensure teacher efficacy in middle school geometry classrooms, it is of utmost importance for a teacher to exercise certain fundamental teaching principles. First is demonstrating cognizance and acceptance of children's divergent ideas. In this instance, the teacher challenges his or her students to think deeply about a given problem they are seeking to solve and reach beyond solutions and algorithms required to solve the problem (Sun et al., 2016). This ensures students can explain methods used for deriving solutions to problems. Second, teachers should be able to influence learning by posing challenging and interesting questions relating to the topic at hand. In this case, the teacher poses questions not only stimulate students' instinctive curiosity but also encourage them to inspect further (Huang et al., 2017). Third, it is vital for mathematics teachers to project a positive outlook regarding their students' mathematics ability (Burić & Kim, 2020). Mathematics teachers must constantly build their students' sense of self-efficacy and instill the belief that not only is the aim of mathematics attainable, but they are personally capable of reaching that goal (Burić & Kim, 2020; Huang et al., 2017). Therefore, mathematics is not presented as something magical or mysterious, but rather a subject which challenges and prompts interest in students.

Students should be actively engaged in mathematics (Burić & Kim, 2020). Teachers must ensure that students are doing mathematics on their own, and not watching others do it for them or in front of them (Burić & Kim, 2020). Students should be involved in solving challenging problems. Teachers should allow students to explore meaningful real-world mathematics problems whenever possible (Huang et al., 2017). Mathematics is a dynamic tool for constructing new knowledge and understanding about how the real world operates. In an effective mathematics class, students should be able to make interdisciplinary connections.

Mathematics is not an isolated subject. Mathematics is best learned when teachers present connections with other disciplines or subjects like art, science, health, and English literature. Rogers et al. (2015) said literature is effective for mathematical investigation. It is a tool that teachers can use to introduce problem-solving situations which can have negative results. Furthermore, these connections aid students to develop a profound understanding of the kinds of vocabulary required to effectively do mathematics and associate mathematical concepts with numerical illustration (Burić & Kim, 2020). This establishes opportunities for refining and critiquing each other's ideas and understanding of topics presented to the class. This form of communication can be done via paired work, small groups, or class presentations (Giardini, 2016). Students must be presented with several chances to communicate their mathematical ideas and thinking, and this can involve drawings, pictures, writing, and engaging in meaningful whole-class discussions and sharing (Giardini, 2016). Students at the middle school level

are at a stage in their education life where they are starting to cultivate their sense of abstract reasoning (Giardini, 2016).

Teachers must ask questions that promote higher-order thinking in the mathematics classroom. This does not mean, however, that a teacher must not ask questions at the lower end of Bloom's Taxonomy of cognitive rigor in the mathematics classroom, teachers must ask a mixture of questions to stimulate student's cognitive growth (Denton, 2017). It is of absolute importance that a teacher begins his/her lesson with questions that allow students to recall basic facts and cognizant levels of Bloom's Taxonomy as a form assessing students' readiness for learning (Denton, 2017). To solve problems meaningfully, teachers must guarantee that their students are questioned with higher-level questions that follow the lower-level questions to simulate the problem-solving process in mathematics (Denton, 2017). Students will find it puzzling to use their mathematical ideas or to analyze a mathematical situation if they are not asked higher-order questions in the classroom while working on mathematics activities and or are engaged in mathematics discussions (Prismana et al., 2018).

The best practice of doing mathematics is actually by demonstrating your understanding by proven to generate desired results to the problem by explaining each step of the solution of the problem (Prismana et al., 2018). In terms of mathematics instructions, it is a common thought that "best practice" as a teaching strategy or a lesson structure will foster a profound student' understanding of mathematics as it allows for the learners to demonstrate his/ her learning (Prismana et al., 2018). As such, The instructional strategies that could be largely considered as "best practices" in

mathematics education. A teacher should: firstly, focus on specific concepts/ skills that are standard- based (Althauser, 2015); secondly, differentiate the instructions through flexible grouping, individualize lessons, compacting, use of tiered assignments and varied question levels (Althauser, 2015); thirdly, ensure that instructional activities are learner-centered and emphasized problem- solving (Althauser, 2015); fourthly, experience and prior knowledge are used as bases for building new knowledge; fifthly, utilize cooperative learning strategies and make real-life connections (Althauser, 2015); sixthly, use scaffolding to make connections to concepts, procedures, and understanding (Althauser, 2015); seventhly, ask probing questions that require justification for responses; finally, emphasis on the development of basic computational skills (Yu & Singh, 2018).

Planty et al. (2009) said that in terms of instructional strategies, higher-performing middle and high schools use mathematical instructional strategies that included certain standard classroom activities. The following are crucial to guaranteeing extraordinary performing mathematics classes: a mathematics teacher should allow for a higher level of student engagement and should be able to stress the need for higher-order thinking; mathematics teachers should follow an inquiry-based model of instruction, including a blend of cooperative learning, direct instruction, labs or hands-on explorations and manipulatives; develop a learning environment in the classroom where a student can link his/her prior knowledge to make meaningful real-world connections; and incorporate literacy activities into the course materials, which should comprise content-based reading strategies and academic vocabulary development (Weintrop et al., 2016).

The assessment showed that it was important for teachers to create a classroom that fosters an environment where students feel safe and less pressured to answer questions, make presentations, and do experiments, even if they make a mistake or multiple mistakes.

While it is essential to follow and adhere to traditional concepts and instructional methods, mathematics teachers must understand that the world is evolving and that students live in an era where the use of technology plays an integral role in their everyday lives. Thus, presenting a lesson while utilizing the use of familiar technological devices (laptops, projectors, etc.) can create an effective mathematics classroom and foster success among today's middle school students.

The integration of technology in mathematics classrooms for learning and teaching is an important element in the field of education. This is not only because today's society is becoming more advanced and reliant upon technology, but also schools are beginning to accept the fact that technology is a vital part of their curricula (Corkin et al., 2016). Bakir (2016) posited that both the opportunity to teach mathematics better and to better teach mathematics should be considered in schools' plans for technology and teacher PD. Consequently, identifying teacher preparation programs that lead towards the development of the technological pedagogical content knowledge for teaching mathematics is what may present challenges. Niess and Roschelle (2018) extended these components to bring clarity in the development of teacher preparation programs. These include an overarching understanding of what it means to teach a subject such as mathematics while integrating technology into learning. Knowledge of instructional

strategies and representations for teaching mathematical topics with technology is imperative in the integration of the mathematics curriculum (Xu et al., 2019). A teacher should have sufficient knowledge about the students' understanding, thinking and learning with technology (Xu et al., 2019); should have sufficient knowledge relating to, knowledge of curriculum and curriculum materials that integrates technology with learning as technology is generally perceived among educators as a vital tool for effective instruction in secondary mathematics classrooms (Rutherford et al., 2017).

In the area of middle and secondary level geometry, it was found that there is an existing misconstrued perspective which some teachers possess when it comes to geometric concepts (Karadeniz & Kaya , 2017). Karadeniz and Kaya, (2017) mentioned that it is an onus on mathematics teachers to develop a concrete abstract understanding of the concepts in geometry if they are to understand the errors their students make while attempting to solve geometric problems. Therefore, the use of concrete material and real-life connections are currently still relevant and irrefutable because it brings a simple and practical approach to guide mathematics teachers in identifying and correcting misconstrued ideas in the teaching and learning of geometry (Tunç et al., 2019).

While it is important to understand mathematics teachers' approach and understating of geometric concepts at the middle and high school levels, it is equally important to understand the students' ability to comprehend and grasp geometric concepts and understanding. Bhagat and Chang (2015), carried out a survey which included fifty students from government schools in India. The fifty students were split into two groups consisting of twenty-five students each- the groups were deemed as the

control group and the experimental group. The students' achievements in geometry were taken and analyzed at the end of the survey. The researchers showed that GeoGebra, which is a free online mathematics software can support students in improving their general results in geometry (Bhagat & Chang, 2015). It has also been proven to be an effective tool for mathematics teachers. This survey remains relevant today in that it provides some practical solutions in addressing pedagogy and increasing student's mathematical achievements.

To ensure that students achieve their highest in mathematics, Capar and Tarim (2015) looked at the idea of cooperative learning, which is students working together on a problem, rather than doing so individually. This study has proven that cooperative learning aids in a student's overall achievement in mathematics. The study also proved that the cooperative learning method, as compared to the traditional method, produces a more desired achievement rate among students. It also creates a more appreciative attitude towards teaching and learning mathematics. In a similar manner, this study is pertinent, and it provides real-world solutions that can be used to advance support to teaching and learning strategies that can be used to bring about favorable changes and effectiveness in geometric classrooms at the middle school level (Capar & Tarim, 2015).

Over the years, it was found that geometry is not just a mathematical subject in a mathematics class, but it plays an integral role in the way one interprets and reflects the physical environment. Geometry also serves as a foundation in advanced areas of mathematics, science, geography, art, design, architecture, engineering, etc. Berenger (2017) suggested that geometry aids in students' development in multiple skillsets, some

of which include visual imagery, conjecturing, deductive reasoning, logical argument, and proof.

According to Alqahtani and Powell (2016), it is important to explore how teachers can use technological tools to promote geometric thinking and to develop an intangible understanding of geometry. In contrast, while educators and mathematics teachers explore multiple ways to transfer the concepts surrounding geometry to students, a recent study suggested that teachers simply cannot expect geometric concepts to be transferred as if it were a bunch of information for students to just memorize (Nurhasanah et al., 2017). The concept of inductive reasoning as an essential form of mathematical thinking may not be as real as one would have previously thought (Gagani & Misa, 2017). In the mathematics classroom, learning happens when teachers believe in their ability to guide students to success (Dofková & Kvintová, 2017).

PD

Teachers with a great sense of confidence in mathematics tend to be better planners, more resilient through disappointment, and more open-minded and accommodating to students (Taştan et al., 2018). School management needs to foster a climate and culture that support teachers, through PD sessions, because support and praise help to raise teachers' confidence level (Aldridge & Fraser, 2016). Poor support and demoralization of teachers based on feedback and comments from the administration and school management can lower the teachers' morale and ultimately impact negatively on classroom performance (Aldridge & Fraser, 2016; Dofková & Kvintová, 2017; Taştan et al., 2018).

PD helps teachers in the profession to develop individual skills, knowledge, and expertise in the teaching and learning process (Sanders, 2016). PD is done through direct coaching and mentoring of teachers or as a group to promote individual and holistic and individual growth (Darling-Hammond et al., 2017). PD help teachers to set high expectations for themselves and students through a growth mindset. PD is also used to facilitate school-wide, district-wide, or state-wide intervention of new programs and policies in education (Darling-Hammond et al., 2017). It is used mostly to promote best practices in education through collaborative planning and sharing.

Actively pursuing PD in education help to ensure that teachers' knowledge and skills stay relevant and up to date with the current trend in education (Darling-Hammond et al., 2017). PD in mathematics can be referred to in-service training wherein the teachers get an opportunity to upgrade their content knowledge and pedagogical skills (Sanders, 2016). Mathematics PD is usually done in an informal setting or though professional settings such as conferences, course work, and academic degrees (Sanders, 2016).

PD is done in a structured professional learning environment with the aim of strengthening teacher content and pedagogical knowledge (Peker, 2016). The content focus PD help teachers to better equip themselves with content knowledge in the subject area and this allows for the building of teachers' confidence in the subject matter. PD also creates a safe professional space for teachers to collaborate and share their strengthens and weaknesses and seek support for growth and development in their practice (Darling-

Hammond et al., 2017). Teachers who are supported and guided by professional tends to grow in their professional practice.

The pedagogical PD seeks to address the best practice in the teaching and learning environment. Teachers who received pedagogical professional practice have a higher chance of developing the art of delivering the lessons in the classroom (Aldridge & Fraser, 2016). As pedagogy is the art and science of effectively teaching the content to the learners. Teachers who received constant support in both content and pedagogy are likely to be a better planner and more confident in their ability to teach in the classroom. PD should be tailor to meet the needs of the individual needs of teachers and this can be done using coaching and mentoring from specialist teachers and school administration (Darling-Hammond et al., 2017). The process of coaching and mentoring in PD for teachers is done by sharing expertise about content with the use of evidence-based practices that are aimed at facilitating the overall growth and development of the teacher's ability in the classroom (Darling-Hammond et al., 2017).

PD in mathematics is important as it provides the teachers with the skills necessary and the ability to communicate the mathematically to the learners in the classroom (Sanders, 2016). For a teacher to communicate mathematically to students he/she must have the required skills and expertise in the content knowledge (Rahmi et al., 2017). Teachers who are supported and feel confident in mathematics allows for discussions in the classroom rather than rely on the textbook solution when solving a mathematics problem (Dofková & Kvintová, 2017). The ability to teach mathematics effectively can affect the outcome the mathematics instruction in the classroom because

teachers who are not comfortable with content and concepts in mathematics tend to plan lessons with lower expectation than the teacher who is supported and has developed the required skills and knowledge in mathematics (Zee & Koomen, 2016).

Careful consideration needs to be given to teachers' content and pedagogical knowledge because it affects intellectual performance and their mathematics skills (Alrajhi et al., 2017). It is teachers' mathematics attitudes that have both direct and indirect effects on mathematics achievement, but teachers' content knowledge as a mediator varies between mathematics instructions and mathematics achievement in the classroom (Tella, 2017). The most powerful way an individual develops mathematics is a feeling of mastery of the experiences (Peker, 2016). Teachers who feel supported through PD are the better planner and set higher goals and expectations for themselves and their students (Desimone & Pak, 2017). PD is the foundation on which teacher self- efficacy is developed because it can be the tool that supports and enhance their knowledge and skills (Epstein & Willhite, 2017; Yoo, 2016). PD and self- efficacy go hand-in-hand because it allows teachers to reflect and make adjustments to their practice in education (Carney et al., 2016). Therefore, mathematics teachers who master the craft of teaching mathematics effectively have higher confidence and self-belief and are more likely to be successful (Peker, 2016). Mathematics teaching can be affected by teachers' self-efficacy domain as self-efficacy belief and self-efficacy judgments are related to the belief system on the ability to organize and carry out tasks to effectively accomplished set goals (Alrajhi et al., 2017; Peker, 2016; Zimmerman et al., 2017).

Teachers' content knowledge and pedagogical practice are of paramount importance for students' success in geometry (Speer et al., 2015). As stated earlier, it is at the middle school level that students are at that crossroads regarding their mathematical education (Aktaş & Ünlü, 2017). Further, it is at this stage where students begin to formulate ideas about the concepts of geometry in mathematics. Consequently, it is this same idea or perception that will dictate how the students approach mathematics-related problems in the future. Bringing geometry and other mathematical topic areas in an applicable and relatable manner to students is essential to eradicate the negatives about mathematics and geometry and fostering a more positive and practical approach to geometry and mathematics problems (Aktaş & Ünlü, 2017).

Multiple studies have been put forward to find the best possible approaches to overcome the challenges which mathematics teachers face in the classroom, especially with the presentation of geometry problems. Such studies explored how geometry is presented in such a way that engages students, as well as challenges them, and in a manner that builds on the emerging interests and abilities of students in middle school. Studies were also conducted to determine the effectiveness of traditional methods in teaching and learning of geometry to today's generation. There should be major adjustments to the way mathematics and geometry are presented to today's generation. In this regard, there were studies aimed at integrating the use of technology in the classroom and using applicable devices such as interactive board, interactive software, smartphones, and computers to help boost students' interest in the learning of geometry. This has

proven to have had an impact in the classroom and it changed the success rate of students in the area of mathematics and geometry for the better.

While much focus was placed on improving the performance of students, it was important to remember the teachers. PD exercises will be carried out to foster teacher development programs, which would equip the teachers with the right tools to face the hurdles which may present themselves in the mathematics classroom. It is easily concluded that much effort was put into ensuring teachers are fully supported in mathematics and can promote geometrical thinking in the classroom. These efforts will ensure that teachers become better presenters of geometric problems in the class, as well as ensuring that students' overall performance in the area of mathematics and geometry is one that is acceptable for students today and in the future.

Implications

To improve teacher self-efficacy in geometry in the middle school classroom, this qualitative project study explored middle school teacher's self -efficacy to teach geometry in their ability to challenge students to solve problems and justify their solutions and the resources or support do teachers need to improve their self-efficacy in teaching geometry at the middle school level. The implications of conducting this study are that it will generate data that will expand or provide the support teachers needed to better use instructional and pedagogical approached to promote teaching and learning of geometry in middle school mathematics classrooms.

When teachers are supported and provided with adequate resources to aid the instruction process in the content area, the greater the chances that their teaching self-

efficacy will increase (Chao et al., 2017; Zee & Koomen, 2016). This study, even though the population is small, will provide the educator with empirical evidence that can be used to develop a teaching manual for geometry. The findings can also be used to develop PD training for mathematics teachers at the middle school level. The deliverables of this project are a detailed description of a two- day PD paper and a geometry teachers' manual that can be used to help improve teachers' self- efficacy in the teaching of geometry to middle school students.

This study offers an opportunity to obtain first – hand information from the teacher about their perception of teaching geometry at the middle school level. Individual, semi-structured, and even group interviews with teachers will provide information about teachers' pedagogy and self-efficacy in teaching geometry to middle school students. The data emanating from this project can be used to inform curriculum planners and mathematics subject specialists at the department of education in Bermuda about the support and resources that are needed to effectively enhance teacher self-efficacy and promote productive geometry classrooms at the middle school level in Bermuda.

Another implication is that it will be used to promote social change in the way the middle school mathematics teachers view their self-efficacy in teaching geometry. It is hoped that teachers will use resources identified through PD sessions and geometry manual to promote geometric thinking in the middle school mathematics classroom. According to Chao et al. (2017), when teachers have a high confidence level in a content

area, there is a greater chance that they will try new things and thus boost their level of self-efficacy.

Summary

The purpose of this study is to understand teachers' self- efficacy and perception of geometry in middle school classrooms, and to provide support through PD and the needed resources to overall boost teachers' self- efficacy in middle schools in Bermuda. When teachers are confident in their ability to teach geometry at the middle school level, then their level of self- efficacy raises, and they can provide instructional practices to the highest level in the geometry classroom (Basso, 2019).

Section 2 includes the process of data collection and analysis. This section will explain the research design, sampling procedures, population, population size, and ethical considerations used to protect the identity of participants of the study. Also, the limitations of the study are explained. Section 3 includes project implementation, description, evaluation, and implications. Section 4 contains recommendations for alternative approaches, implications for social change, and scholarship regarding project development and evaluation. Reflections on the importance of the work, implications, applications, and directions for future research as well as the conclusion of the study appear in Section 4 of this study.

Section 2: The Methodology

Qualitative Research Design and Approach

In Section 2, I describe the methodology that was used for this basic qualitative study. A qualitative design was used to understand teachers' self-efficacy and perspective regarding teaching and learning of geometry in middle schools. I collected data for this basic qualitative study via interviews. A convenience sample population of 12 participants was used for this basic qualitative study because there are four middle school schools who teach at least three mathematics classes at each of the schools. This basic qualitative study involved teachers' self-efficacy in terms of teaching geometry and their ability to challenge students to solve problems and justify solutions and resources or support teachers needed to improve their self-efficacy when teaching geometry at the middle school level.

This study involved investigated teachers' efficacy in terms of instructional practices in geometry middle school classrooms in Bermuda. A basic qualitative design was selected because it helps determine clear and anticipated priorities, develop working definitions, and outline method of data collection to answer each research question. A qualitative study is an appropriate methodology because the intention is to identify the relationship between teacher motivation and confidence and pedagogy as it relates to geometry content and instruction. This phenomenon was located specifically in a local school in the island nation of Bermuda. A basic qualitative study design was used to provide unique opportunities for the application of research knowledge and skills to

develop, implement, and analyze a practical project in an educational setting with a focus on creating a positive change in that community or environment.

This basic qualitative study research established clear boundaries for the collection of data and other empirical evidence to answer the research questions. Basic qualitative studies by nature are idiographic work involving empirical evidence gathered through interviews, observations, or survey questionnaires which are analyzed using interpretation. Data involved interviews to ascertain levels of competency during teaching and learning of geometry at the middle school level. Data were obtained in this study to identify level of self-efficacy of teachers and their perceptions regarding geometry in middle schools and future plans for PD to aid teachers in terms of both content and pedagogy in the teaching of geometry.

This study does not meet the criteria of an ethnographic study because it does not emphasize long-term observation and data collection. It focused on a classroom culture, and this term is debatable in terms of its meaning. The ethnographic study involves people and their environment and methods such as participant observation and face-to-face interviews. It involves patterns in human behavior and traditional anthropological texts as well as interviews to understand how users relate to products or services (Burkholder et al., 2016). Schools and teachers have their own culture and may have different belief systems, values, and attitudes. Teachers selected for this study represent different cultures; this study therefore fails to meet the requirements for an ethnography study.

Grounded theory research involves arriving at theory by beginning with data (Burkholder et al., 2016). It involves data through interaction and interpretation of a social phenomenon (Burkholder et al., 2016). The grounded theory is more inductive in nature because it involves generating a new theory emerging from data. This basic qualitative study involves understanding teachers' self- efficacy perceptions of middle school geometry and not developing a new theory.

Phenomenology involves exploring lived experiences as well as their deeper meaning (Burkholder et al., 2016). It was not possible for deep investigation regarding what it means to be a middle school mathematics teacher with understanding of geometry because of time constraints and the identified population.

A basic qualitative study design is unique in the sense that it allows the researcher to apply knowledge and skills to develop, implement, and analyze a practical project in an educational setting to create a positive impact (Fullan, 2014). Ravitch and Carl (2016) said the qualitative methodology allows the researcher to investigate and understand how participants see, view, approach, and experience the real world. Qualitative research is a method that is used to collect and analyze data in the form of spoken language and expressions of personal experiences as well as social interactions (Harding, 2018; Howitt, 2016).

Based on the problem identified in the study, this design yielded the best evidence-rich descriptions of the phenomenon to gain a deeper understanding of teachers' self-efficacy and resources and support needed to effectively teach geometric concepts to middle school students. It is guided by the research questions. The two research questions

in this study were used to understand problems that exist among mathematics teachers involving the teaching of geometry at the middle school level. A basic qualitative study is constructivist in nature because it involves constructing ideas and a sense of reality by learning from research processes and outcomes (Burkholder et al., 2016). Interviews are used to collect rich information about peoples' behaviors, attributes, preferences, feelings, attitudes, knowledge, and opinions (Creswell, 2012; Kumar, 2019; Ravitch & Carl, 2016). According to Ravitch and Carl (2016), interviews are designed to collect richer sources of information from a small number of people. Interviews are most effective for qualitative research because one can better understand, explore, and explain research subjects' opinions, behaviors, experiences, and phenomena. Questions are usually open-ended so that in-depth information can be collected (Creswell, 2012; Yin, 2014). The qualitative format affords one the ability to seek in-depth knowledge about each participant and adaptability in questioning needed to fully explore the topic of this study.

Participants

Criteria for Selecting Participants

All participants taught geometry at the middle school level. Participants were selected using a convenience sampling procedure because this study requires participants who are teaching mathematics at the middle school and have taught the geometry unit . Participants were 10-12 teachers from three middle schools who were selected based on their experiences teaching geometry. Participants taught geometry for sixth, seventh, and eighth graders in middle school.

Justification for the Number of Participants

The four schools on the island of Bermuda have 10-12 mathematics teachers, including myself (a head of a department) and other heads of department. Each teacher is involved in the teaching of geometry. However, data for this study were only collected from three of the four middle schools because I am a content leader at one of the middle schools. Vasileiou et al. (2018) said sample size should be large enough to allow for a newer and richer understanding of the phenomenon via an in-depth analysis of data. A population below 20 in a qualitative study allows for the selection of individuals who are knowledgeable regarding the phenomenon (Creswell & Poth, 2018). A smaller sample size helps foster a close relationship between the researcher and participants, which enables the smooth collection of data. The fewer the participants, the deeper the inquiry per participant, which allows for rich data collection (Creswell & Poth, 2018). The closer the relationship between the researcher and participants, the greater the chances of reducing bias and validity issues that are associated with qualitative research and data collection (Creswell, 2012).

Procedures for Gaining Access to Participants

I gained access to participants by seeking permission from the school administration through the Department of Education. Each participant was given a detailed description of this basic qualitative study and the purpose of the study. I interviewed participants voluntarily in their educational setting to create a space of comfort so that they can freely express themselves. Ravitch and Carl (2016) said the interviewer must create a climate that makes the interviewee comfortable. All participants

was emailed a consent form with detailed terms of their participation. Email addresses for participants was obtained from the Department of Education email database. The email also explained to participants that all personal information would be kept confidential and that the findings of this study would not be traced back to any individual participant. Ravitch and Carl (2016) said it is important to protect the identity of the human participant when conduction research. Once I received written permission from the department of education to conduct the study, this was conveyed to school principals to ensure there are no conflicts as regards teachers' participation in this study. A copy of the written permission sent to Walden University Institutional Review Board (IRB).

Establishing a Researcher-Participant Relationship

To establish a research-participant working relationship, I reached out to participants during our monthly common mathematics planning where all the middle school mathematics teachers meet to plan to determine their interest in participating in this study. I also reached out to participants, though emails containing a brief description of the study, which contained a sample of the consent letter, as well as my personal contact information. Appendix C contained a sample of the email that I sent to each participant.

As a current staff member and content leader for mathematics of one of the participating schools, I have an established relationship with staff members in the mathematics department. I have also an established relationship with mathematics teachers in the other middle schools on the island because of our monthly common planning time. I maintained a level of objectivity and did not allow my personal opinion,

views or experiences interfere with this study. Ravitch and Carl (2016), posited that its significance of ensuring objectivity and keeping reliability as required conditions, as they are directly related to the validity of any form of assessment or analysis.

Protection of Participants' Rights

Strict measures were be taken to ensure the protection and privacy of the participants. Each participant was assigned a letter of the English alphabet that were only privy to the researcher, as privacy and confidentially and confidentiality are two ethical concerns that must be adhered to when conducting qualitative research (Gaus, 2017; Ravitch & Carl, 2016). The English alphabet formed of coding in the data collection process to help the research to protect the identity of the participant. Measures was put in place for all participants to read and sign the consent form. All forms and data are password protected on the computer and stored on an external hard drive by the researcher for additional security.

Privacy and confidentiality are essential aspects in conducting this study as they both form the bases for ethical consideration and the protection of the research participants and data collected (Pietilä et al., 2020). Questions for the interviews was developed so that it prohibits the researcher to solicit private information that does not support the research questions (Pietilä et al., 2020). The confidential questions in the interviews were limited so that the demographic information to be collected did not reveal the identity of the participants (Pietilä et al., 2020).

Data Collection

Data Collection Instrument

Qualitative data in nonnumeric form, was observed and recorded. Data were collected through the methods of one-to-one interviews with an individual participant. The data collection source is a semi-structured interview with each participant. The interview was in the form of open-ended questions. Ravitch and Carl (2016) said open-ended questions allow participants to provide rich data points. The use of open-ended questions allowed participants to provide detailed descriptions of the strategies and methods used in teaching geometry to middle school students (Driscoll, 2011; Gaus, 2017). The data collected was analyzed to improves the trustworthiness and the validity of the study and allowed for saturation of data (Amankwaa, 2016; Sanjari et al., 2014). Data collection did not commence until after approval is granted from Walden University's Institution Review Board (IRB) and permission from the Commissioner of Education in Bermuda.

Interviews

Interviews are an excellent way of obtaining in-depth information from the research participants (Driscoll, 2011; Sanjari et al., 2014). Interviews can be conducted face-to-face or virtually using available technologies (Driscoll, 2011). Face-to-face interviews have the potential to produce more data collection because the researcher can use no-verbal cues to communicate with research participants without adding a sense of biasedness (Gaus, 2017). Interviews allow for the asking of probing or follow- up questions to probe deeper for information that will help to answer the research questions

(Driscoll, 2011; Gaus, 2017). It must be noted that technology also provides a platform to conduct interviews in the form of emails, skype, zoom meetings, or in the form of a conference call. The benefit of using the technology platforms is that you can ask follow-up questions to answers to information that is already sent from participants (Driscoll, 2011).

Interviews were conducted using open-ended questions to allow participants to provide a detailed account of their self-efficacy in the middle school geometry classroom. The interview was used to collect data used to answer question one of this research paper as it seeks to find out more about teachers' efficacy in teaching geometry to middle school students (Bogner et al., 2018; Creswell, 2012). The interview served as one of the main sources of data collection for this study as it revealed participants' perspectives regarding the teaching and learning of geometry in the middle school mathematic classroom (Creswell, 2012; Rosenthal, 2016). Interviews serve as an ideal source of basic qualitative studies where open-ended questions can be asked and open-ended conversations can occur, thus provide key information to this study (Vasileiou et al., 2018; Yin, 2014).

The framework and the literature review guided the researcher in developing the interview protocol for this study. I developed the interview protocols and research questions after reading, examining the literature and research so that it captures enough information and that a feasible understanding of the research problem can be concluded (Creswell, 2012; Gaus, 2017). Interview protocols were used to help researchers to stay within the parameter of the research problem while gathering information from the

participants (Ravitch & Carl, 2016). To ensure that the data collected from each participant are constant, the same questions was used each participant. Interviews allowed the researcher to probe deeper for answers by asking open-ended questions and follow up questions to seek clarity (Gaus, 2017; Ravitch & Carl, 2016).

Some well-known data collection instruments for qualitative research design are observations, interviews, and textual or visual analysis (Moser & Korstjens, 2018). For this study, as mentioned before, interviews were be used as the data collection tool. The interview allowed the participants to evaluate their teaching process in the classrooms and also their efficacy by answering questions (Creswell, 2012; Yin, 2014). The data from the interviews was analyzed to identify common themes and patterns that can be used to answer the research questions (Gaus, 2017; Ravitch & Carl, 2016). The interview instruments was sued to pinpoint the strengths and weaknesses of the teaching and learning process; identify the inadequacy of resource materials; the suitability of manipulatives; the adequacy and level of questions asked; measure the motivational level of students and teachers; determine the content knowledge of the teachers and appropriateness of teaching strategies and methods utilized (Ravitch & Carl, 2016).

Sufficiency of Data Collection

Participants was selected to share perspectives that was used to answer the research questions. The interviews for this study was held at a time convenient to the participants to eliminate distractions, not affect teaching duties and other responsibilities during the normal workday (Ravitch & Carl, 2016; Yin, 2014). After school, online using zoom, facetime, phone calls, and weekends was utilized for this activity (Creswell, 2012;

Snyder & Dillow, 2015). Interviews was held at participants' schools or place convenient to them since they are from are four different locations on the island. I adhered to all the procedures and protocols set out by Walden University before engaging participants in the data collection process. No, data was collected without prior approval from Walden University IRB. Participants of this study received a copy of the transcript, coded and un-coded data in the form of a printed document. They were informed as to where to view a copy of this research project findings. A PDF (portable document format) copy of this research project was provided to participants upon.

System for Tracking Data

A daily log was be kept throughout the data collection period to ensure that deadlines are met in terms of interviews, communication with participants, and personal reflection done (Clark & Vealé, 2018; Creswell, 2012). All documents that was used and data collected during this period was placed in a folder in a secured filing cabinet. Ravitch and Carl (2016), said that all data collected must be kept confidential to protect the identity of the human participants. Thus, if there should be a breach in the confidentiality of information, immediate contact should be made to the IRB for guidance on the way forward. Contact was also made with the participants so that they are allowed to either continue with the process or have their information removed as a method of security and validity of the data.

Role of the Researcher

The role of the researcher in a basic qualitative study is to access the thoughts and feelings of the participants of the study (Shaheen, & Pradhan, 2019). The researcher is

also responsible for safeguarding the data collected and the participants' identities. The researcher has a responsibility, to be honest, and ethical throughout the research by not allowing personal experiences and views interferes or influences the data collection process (Creswell 201; Shaheen, & Pradhan, 2019). I am fully aware that I am employed at one of the schools as the content leader in mathematics and have also contributed to the planning session with middle school mathematics teachers on the island. Therefore, as the researcher, I remained neutral in my contact with the participants during the classroom observation and interviews. I ensured that all participants in this study have given written consent, are participating voluntarily and can withdraw at any time, that no harm is done to participants, all information and data are confidential and remains anonymous as part of the ethical consideration in protecting the human subject (Ravitch & Carl, 2016; Yin, 2014).

Data Analysis

I used a basic qualitative approach to collect, transcribe, and analyze data to understand, address, and draw conclusions on the identified problems and research questions. The only source of data for this study was derived from interviews. The interviews were recorded and then transcribed into words. Ravitch and Carl (2016) stated that creating a transcript from spoken words is vital for qualitative data collection. I used the Zoom platform to conduct and record the interview. My laptop computer was used to capture and record the full context of the interview for later transcription without having to hand record interviews, resulting in inaccurate or incomplete notes of spoken words (Clark & Vealé, 2018). To ensure the security of data, additional copies of the interview

would be available. If something happened to the computer on which the interview was recorded, I transferred the interview recording to my cell phone and locked it with a passcode. The recording from zoom allowed me to play, pause and replay in transcription to ensure the accuracy of the interview captured in the recording.

This phase of data analysis enlisted listening to recorded interviews (Alase, 2017). This phase continues until I used Microsoft Word to transcribe all interview recordings. I used the recording that was transferred to my cell phone to verify that the transcripts were related to the recordings and were accurately captured. Each interview protocol was saved in a Word document and used as a template for transcribing the interview and made it easier to transcribe what the question already was in the word protocol. I could quickly determine where to start typing from the recording following each question's introduction during the actual interview. I read and reread each participant's responses to familiarize myself with the response gaining an in-depth knowledge of the response and visually associating the participant's response for the latest transcription and narrative.

I categorized and coded interview data for further analysis (Alase, 2017). The interview questions were divided and six categories, with each category aligned with one of the two research questions. I used text segment coding, which involves using words and phrases to correlate sentences and paragraphs. The NV-vivo code includes coding of participants' exact words to analyze the interview data (Creswell, 2012). Then I used thematic code in the review color-coded groups for words and phrases.

I analyzed data from interviews to ascertain the findings of this study. Creswell (2012) viewed qualitative data analysis as a process that allows the researcher to collect

data and organize it to meaning to the data. Yin (2014) describes the data analysis process as an inductive reasoning method as it allows the researcher to generate, gather, and recorded data. The inductive reasoning process in data analysis entails the researcher to organize, analyze, transcribe, and interpret the data to uncover meanings (Clark & Vealé, 2018; Yin, 2014). To make meaning of the data, I classified data into separate parts according to themes to making meaning of the data collected. I assigned each participant a pseudonym, and sorted by the school of employments. For example, the teachers were identified as WTeacher 1, WTeacher 2 WTeacher 3, WTeacher 4, DTeacher 1, DTeacher 2, DTeacher 3, DTeacher 4, STeacher 1 STeacher 2, STeacher 3, STeacher 4, CTeacher 1, CTeacher 2, CTeacher 3 and CTeacher 4.

I used Microsoft Word to transcribe interview transcripts. I reviewed the transcribed data against the recordings and original notes to ensure the accuracy of the transcription. The review was done as a quality check to ensure that transcribed data match the recording and notes. The data was copied into an excel sheet to match each question, and this was done to allow for easy identification of similar words and phrases. Once similar words and phrases were identified, I coded similar words and phrases using different colored texts in each group of words and phrases.

Qualitative data analysis involves systematically arranging interview transcripts and other non-numerical data the researcher has accumulated to understand better the phenomenon in themes (Klenke, 2016). Qualitative research aims to generate knowledge grounded in human experiences through interviews (Clark & Vealé, 2018; Ravitch & Carl, 2016). For this basic qualitative study, I used thematic analysis because it is more

flexible to understand the qualitative data better. Themes and codes were created based on the similarity of data collected in the interviews. In the first cycle, NV-vivo, coding was used, and the second cycle axial coding.

NVivo coding is a qualitative data analysis method that emphasizes the participants' actual spoken words (Saldaña, 2014). The use of thematic analysis allowed to correspond to key concepts and to make generalizations of the data. Themes help to provide a broader understanding of the research questions as it relates to the data collected. The recorded voice data from the interviews were transcribed into a Word document using tables and headings for each participant. I highlighted similar words, statements, and phrases from each participant interview. The highlighted words, statements, and phrases were placed into themes for further analysis to answer the research questions. The table had two columns; one with the heading interviewee code name, and the second column was the transcript of the recording. I used the NV-vivo software to code and analyzed the interview data. This allowed me to transcribe the interview recording into text and assigned color codes and nodes to similar words, statements, and phrases from each participant interview. The process helped reduce the quantity of data by putting it into perspective by using repeated phrases, words, statements, or expressions used by the participants and providing information that can be used to answer the research question (Saldaña, 2014) potentially. A numerical coding to similar words and repeated phrases was assigned to each participant. For example, 001 was assigned to similar words and 002 for repeated phrases.

The axial coding was used to identify established relationships among phrases, word statements, or expressions identified in the first coding cycle. Patterns were identified among the axial codes to create themes. Creswell (2012) remarked that it is essential that the researcher develop themes from the axial coding process to help with the data points' organization. Data was placed in a table format for easy analysis and interpretation. The organized data was used to answer the research question based on the themes, patterns, and words pertinent to the understanding of the research questions (Clark & Vealé, 2018; Ravitch & Carl, 2016).

To ensure the quality of the data collected and avoid potential research bias, each participant was given a hard copy and an email copy of the findings to check for accuracy. Participants were asked to highlight the inaccuracies of the findings and the page number and send the correct responses that should be used (Clark & Vealé, 2018; Ravitch & Carl, 2016). However, if no inaccuracies were identified, the participants signed agreement with the findings. Participants were given 10 days to verify the findings, after which they returned the hard copy of the document.

Peer debriefing is another form of quality checking for the accuracy of data. Participants were allowed to review the data collection and analysis processes. According to Richards and Hemphill (2018), peer debriefing enables teachers to review the entire process of data collection and data analysis and provide feedback that help validate the entire process's accuracy. A log of the entire process was kept, identifying discrepancies and consultations with participants to resolve the identified discrepancies. However, as no discrepancies were identified, the data and analysis were accepted as true and correct.

A confidentiality agreement form was signed to safeguard the privacy of the human participants' data collected.

Qualitative data analysis is a method that allows a researcher to collect data and organize it in a manner that gives rich meaning to the data collected (Moser & Korstjens, 2018). The analysis process followed an inductive reasoning method that generates, gathers, and records data (Nowell et al., 2017). This process includes organizing and transcribing interviews and analyzing and interpreting data from the interview to discover meanings (Assarroudi et al., 2018). Classified data analysis is a process of separating something and then assigning meaning to the individual parts (Riffe et al., 2019). Data from the interview was placed in the four themes and were highlighted with different colors. I assigned each potential participant as pseudo and started by the school of employment; for example, the teachers were identified as teacher one, teacher two, teacher three, teacher 4, and teacher 5.

The interviews were transcribed into words. I then reviewed the transcribed data against the recording and original notes to confirm the transcription accuracy (Ose, 2016). Once I completed the reading of the data and clarified the accuracy of the transcript notes, I copied the interview data into a table in Microsoft Word for the process of coding. Having the response per interview question in one column allowed for easy identification of similar words and phrases (Ose, 2016). This process also allowed the search tool to identify similar words and phrases across interview questions. As the words and phrases were identified, I coded identical words and phrases using a different color for each group of words or phrases.

I conducted text segment coding as I reviewed the interview document to identify keywords and phrases like those resulting from an interview transcripts analysis. I used the find tool to find words on the page in each document's portable document format and then highlight similar words and phrases (Ose, 2016). I continued using thematic analysis to review decoded words and phrases. Having the text in different colors helped me identify the emerging teams. As the words and phrases were repeatedly reviewed, I adjust the font to the color that identifies text similarities. I categorize the initial codes from the interview listed in appendix G into four teams. While there was a slight variation in those quotes that emerged, a common theme emerged from the interview. As I identified similar words and phrases, the words and phrases were added to the table I created in Word (Appendix D).

The technology was essential in the data collection and analysis process (Clark & Vealé, 2018). I used my email address for initial contact with the prospective participant of this research. Due to the COVID-19 pandemic, I used the zoom platform for recording and conducting the interview. I used Microsoft Word software to transcribe the interview, track emails, sort interviews, and identify and color-code emerging words and phrases (Clark & Vealé, 2018). All data for this study was collected from the zoom platform.

I structured interviews to capture participants' perspectives of teacher self-efficacy in geometry in middle school mathematics in Bermuda. The same number of interview questions were used for all mathematics teachers on the island, whether they were heads of departments or not. The interview was planned for 30 minutes; however, only one interview lasted for more than 30 minutes, with others averaging in about 25 minutes.

Due to the COVID-19 pandemic and health and safety reasons, all interviews were conducted via zoom.

Each of the interview questions surfing at the front column head in this form allowed each participant's response to be aligned in one column. This made it easy to identify similar words, phrases, and sentences. After I transferred the responses, each response was read and reread to identify keywords; sentence phrases. As I identify the keywords and sentence phrases in the response, I use a different color font to distinguish the different words, phrases, or sentences. This process of reducing larger chunks was completed for each interview question (Creswell, 2012). I then used the Word document search tool to search the entire document for the same keywords or terminology in each question to identify phrases or terminologies that were identified and other responses I color-coded those words or phrases. This process was repeated until all responses were read with keywords and phrases identified and color-cod. Each word or phrase was color-coded using a different color for similar occurrences.

I copied the color-coded words and phrases into another Word document, with each color phrase being copied into one column. Using the inductive approach, codes and themes were not specified as a priority but were identified during the raw data transcription (Ose, 2016). While there were many techniques to code and display data to identify teams, research must use a method that connects the data meaningful to them and the reader (Riffe et al., 2019). I created and coded a subcategory of each research question with a different color.

As I analyzed the data, five categories emerged. Following a detailed analysis of the data, six themes emerged. The six themes are PD, a methodology for teaching geometry, the confidence level in the geometry classroom, professional experiences, personal experiences. It was noted 5 to 7 teams should be sufficient for discussion of study finding so the similarity of the data would be redundant if identified as individual teams, words and phrases like PD for teachers, methodology, personal experiences, content knowledge, and pedagogical approach to the effective teaching (Creswell, 2014). This process continued until a refinement process, and I was completely satisfied with the categories and all the notes.

Establishing Credibility

I conducted member checking as a safeguard so that to ensure the results of this study are consider credible and accurate. Member checking is an approach the involves multiples of external data collection method, thus helps to mitigate bias and control any influence that the researcher cultural and background experiences can have on the findings or interpretations of the study's results (Amankwaa, 2016; Ravitch & Carl, 2016). I used members checking to cross-check the varying data sources to confirm that the information is correct (Creswell, 2012; Yin, 2014). To ensure the quality of the data collected and avoid potential research biasness each participant was given a hard copy and an email copy of the findings to check for accuracy (Creswell, 2012; Vasileiou et al., 2018). Participants were asked to highlight the inaccuracies of the findings and the page number and send the correct responses that should be used. However, as no inaccuracies

were identified, the participants agreed with the findings. Participants were given 10 days to verify the findings, after which they returned the hard copy of the document.

Peer debriefing was used as a form of quality check for data accuracy. Participants were be allowed to review the data collection and analysis processes. According to Richards and Hemphill (2018) peer debriefing is the process of allowing teachers to review the entire process of data collection and data analysis and provide feedback validating the accuracy of the entire process. A log of the entire process was kept for identifying discrepancies (Yin, 2014). However, as no discrepancies were identified, the data and analysis was accepted as true and correct. A confidentiality agreement form was signed to safeguard the privacy of the human participants' data collected.

Discussion of Findings

Two research questions guided this research that focuses on identifying teacher efficacy and middle school geometry classrooms in Bermuda. The interview protocol is in appendix A. I developed a detailed, thick description of data that would help answer the research questions that identify how to resolve the identified issue in middle schools in Bermuda. The interview protocol had the same or similar questions for all middle school mathematics teachers. The island of Bermuda is faced with students underperforming in mathematics, especially in the geometry unit at both internal and external examination. Using the interview data, the answer to research questions provided a perspective from the voice of those in the middle school mathematics classroom to address the problem that overshadows the island mathematics performance.

RQ1

RQ1 sought to capture middle school teacher's self-efficacy to teach geometry in their ability to challenge students to solve problems and justify their solutions. The interview questions from the interview protocols were used to capture data to address RQ1. The themes that emerged from the interview questions were grouped into the following themes: personal experiences, professional experiences, the methodology for teaching geometry, and confidence level in teaching geometry in the middle school classroom. Content Leader Mathematics 1 stated that geometry is her strongest area, but there is still a need for more experiences in some areas of the content in geometry. Content Leader Mathematics 2 said she is proficient in teaching geometry; however, Content Leader Mathematics 2 noted that there is also an area for growth in the mathematics classroom as a mathematics teacher. Content Leader Mathematics 3 noted that geometry is her strength, and therefore, she is very good at the content. Content Leader Mathematics 3 also noted that there are areas for growth in geometry teaching and learning. Mathematics teacher 1 said that geometry is a challenging area for students to learn, especially when it required them to justify their answers.

However, Mathematics teacher 1 in school 2 noted that he is proficient in content knowledge of teaching geometry. Mathematics teacher 1 in school 2 said he is very confident in teaching mathematics at the middle school level. Mathematics teacher 1 in school 3 said that he has been teaching mathematics for five years (5yrs) at the middle school at an M3 level. Mathematics teacher 1 at school 2 expresses that he is confident about his content knowledge in geometry at the middle school level; however, if he has to

teach beyond the middle school level, he may have to refresh his knowledge. Mathematics teachers and content leaders for mathematics who participated in the interview survey have five years (5yrs) or more teaching experiences at the middle school level. Two of the five mathematics teachers are currently teaching mathematics horizontally, meaning they teach all the classes at a one-year level. The other three mathematics teachers are teaching across all three-year levels in middle school. Mathematics teachers believed that geometry is taught very abstract in the classroom with no link to the real world and spatial awareness. One mathematics teacher expresses that he links his geometry lesson to playing football and other sporting activities.

Moreover, the consensus was that enough is not done to bring real-life or real-world experiences to the geometry classroom. One mathematics teacher said that it is always a challenge to get students to work with mathematical instruments in the geometry classroom because they have no previous knowledge of the geometrical instruments and how to use them during the mathematics lesson. Mathematics teachers believed that students struggle to use mathematical geometrical instruments like the compass and protractors to construct simple line segments and measure angles. Teachers have also pointed out that there is a need for formative and summative assessments for geometry to check students' progress and provide both the teacher and students with data that can be used to inform instructions in the geometry classroom.

Overview of Themes for RQ1

Data from the interview transcripts were analyzed to identify emergent themes. The interview questions were categorized into six headings: personal experiences,

professional experiences, the methodology for teaching geometry, confidence level in teaching geometry in the middle school classroom, in the geometry classroom, and PD. Text segment coding, which involved using words and phrases to correlate sentences and paragraphs, and in vivo coding, including coding of participants' exact words, were used for data analysis (Creswell, 2014). Thematic analysis was used to identify the major themes, and these themes were then aligned to the two research questions.

Theme 1: Personal Experiences

This theme emerged from interviews with each of the participants in response to several of the interview questions. All five participants view personal experiences as a vital factor in teaching geometry at the middle school level. All five participants express the view that their personal experiences at the middle school level influence how they approach their middle mathematics lessons. All five participants have five or more years of teaching experience at the middle school level in mathematics.

CW001 said:

> I am teaching middle school mathematics for the last 15 years. I have taught all three-year groups at the middle school level. I am the content leader for mathematics for the last 5 years now. As much as geometry is my strong area, I would say that I need more experience in some of the Geometry content areas.

DW001 said:

> I am teaching mathematics at the middle school level for the past 10 years. Currently, I am teaching mathematics at all three- year levels. I am currently the content leader.

S001 said:

> I have experience of teaching mathematics at both middle and secondary school level. I have 24 years of teaching experience altogether. I am currently teaching math at the middle school at two-year levels and serving as the content leader.

DW002 said:

> For the last 5 years, I am teaching mathematics at the middle school level. I have only worked at a middle school. So, my experiences are only at the middle school level in teaching mathematics.

SA002 said:

> I have 5 years of experience teaching mathematics at the middle school level. I teach only a 1-year group of students. I prepare my students for the Check- Point and City and Guild examination.

Theme 2: Professional Experiences

This team emerges as the interview questions seek to address issues in the geometry classroom. Three of the five participants in the interview said that they were content leaders for mathematics or the mathematics department's head at their respective schools. The other two participants were regular mathematics teachers. One of the content leaders for mathematics said that they could see themself growing in geometry and need more experience with the geometry content. Four of the five participants pointed out that they teach vertically across all three middle mathematics classroom levels. One participant said that they teach all the classes at a one-year level.

CW001 said:

> As content and an instructional leader for mathematics at the middle school level, I could see myself growing in many areas of mathematics content. I want to say that Geometry is my strongest area. I definitely can handle it, but I just think that I kind of put it to the sideline over the years. So, yes, I think I am good with the content but need more experience in teaching it.

DW001 stated:

> I am the content leader, and I teach mathematics vertically at all three- year level at the middle school level. I provided content and curriculum guidance for my department. I am knowledgeable of the middle school mathematics curriculum

S001 stated:

> I started M1, then move to M2, then M3; now I'm teaching all three levels. I am tasked with providing content and pedagogical support for the department members as the content leader.

DW002 stated:

> I feel good regarding my middle school teaching experiences.

SA002 commented:

> I am a mathematics teacher who teaches across two syllabi. I teach or prepare students for Check Point and City Guild Exams. I teach mathematics using the discovery approaches. I let my students discover their learning.

Theme 3: In the Geometry Mathematics Classroom

It is important to understand what is happening in the middle geometry classroom as students' success or failure is primarily hinged by the teacher's content knowledge and pedagogical approach to delivering mathematics contents and concepts in the classroom. CW001 said:

> I'm trying to figure out the gaps to know where the students might be in mathematics as this will help an effective plan for students' needs in the geometry classroom. There is also a need for more formative and summative assessment to help guide the planning of lessons to meet learners' needs in the geometry classroom." Content Leader CW001 stated that due to the COVID-19 pandemic, students transitioning into middle schools from primary school are lacking the prior knowledge of geometry.

DW001 stated:

> I provided manipulatives in the form of a cut of polygons and asked students to tell their friend which polygon they have. This was done to encourage students to discuss their observations in the geometry classroom. It also allows for the think-pair-share approach to learning the geometry classroom. Students were allowed to explore and discover multiple pathways to arriving at the correct answers in the geometry classroom. The COVID-19 pandemic and the early closure of school are two major factors affecting students learning in the classroom as they were not exposed to much of the geometry concepts at both the primary and middle school level, hence the lack of prior knowledge.

S001stated:

> I will start my geometry lessons with numbers just to get to understand students' background knowledge of numbers because students are required to do a lot of computation in geometry. Geometry lessons are sometimes linked to real-world connections. If students do not understand the concepts, I will reteach the concepts to ensure that all students understand.

DW002 commented:

> I would start my lesson with some number sense, a couple of addition, subtraction, multiplication, and division problems and then follow-up with a link to geometrical concepts such as exploring and classifying angles. This would also be done with a lesson on the properties of angles. Mathematics teacher DW002 also noted that the use of questioning strategies was used intentionally in his geometry lesson as a form of probing students' thinking skills. Geometry lessons were also linked to a real-world connection such as sports. Football is a major sport both male and female students play; therefore, the link was easy to create; angle to kick the ball to score a goal, the best angle for the penalty kick, and the marking of the football field are all related to geometry.

SA02 explained:

> I allow my students to explore the content and discuss the approach they will use to solve the problem. I let my students explore concepts to develop an understanding of the questions asked or the problem presented to them in geometry. Geometry lessons in my mathematics classroom are very practical as students are allowed to

discover, discuss, and explain their answers to the questions or problems that were presented to them.

Theme 4: Methodology for Teaching Geometry

The pedagogical practice in teaching geometry is to link concepts to the real world or real-life scenarios where students can make a meaningful connection to space and shapes. Vygotsky's social-cultural theory posited the importance of the social aspect of learning and thus teaching geometry using a scaffolding approach to increase students' participation in the geometry classroom (Schwarz et al., 2018). The teacher should ask leading questions, provide hints, allow for errors and mistakes, and create a healthy space for discussion in the classroom (Chiang, 2017). These approaches will encourage students to see the value in discussing geometry concepts with their teacher and provide them with an understanding of geometric concepts (Ngirishi & Bansilal, 2019).

CW001 stated:

> There is a need for assessments in the geometry classroom and the mathematics classroom. These assessment tools should be geared to help students prepare for the Cambridge Checkpoint Examination. There is a need for time to pace the geometry as this will help teachers to deliver the geometry concepts to students better. Students should be allowed to explore geometry problems and discuss with their classmates before providing answers. Geometry is more critical thinking rather than just giving the correct answers.

DW001 is of the view:

> Students should be allowed to explore how geometry is linked to real-world and daily life. Students should understand concepts before moving on to other topic areas in geometry. Students must develop a concrete understanding of concepts and can confidently provide solutions with justifications.

SA001 stated:

> Students must be allowed to justify their answers. Students must also be able to justify any proof they put forward as part of their answers. I sometimes find that students do not have the background knowledge to pull from; hence, they cannot justify the process they used to arrive at the answer, much less justify geometrical proof.

DW002 stated:

> I like to see how they can use it through different subjects and how geometry is our daily life. I would first want to make sure they understand the concept before I move on to the problem-solving basis, but once they have that concrete understanding, I feel very confident and then be able to give them problem-solving.

SA002 stated:

> I write my learning Intention with students' inputs. I let my students help me create the success criteria for my lessons too. My students are very involved in my math class. I use a more think- pair share approach to get students involved in the learning process.

Theme 5: Confidence Level

CW001 stated:

> I am confident in teaching geometry; however, anything where students are using geometrical tools, I'm a little bit nervous about just because a lot of times this is their first-time students are using them. I feel like I understand it, but I feel I have not put it in too much teaching practice because we cannot always race through the topics in geometry, so this is an interesting year due to the COVID-19 pandemic, I am not able to do one-one teaching due to social distancing.

DW002 stated:

> I would not say least confidence are two methods that I just don't like, which would be rote memory and algorithm-based teaching. I am confident in teaching geometry at the middle school level.

DW001 stated:

> I would say that I am pretty confident in the content level for geometry.

SA001 stated:

> I would say I am proficient or at a level of proficiency. I am getting better with the pedagogy with the learning support group of children.

SA001 stated:

> I would say I am good at the content level for middle school geometry. If I have to teach higher-level geometry, I will have to refresh my skills and knowledge.

RQ2

RQ2 was about what resources or support teachers need to improve their self-efficacy in teaching geometry at the middle school level. The following theme emerges

from the analysis relevant to RQ2; in the geometry classroom and PD. Participants noted that middle school students have gaps in geometry concepts. Therefore, it is always a challenge teaching geometric concepts to students because they first have to identify the gaps and address the same before progressing through the lesson. Participants also pointed out that in many cases, before starting the geometry lesson, they have to address student number sense deficits before teaching concepts such as finding the missing angles, measuring angles, and construction. It was evident that there is no support available locally for mathematics teachers in the area of geometry. All five respondents in the interview said there is no geometry PD session available for middle school mathematics teachers on the island. Four out of the five participants in this study said they had not attended any PD for geometry locally or internationally within the last 5 years. One participant said that they had attended an online math PD in geometry during the summer break. All five participants in the study concluded that there is a need for PD sessions for middle school mathematics teachers focusing on unpacking geometry content and concepts. Participants also express the view that there is a need for greater collaboration between middle school mathematics in planning and sharing best practices in teaching mathematics, focusing on teaching geometry.

Theme 6: PD

PD for educators is a crucial element in effecting change in the learning environment. Wieczorek (2017) said collaboration is one of the most effective ways to ensure that continued PD enhancement. Mitchell (2017) said educational settings could

get greater levels of students' engagement and achievement when collective efficacy among educators is practiced.

CW001 noted:

> I haven't attended any actually. There none available for geometry; I am not too sure if there is any specific to geometry, I haven't seen one or recall any for geometry. If I am honest, I do not think we have any session for geometry locally. There are no current geometry ones I have not found. I do not know if I missed.

DW002 stated:

> I have not, and that was with the aspiration of geometric concepts through problem-solving and relating real-life relate in real life and everyday life. I do not think there is anything available. I do not think any I had. I said none is available locally. I have not done any geometry workshop.

DW001 said:

> I have done some summer online PD on Geometry. There is no PD here in Bermuda on Geometry.

SA001 stated:

> In Bermuda, not any really on geometry. I do go to a workshop. It is usually not a geometry one, and it is more focused on the lower level. I would like to see workshop gear for the middle school geometry model. For geometry in the country or this country none that I know of currently or previously.

SA001 stated:

> I do not think any PD is available here on the Island in Bermuda specifically to geometry. The ones I have been to are for Number sense. I hope there will be a geometry PD geared to Middle school mathematics teachers.

The finding of this research is revealing that this is no PD session on the island that is geared to middle school geometry. There is little to no collaboration between middle school mathematics teachers across the island. Effective PD enables educators to develop the knowledge and skills they need to address students' learning in the mathematics classroom. Ongoing PD ensures that teachers' knowledge and skills stay relevant and up to date with the best educational practice. PD has the potential to change teachers' beliefs about their individual and collective efficacy (Zambo & Zambo, 2008). Personal effectiveness is positively associated with teacher motivation, which in turn affects student achievement (Bandura, 1977).

It was found that there is a lack of collaboration amongst middle mathematics on the island of Bermuda. Partnership forms an integral part of the education profession as it allows teachers, more so mathematics teachers, an opportunity to engage in joint activities, shared planning, critical dialogue and inquiry, mutual support, and addressing best practices in the mathematics classroom (Jaworski et al., 2017). Collaboration between teachers contributes to school improvements and students' success (Jackson et al., 2017). When individuals work together openly in education, the process and goals of teaching mathematics become more aligned, leading the group towards a higher success rate of achieving a common goal (Reeves et al., 2017). Teachers with a strong sense of individual efficacy tend to spend more time planning, designing, and organizing what

they teach. Teachers with a strong drive to collaborate are more open to new ideas, willing to try new strategies, set higher goals, and ready to work through setbacks and challenging times (Schipper et al., 2018).

Research question 1 asked, "What is middle school teacher's self-efficacy to teach geometry in their ability to challenge students to solve problems and justify their solutions?" In answering research question 1, several questions were posted as they related to the teaching and learning in the geometry classroom. The identification of teaching struggles and student's engagement in the classroom was made through students' active involvement in lessons and the differentiated instruction of think- pair sharing. Content leaders and mathematics teachers shared that students are allowed to explore geometry concepts and share their findings with the class. Mathematics teachers also shared that students have a deficit of geometry knowledge because of the pandemic many students were either not exposed to any geometry concepts before transitioning to middle school from primary school, or the middle school students were not exposed to geometry because it is usually the last topic to taught on the mathematics syllabus.

Research Question 2 asked, "What resources or support do teachers need to improve their self-efficacy in teaching geometry at the middle school level?" In answering this question, interview questions were posed related to PD and support available for middle school mathematics teachers on the island locally. The overall answer to this question from the interviews was that there is no PD session offered for middle school mathematics in the area of geometry. Teachers felt too there is a lack of collaboration across the island amongst middle school mathematics teachers.

Study findings support the development of a comprehensive PD plan for middle school mathematics in the area of geometry. The workshop will be focused on increasing efficacy and collaboration for middle school mathematics teachers. Through the development of collaborative relationships, middle school mathematics can create a culture of learning that will bring together the voices of all stakeholders to realize a rigorous effort of helping students in the geometry classroom attain academic success.

Discrepant Cases

Discrepant cases occur when participants or samples do not fit according to the research design and can potentially modify the outcome of the study (Hackett et al., 2016). Constant comparisons of data are an essential process because it allows the researcher to identify deviant cases (Flick, 2018). Constant comparison is a coding technique that allows for the comparing text all the time, intending to find features about the text and its content (Glaser, 1965; Ravitch & Carl, 2016). The researcher must analyze to purposefully look for data that might modify or change the outcome of the finding of the study (Merriam & Tisdell, 2015). A researcher's goal is to look for patterns and conclusions from which substantial evidence can be formed or assessed (Merriam & Tisdell, 2015). If discrepant cases are identified, these will be reported in the study.

The strategy I employed while analyzing the data was to identify or factor in discrepant or disconfirming data. When analyzing the interviews, no outliers or conclusions that would not be consistent with other study findings or that would alter the study's findings were identified. Creswell (2012) indicated that researchers should look

for data that may conflict with the study's findings. However, I did not detect any evidence of discrepant cases or unfavorable findings.

Evidence of Quality

Members' checking was conducted as a safeguard to ensure the results of this study are considered credible and accurate. Member checking is an approach that involves multiples of external data collection methods, thus mitigating bias and controlling any influence that the researcher's cultural and background experiences can have on the findings or interpretations of the study's results (Amankwaa, 2016; Ravitch & Carl, 2016). Member's checking was used to cross-check the varying data sources to confirm that the information is correct (Creswell, 2012; Yin, 2014). To ensure that the data's quality is collected and avoid potential research biases, each participant was given a hard copy and an email copy of the findings to check for accuracy (Creswell, 2012; Vasileiou et al., 2018). Participants were asked to highlight the inaccuracies of the findings and the page number and send the correct responses that should be used. However, no inaccuracies were identified the participants signed in agreement with the findings. Participants were given 10 days to verify the findings, after which they returned the hard copy of the document.

Peer debriefing was used as a form of quality check for data accuracy. Participants were allowed to review the data collection and analysis processes. Peer debriefing enabled teachers to review the entire process of data collection and data analysis and provide feedback to validate the entire process's accuracy (Richards & Hemphill, 2018). Entries in a log of the entire process were kept to identify discrepancies

(Yin, 2014). However, no discrepancies are identified, and the data and analysis were accepted as true and correct. A confidentiality agreement form was signed to safeguard the privacy of the human participants' data collected.

Data Validation

Data validation is crucial for establishing the accuracy and validity of the research findings. The researcher needs to understand the importance of being accurate in interpreting the data and reporting the findings of the research. Findings from case studies are believed to be more precise and convincing if the findings are derived from multiple sources of information; however, due to the pandemic of COVID-19, it was impossible to collect data from other sources. The finding of the research can also be validated by conducting a member check. After the transcription of the interviews and data analysis, I emailed the summary of the findings to the participants to confirm accuracy. This process was used for the respondent to validate the participant feedback interpretation (Jones et al., 2020).

There were no edits made or a request from the review of the findings. I used the themes emerging from the interviews with the mathematics teachers to establish the study's findings. Data from the interviews were the only source of data collected.

Project Description

The data were analyzed the data from the case study interviews to establish how best to address the teacher's self-efficacy and support the need to promote best practices in the geometry mathematics classroom. An analysis of the interview data led to the emergence of numerous themes: Personal experiences, Professional experiences, In the

Geometry mathematics classroom, Methodology for teaching Geometry, Confidence Level, and PD. Based on the interview data analysis, a logical project was developing a PD plan designed based on best practices and up-to-date research. In the PD plan, Teacher will be provided with resources to implement in their geometry classroom. A detailed scheme of work for geometry will be given to teacher and assist middle school mathematics teachers in unpacking the content in the classroom.

All participants noted that PD is offered in Bermuda; however, none of the PD targeted middle school geometry. Therefore, a comprehensive geometry PD plan will provide more than just sit and talk sessions, which is not the best approach to impart knowledge in an educational environment. The plan will focus on building capacity in middle school and providing a platform for collaboration and sharing best practices in geometry and mathematics in general.

Conclusion

A qualitative case study was designed to address students' prevailing problems underperforming in geometry at the middle school level and to identify middle mathematics teacher self-efficacy. To gain an understanding of this phenomena, interviews were conducted with full-time middle school mathematics teachers. The interviews as a data collection tool informed the direction of the study as a qualitative case study, which was the most suitable research design to address the local problem and research questions. In Section 2 of this qualitative case study, I presented the study's methodology with a detailed description of the rationale for the study design and

approach; participant selection: procedures for data collection, data analysis, and credibility of the findings from data analysis.

The data collection process was done using interviews with middle school mathematics teachers. Five middle school mathematics volunteered for the interviews. The interview was transcribed, analyzed, coded, and interpreted the interview data to identify emerging themes. The study's findings was used to develop a PD plan for middle school mathematics teachers with a focus on Geometry. Due to the COVID-19 pandemic and busy hurricane season, teachers are overwhelmed, and therefore, only five teachers across all three middle schools volunteer to participate in this study.

In Section 3, I outlined the project that I will be developing to tackle the study's findings. This section includes a rationale for the selected project, a review of literature, a supporting framework, a description of the project, and an evaluation tool for measuring the plan's effectiveness. The project will focus on capacity building and collaboration across middle school mathematics teachers to boost teachers' self-efficacy and promote best practice in Bermuda's mathematics geometry classroom.

Section 3: The Project

Introduction

PD is used for the growth and development of teachers. Effective PD enables educators to develop knowledge and skills they need to address students' learning challenges and needs effectively. It helps teachers continue to not only be competent in their profession but also excel at it. It also allows teachers to reflect on and improve their instructional strategies, which helps develop students' interaction skills and enhances their full learning potential. This study involves three themes that contribute to the PD of mathematics teachers, active engagement of adult learners, and collaborations.

Collaboration through PD gives teachers the chance to reinforce existing and learn new skills that were not covered during their training. In essence, PD allows school administration, boards of education, and the Department of Education to retain their best educators and prepare and identify future education leaders. PD in the broader sense helps organizations grow their human resource capital to cope with new dynamics of the working environment. Educational PD contributes to nurturing best practices for classroom professionals, content leaders, and school administration in order to deliver education effectively. The purpose of this qualitative case study was to identify the needs of middle school mathematics teachers in Bermuda which promote their self-efficacy and students' achievement in the middle school geometry classroom.

A comprehensive PD plan was developed to address the needs of middle school mathematics teachers in Bermuda. The development of the plan was based on and guided by themes that emerged during the data analysis process: collaboration, support, PD, and

the professional learning community. The project was developed with a focus on collaborative professional learning with strategies to increase students' performance in geometry and help teachers be more confident during the delivery process of teaching and learning geometry at the middle school level.

In Section 3, I describe the premise for a comprehensive PD plan, project goals, rationale for the selected plan, implications for social change, and the evaluation tool used for measuring the plan's effectiveness. Further, a literature review is discussed. This is based on andragogical practice and the adult learning theory. This section also includes information regarding implementation, timetables, potential resources, existing support, potential barriers, roles, and responsibilities (see Appendix A).

Project Description and Goals

The project study is a well-structured PD plan focused on needs of middle school mathematics teachers via a professional learning community. It involves planning of lessons, content development, and quality assessment of middle school geometry. The plan incorporates learner-centered best practices and research-based approaches that are critical for successful PD through increased professional learning communities.

The overall goal is to empower middle school mathematics teachers to create a collaborative culture and climate that allows for the sharing of resources, knowledge, and skills that will increase students' performance in geometry at the middle school level. The program will amplify the current PD with a plan that incorporates all middle school mathematics teachers and curriculum officers to promote growth and development during

the teaching and learning of geometry, contributing to overall pedagogy in mathematics at the middle school level.

Rationale

This study will help teachers develop content knowledge and pedagogical skills as well as a higher level of self-efficacy through collaborative learning communities. As teachers grow from new learning and knowledge, students benefit from transfer in the classroom.

When teachers receive PD, the classroom environment is enriched (Kaur & Wong, 2017; Mohr & Shelton, 2017). This means that there is a direct transfer of knowledge from teachers to students. When mathematics teachers are engaged in PD, there is an opportunity to foster understanding, share information, exchange ideas and perspectives, and develop a professional learning community (Bergmark, 2020). These sessions will be differentiated to meet the needs of teachers participating in sessions in terms of content knowledge, planning lessons, and writing assessments for the geometry units. Differentiated PD targets teachers and educators' specific needs and is more effective as it allows sharing of new knowledge, skills, and expertise during sessions (Valiandes & Neophytou, 2018).

This plan was developed from findings during interviews. The plan addresses issues related to supporting teachers' needs to grow professionally, set a high level of self-efficacy, and provide lessons to challenge students in terms of critical and analytical thinking in geometry. Developing a project centered on PD is ideal for addressing the needs of middle school teachers who participated in this study. PD is used to effect

change in the education system. The use of PD in geometry, in this case, is specific to the needs of middle school mathematics teachers. The plan was developed with the hope of fostering better collaboration, building capacity, and promoting a rich culture of collaborative learning for middle school mathematics teachers in Bermuda.

Review of the Literature

The purpose of this section is to provide a scholarly literature review of current research on the use of PD and collaborative learning to bring about change in the learning environment of the mathematics classroom. PD that is continuous and sustained through collaborative practice was found in literature as a means of developing and cultivating a climate that is conducive to sharing and exchanging best practices in teaching and learning. It was also noted that the culture of collaboration helps increase students' overall academic performance because teachers are more equipped to address students' diverse needs in the mathematics classroom.

Strategy Used for Searching the Literature

The literature review in this section involves PD and cultures of collaborative learning for mathematics teachers to increase students' achievement in mathematics. PD is essential as it builds the capacity to improve teachers' knowledge in their area of specialization. The approach used to conduct this literature review included a comprehensive review of literature related to PD and collaboration in mathematics. Key terms used in searches related to PD were *professional development for mathematics teachers*, *effective professional development*, *adult learning theories*, *andragogical practice in professional development*, and *benefits of learning communities for*

mathematics teachers. SAGE Journals, ERIC, and Google Scholar were used to find peer-reviewed articles published within the past 5 years. This review of literature involved development of themes related to the benefit of PD for mathematics teachers and how to address PD for adult learners.

Learning Theory

PD for teachers involves the andragogical practice of teaching and learning. Adult students gravitate to lessons that are important to them and at the same time bring about change in their knowledge. Knowles et al. (2015) said adults are self-directed and expected to take responsibility for their learning. Andragogy refers to adult education's methods and principles (Granziera & Perera, 2019; Hagen & Park, 2016; Knowles et al., 2015; Loeng, 2018). Andragogical practice focuses on adult education and space on the following precepts that adults: direct their learning, connect past learning experiences to current experiences, must be intrinsically motivated to participate in learning, have a readiness to learn what is essential to deal with a real-life situation, learn best when that topic is of immediate value to them and approach learning's problem solving (Galustyan et al., 2019; Hagen & Park, 2016; Knowles et al., 2015; Loeng, 2018).

According to Knowles et al. (2015 andragogy is an enhancement to create a conceptual framework of adult learning. Knowles defines andragogy as the Art and Science of helping adults learn (Loeng, 2018). Andragogy is grounded in the principle that teachers enable a climate of “adultness” in the classroom environment; an atmosphere of mutual inquiry and learning occurs (Hagen & Park, 2016). Based on these premises, Knowles et al. (2015) defined four basic principles including; adults have a

self-directed self-concept, adults bring a wealth of experience to the learning process, adults enter the learning process ready to learn relevant information, and adults are oriented toward the immediate application of learning (Arghode et al., 2017; Hagen & Park, 2016; Loeng, 2018).

Knowles et al. (2015) said adult learning as being problem-based and collaborative. Knowles et al. said adult learners respond to growth and learning when external motivators are present. Adult learning, according to Knowles et al. should encourage learners to learn more when adults have some buy-in and input in the learning process; they are more prone to engage in the process actively. Knowles said that an adult making their decision relative to learning is a motivational factor. The adult learner is self-directed free and in a growth mindset, all of which are factors or attributes of an andragogical practice (Arghode et al., 2017; Hagen & Park, 2016; Knowles et al., 2015; Loeng, 2018). The premise of adult learning is to transfer knowledge and practice in the classroom to increase students' performance (Arghode et al., 2017; Hagen & Park, 2016; Knowles et al., 2015; Loeng, 2018).

In relation to this study, that would entail the teacher's self-efficacy and students' academic success in the geometry classroom on Bermuda's island. Knowles et al., 2015 view andragogy as a form of adult learners, is self-directed, free, and growth – a learning mindset. Knowles' theory of andragogy assumed that students' motivation is key to getting students to participate in classrooms. The principle and practice of adult learning are to transfer the knowledge to the classroom practice for growth and student achievement (Fischer et al., 2018).

PD for Mathematics Teachers

PD will be conducted over a three-day period via zoom. The three days professional development will target all middle school mathematics teachers. This project's overall goal is to develop a comprehensive professional learning community on the island where mathematics teachers can share their knowledge and skills in creating a culture of learning. This project's underlying goal is to increase teachers' self-efficacy in the teaching of mathematics in the middle school classroom and increase students' overall academic performance in mathematics. Additionally, this plan aims to create a cohesive learning community that fosters collaboration, engagement, and input from all middle school mathematics teachers on the island of Bermuda. The professional project plan is attached in appendix A.

Effective PD

Professional development increasing teacher's self-efficacy was generally focused on building the teacher's capacity to promote students learning of geometry in the classroom (Simamora & Saragih, 2019). Effective professional development for mathematics teachers only happens when the session addresses the mathematics teacher's specific needs (Sims & Fletcher-Wood, 2021). Effective professional development considers the teacher needs, allows for teachers to be part of the planning process, and leads to the increase of teachers' knowledge (Darling-Hammond et al., 2017; Jacob et al., 2017).

High–quality, effective PD for mathematics should be sustained, content and pedagogical focused, research-based, centered on teacher self-efficacy, and involved in

active learning to promote a growth mindset (Darling-Hammond et al., 2017; Jacob et al., 2017). Effective professional development focuses on three concepts; content, context, and process (Darling-Hammond et al., 2017; Desimone & Pak, 2017). The process through which knowledge is imparted during professional development is called the content (Drossel et al., 2017).

An effective PD is built on three conceptual foundations of content, context, and effective process of engaging a learning community of education (Vangrieken et al., 2017).

During professional development, the content presented is the knowledge that is being transferred or imparted. The context is the environment in which the knowledge is shared. The process is the approach used to present the PD session (Almuhammadi, 2017). These three categories incorporated the TPREP standard 2: Demonstrate Knowledge of Content and Curriculum adopted by the Bermuda Department of Education to guide best practices in the classroom. When mathematics teachers and mathematics content leaders participate in professional development, it will allow them to develop a culture of sharing knowledge, incorporative collaboration, and be exposed to new perspectives (Lotter et al., 2020). Delivering professional development using the workshop method can be a crucial barrier to effective PD (Shernoff et al., 2017). The workshop approach to professional development can be seen as a passive approach and does not consider teachers as learners and does not rely on or built on teachers' prior knowledge and experiences (Shernoff et al., 2017).

The desired goals and outcomes from a professional development can only be achieved if the planning and preparation execution process is effective (Mohr & Shelton,

2017). A successful professional development can lead to a growth mindset for mathematics teachers and mathematics content leaders, resulting in increased students' achievements (Jacob et al., 2017). With collaboration amongst middle school mathematics teachers identified as the key that drives change in the learning environment, all middle school mathematics teachers must be included in the PD (Akkuş & Karakaya, 2020). When mathematics teachers collaborate ideas, knowledge, skills, and best practice, it enhances the teacher's self-efficacy in the middle school mathematics classroom.

Ineffective PD

On the job training that allows participants to engage in meaningful discussions, activities, and projects that will allow for growth and new knowledge is considered professional development (Pérez-Foguet et al., 2018). When PD is implemented in fragments, poorly planned, and does not consider the needs of teachers, it can be regarded as ineffective PD (Van der Klink et al., 2017). PD that does not consider the subject matter, teaching age group, and professional experiences of the teachers is unproductive and ineffective. The one size fit all professional development is not effective in achieving the session's goals and outcomes (Almuhammadi, 2017).

As much as professional development is done in mathematics, if it is not geared to content specifics for mathematics, some teachers will lose interest. Professional development does not get attention unless it is addressing the specific needs of mathematics. It is essential to create professional development that considers the audience, the needs of the audience, and the method of delivering the professional

development to the targeted audience (Jin et al., 2019). Adult learners are very different from students as they are bringing to the learning environment prior knowledge and experiences. If the learning is not connected to current learning, they will not remember it.

Active Engagement of Adult Learners

Adult learners are most likely to be actively engaged in learning when given a menu of choices and are in control of the learning process (Knowles et al., 2015). To keep adult learners engaged, the PD must be relevant, include activities and assignments that encourage adult learners to explore. PD must consider the experiences and educational background of the adult learners and provide immediate feedback to allow adult learners to learn from their mistakes and integrate emotionally-driven content (Housel, 2020). The driving motivation for adult learners is a general self of accomplishment. Adult learners want solutions to their real-world problems or issues they may have limited knowledge or experiences, so PD has to meet every participant's needs. As the world shifts its focus to 21st-century teaching and learning, teachers must be given an opportunity through PD to explore and learn what is required of them to effectively deliver education in the 21st-century classroom (Koh et al., 201).

Teachers must embrace that self-efficacy is essential to continue to be effective in a mathematics classroom, and self-efficacy comes from being an actively engaged learner in the mathematics classroom (Kutaka et al., 2017). Policymakers should consider creating a space that will continuously engage mathematics teachers and professional development as a useful measure for improving students' overall achievement (Kutaka et

al., 2017). For educators to learn and be better at their craft and raise students' achievement, they must be meaningfully engaged in professional development. Professional development is a strategy used by the education system to actively engage educators to strengthen their performance levels (Kutaka et al., 2017).

Active learning works well and is useful when it engages the learners in the learning process. Active learning allows for the sharing and respectful exchange of thoughts and ideas. It allows for discussion, problem-solving, case- study, role play, and effective communion of ideas (Khan et al., 2017). There are four essential components of active learning: planning instruction, providing professional presentations, conducting peer observation, and engaging in a collaborative discussion (Desimone, & Pak, 2017; McGee & Nutakki, 2017). Teachers who are always involved in professional development as a form of active learning show increased knowledge and instructional practice in the classroom (Almuhammadi, 2017). Teachers who are actively engaged in professional training and professional development acquire the essential skills for fulfilling their duties and assuming roles as influential content leaders for mathematics.

Learner-Centered Approaches of Adult Learners

A learner-centered approach views learners as active agents (Yasmin et al., 2017). The learner-centered approach is suitable for the adult learner because they contribute to the learning environment their knowledge, past experiences, education, and ideas, allowing them to link new learning to prior experiences (Lojdová, 2019; Yasmin et al., 2017). It is essential to consider the adult learner's interests, needs, and expectations when planning professional development (Mohr & Shelton, 2017; Powell & Bodur,

2019). Learner-centered approaches in professional development encourage adult learners to construct their meaning of information presented to them (McDonough & De Vleeschauwer, 2019; Paquette & Trudel, 2018).

Collaborative Learning

Collaborative learning is an umbrella term used in education to describe the engagement of educators or students' intellectual efforts to come together to work on problems and the share of ideas (Major, 2020). Collaborative learning helps develop a higher – level of thinking, self-management, leadership skills, and good oral communication, all of which are via for self-efficacy in education (Zheng et al., 2019). Collaborative learning assists in these seven characteristics; strong leadership, clearly defined roles for sub-groups, consistent, united, and enthusiastic effort, effective and frequent communication, shared resources, focus on a common goal, and provide selfless dedication to work for the good of the goal (Brown & Poortman, 2018). Collaborative leadership in education is when teachers, staff, parents, students, and building leaders in education collaborate to solve problems that are affecting education (Preston & Barnes, 2017). It is a process of working together to create an engaging climate that will accelerate student learning overall (Preston & Barnes, 2017). Teachers' continuous engagements in professional learning communities and collaboration activities are critical for improving their knowledge, instructions, and students learning overall (Preston & Barnes, 2017).

Project Description

This project was created to address the problem based on teacher perceptions of teaching geometry at the middle school level on the island of Bermuda. This project consists of three days professional development session via Zoom. This project will address the concepts of collaboration amongst middle school mathematics teachers, test development for the geometry unit and unpacking the geometry curriculum for middle school mathematics teachers.

The project aims to provide professional development opportunities for middle school mathematics teachers and develop a professional learning community to allow middle school mathematics teachers to develop self-efficacy in the teaching and learning of geometry. This project was designed to address the teachers' self -efficacy in the middle school classroom through the following; engaging middle school mathematics teachers in a conversation about the strategies that can be implemented to address best practice in the mathematics classroom ,identify the resources needed at the middle school level to deliver the mathematics curriculum effectively, utilizing professional development and collaboration to build system capacity for middle school mathematics teachers and being proactive in addressing the needs of middle school mathematics teachers to increase learning opportunities. The project will serve as a deliberate approach to help the island rethink how students' learning might be improved through the support given to mathematics teachers.

Implementation

The project is aimed at increasing the self-efficacy of middle school mathematics teachers through professional development. The project will include three-day Zoom PD meetings for middle school mathematics teachers. Due to the COVID-19 pandemic, face-to-face sessions are not possible; hence participants will be engaged in the learning session via zoom. Following the three-day PD training sessions, there will be a follow-up professional learning community for collaboration and sharing best practices in mathematics for the remainder of the academic year.

Resources

Since the session will be held via Zoom, it is important to ensure that all necessary material for the PD is sent to participants via email in advance. There are 15 mathematics teachers in 4 middle schools. One of the major resources is connectivity to a stable internet connection for the sessions. The availability of scheduled time for the PD for mathematics teachers is another factor that has to be worked out with the schools and the Department of Education. My knowledge of organizing and planning sessions for professional development in education and my understanding of the finding of the study I disbanded through the interview will help develop a professional learning opportunity that meets and identifies the needs of the island of Bermuda.

The Department of Education in Bermuda has a yearly schedule allocated to these PD's required for staff developments. Therefore, the time to conduct the PD will not be an issue with approval from the Department of Education in Bermuda. This professional development opportunity can be used in place of one of the islands usually provided. The island also has facilities with ample space for conducting professional development by

implementing zoom sessions, which is another online platform due to the COVID-19 pandemic. Zoom platform provides for extensive group sessions as well as accommodating breakout sessions during the training. Other resources such as technology needs are readily available on the island, and qualified professionals who can conduct the session to build system capacity and promote a team culture.

Potential Barriers

The current design for PD is the lecture method or sit-and-go session. However, I plan to have more discussion and input from each of the participants during the PD session. Therefore, I will have to work around the lecture method's culture or sit-and-go session PD and in a cooperative, participatory approach. Participant may resist change because are accustomed sit-and -go during PD sessions.

Other factors that may pose barriers include internet connectivity, working laptops, administrative policies, and commitment from mathematics teachers to participate in the sessions. The COVID-19 pandemic and the constant changes in how the school operates from online teaching to in-class teaching may cause teachers to be overwhelmed and therefore hesitant to participate in professional development.

Solutions to Barriers

To address the issues of sit-and-go or lecture method professional development, I will use breakout groups via Zoom platform to have teachers work in groups according to the year level they are currently on assigned task. Task will be timed so as to provide a more structured and meaningful engagement during the sessions. To ensure that all participants have a working device and internet connectivity I will liaison with IT

department of the Ministry of Education prior to sessions, so as to ensure that they check each teacher device and internet connectivity at school. School leaders will be informed in advance of the professional development sessions so as to address any administrative concerns.

Role and Responsibilities of Teachers and Facilitator

Facilitator

As the researcher, my role was to develop a professional development plan. I have outlined the goals and objectives of the plan. The plan was developed after analyzing the findings from the data gathered and during the interviews conducted. It was seen from the data collected and analyzed that there is a need for PD for mathematics teachers in geometry at the middle school level. My responsibility was to identify an issue confronting the island, determine what was causing the problem and develop a plan to address the island's issue.

A review of island data reflected that an issue the island was facing was a low academic achievement in mathematics and particular geometry. My role was to collect and analyze data to identify what was prompting students to perform poorly in the geometry units at the middle school level. Based on my findings of the data collection and analysis, my role was to develop a plan with the increasing success of students' overall performance in geometry and more so in mathematics at the middle school level. As the plan was being developed, each aspect of our component had to be perfected and addressed in the culture and climate of the learning environment on Bermuda's island.

This entails that mathematics teachers understand that their overall self-efficacy affects students' academic achievements in the classroom.

Teachers

The role of the teachers is to become active participant in professional development sessions. Teachers are also expected to take lead in sharing out from group presentations. Teachers will also do a daily reflection on the professional development session and provide the facilitator with feedback. Teachers must also be willing to complete the survey at the end of the three days sessions. It is also expected that teachers will be committed to developing a professional learning community through collaboration for the staring of best practice in the teaching and learning of geometry at the middle school level.

Project Evaluation Plan

Formative Evaluation

The evaluation plan for this study is to review feedback captured on the attendee feedback survey. This formative part of the process will help capture data from the survey to determine the PD's perceived effectiveness and gauge the need for continued professional development throughout the year. The evaluation reviews will be conducted immediately following the three-day sessions to ensure there is ample time to implement follow-up sessions as needed throughout the year. Follow up will include completing an online survey using Google Forms across all middle schools in Bermuda.

Summative Evaluation

The evaluation will be conducted at the end of the year in the form of a summative assessment to determine the PD's effectiveness. Part of the evaluation will include monitoring students' academic performance over the academic year on Bermuda's island with data gathered from both internal and external examinations. Effectiveness of the PD for mathematics teachers and content leaders will also be conducted at the end of the year through a student survey to determine if students distinguish a change in the learning environment. Evaluations from school leaders will also capture growth and envelopment and a form of mathematics teachers' self-efficacy in the mathematics classroom.

PD will be structured to engage all mathematics teachers and content leaders for mathematics on Bermuda's island who are involved in teaching mathematics at the middle school level. Professional development's overall goal is to determine whether collaboration among middle school mathematics teachers is effective in cultivating the culture and climate to increase student achievement in the mathematics classroom. Additional goals would be to create a collaborative learning culture where teachers are the central focus of the PD and foster inter-professional development collaboration. Students become the central focus of the overall team.

The project evaluation will be an ongoing effort to allow ample time to monitor and determine the plan's effectiveness. The plan's suitability will be affected by many variables, internal and external, which the schools' control. In this process, time is an essential factor as it will determine how each variable impacts the plan's effectiveness.

Time will also tell if other factors dictate a need to change or adjust to the plan to activate the goals and attain the objectives outlined effectively.

Project Implications

Findings from this study provide a rationale that working in isolation as a mathematics teacher is not efficient to bring about change in the learning environment. This research confirms that effective professional development for all middle school mathematics teachers who are teaching at the middle school level can catalyze changing the culture and climate on the island resulting in an increased student academic achievement in mathematics at the middle school level. Research findings further reflect that sustained collaborative, coherent, and content focus professional development is essential and serves as a tool for addressing teachers' self-efficacy and teaching and learning geometry on the island. In addressing the issue of poor mathematics performance, it must be noted that effective PD targeting the specific content area in mathematics can impact students' academic performance.

Conclusion

This project's overall goal is to increase teacher self-efficacy and the teaching and learning of geometry at the middle school level on the island of Bermuda. The project also strives to build a climate of collaboration with mathematics teachers at the middle school level. This project was developed with adult learning theories and strategies to actively engage the adult learner through professional development sessions in Section 3. In describing the project, I provided a theory of the framework and a review of the literature to substantiate a comprehensive professional development plan. Section 4

describes the strength and limitations of the project self-analysis recommendations for alternative approaches, implications, applications, and directions for future research.

Section 4: Reflections and Conclusions

Section 4 includes strengths, limitations, and recommendations of the project. This includes an overview of my role as the scholar, project developer, and practitioner, as well as how middle school mathematics teachers can be useful in terms of bringing about change in the delivery of geometry content in the classroom. Section 4 concludes with reflection regarding work implications and directions for future research.

Project Strengths and Limitations

Strengths

This project has both strengths and limitations. One strength of this project is that findings from the research study and current literature were used to develop the project. Another strength of this project is that data collected through interviews were used to develop teams that reflect similar needs involving effective change and delivery of geometry content at the middle school level as well as needs for PD for mathematics teachers. Providing workshops that caters to participants' needs may lead to an increase in collaboration among middle school mathematics teachers as well as better 'buy-in' from schools and building leaders.

Government policies and regulations often dictate what happens in terms of curriculum delivery within schools. However, some of these policies do not consider individualized needs involving PD for teachers within the mathematics classroom. Addressing this issue of PD for mathematics teachers' needs, especially in terms of teaching and learning geometry, led to both strengths and limitations for the study.

Limitations

One limitation was the sample size of the study. Due to the COVID-19 pandemic and a busy hurricane season, teachers were overwhelmed, and only five mathematics teachers volunteered to participate in this study. In view of this, three were content leaders for mathematics and two were regular mathematics teachers with 5 years and more years of experience teaching middle school mathematics.

Time was also a major constraint since sample population consist of all full-time teachers, hence scheduling interviews proved challenging. This study provides PD that addresses middle school mathematics teachers' needs through data which shows how to make connections between curriculum, instructions, and assessment when delivering concepts of geometry to middle school students which has proven to be a necessity that was lacking.

Recommendations for Alternative Approaches

PD in education plays a vital role in the growth and development of teachers. PD should be an ongoing process, and there are many approaches to addressing the professional growth of mathematics teachers at the middle school level in geometry. One would be to embed professional learning opportunities throughout the school calendar year and provide adequate resources for middle school mathematics teachers that are both specific in terms of content and pedagogy that is specific to their needs. Education officers, curriculum planners, and building leaders should have specific PD required yearly for each mathematics teacher at the middle school level. PD can be mandatory, but some can be in-service if required training is covered over time.

Scholarship, Project Development, and Leadership and Change

Through this process, I have become a scholar. I have learned how to live an academic life by researching and applying knowledge and skills into my daily practices in the classroom. As a scholar, I have shared my new knowledge, experiences, and skills with school administration and fellow professional educators who can influence change. I have always been an advocate for quality and equality in education. I believe that the lack of good quality education can impact an individual's ability to be a productive member of the global society. I am conscious that there are jobs that individuals may be successful in without education in that area; those with education may have more significant advantages in terms of securing a job. Any education system that lacks a visionary leader and contains unskilled educators, limited resources, and disconnect from students' needs and the community cannot fully meet the needs of learners.

Being able to ensure students are afforded the best quality education and mathematics assessment is a passion of mine. I am eager to contribute to literature that addresses mathematics teachers' efficacy in middle school classrooms. As a mathematics teacher and content leader for mathematics myself, I can see the direct impact quality instruction and assessment in the middle school mathematics classroom can have on students' ability to develop critical mathematical thinking skills at the middle school level.

Conducting the study and developing the project allowed me to improve my skills as a scholar further. Conducting this study enabled me to research current best practices related to delivering PD and build collaborative and professional learning communities

among mathematics teachers at the middle school level. I have gained additional insights that may prove beneficial as I continue contributing to education, especially in mathematics, and make a difference in the lives of mathematics teachers and students I have come in contact with.

My current role allows me to have an even more significant impact on social change. I am currently working alongside the education officer and math education officer for training and mathematics development. I was also instrumental in helping the Department of Education prepare the pacing guide and essential curriculum for middle school mathematics. This role allows me to bring about social change for middle school mathematics teachers on the island.

Project Development

Developing any project can be a tedious yet rewarding task. Several internal and external variables must be considered when planning a project. One key factor to consider when developing a project is anticipated or expected outcomes of that project. The outcome or objective is also what drives and dictates the direction of project development. In developing projects, I prefer to do a project analysis to identify everything that impacts the project's full implementation and outcomes. There are always opportunities for roadblocks, setbacks, and sometimes different directions for a project. Proper planning of a project prevents poor performance during the project's implementation stages.

The interest and developing a comprehensive professional development plan grew out of the need to address the problem identified in middle school mathematics teachers

on the island, study finds, and approach methods to address the problem as reflected in the review of the current literature. There are many and varied reasons why middle school mathematics teachers' self-efficacy determines their ability to effectively deliver the mathematics curriculum to the learners at the middle school level; however, this study focuses on teacher self-efficacy in middle school geometry classrooms. I identify that there was no professional development in geometry for middle school mathematics teachers on the island through study findings. Therefore, I decided to develop a project to address mathematics teachers' needs at the middle school level on the island. This project's development will help me provide a course of action for middle school mathematics teachers on the island to address a prevailing issue on geometry.

Leadership and Change

Leadership by nature is a process of social influence that guides a team of people to achieve a common goal. Leaders set the direction; they must also use management skills to guide their people in the right direction smoothly and efficiently to achieve the organization's overall objective and the project they're overseeing. In this regard, continuous professional development is a prerequisite to refine and cultivate the characteristics an effective leader must acquire. Professional development for mathematics that is round by the Department of Education is sometimes poorly prepared and therefore does not cater to middle school mathematics teachers' needs. Content leaders for mathematics are occasionally charged with promoting teacher's growth and development through professional learning communities within their building.

Influential mathematics leaders should exhibit a strong character, a strong content knowledge, a robust pedagogical understanding of the content of mathematics, and they should also demonstrate good leadership qualities such as honesty, integrity, trustworthiness, and ethics. Mathematics leaders within the building must be abreast of current best practices and trends in mathematics education. An effective content leader for mathematics well evaluates his or her school's performance against that of the country's performance and the other middle schools on the island.

Reflection on the Importance of the Work

Developing this project is essential as there is a dire need for professional development in geometry for middle school mathematics teachers. Establishing the factors that lead to the island's identified problem is necessary for determining the approaches to tackle the problem. Social change can only take place when someone is willing to research and plan for change. It is often easy to find a problem and identify the issues, but only when a solution is offered to address the problem and issue only then change can happen. The development of a comprehensive professional development plan was identified as one way for the island to address the problem of mathematics of teacher's self-efficacy and teaching and learning of geometry at the middle school level. Tackling the problem resulted in managing the growth and development of mathematics teachers through the professional development of those who impact making changes. Individuals need to provide learning opportunities for teachers to be afforded the opportunity for growth and learning themselves to impart knowledge in the area of mathematics to the students at the middle school level.

It's always easy to complain about the problem without having to identify the root of the problem. As a scholar, I would better understand an issue through data collection and analysis. Only with true comprehension of the problem I would be able to provide useful suggestions for resolving the issues. The problem identified was clarified true data analysis and interpretation. Once the problem was identified, I worked to develop a possible solution to address the identified problem. The solution plan provided an organizational way to work through the problem to determine the best and most credible choice. From here, I devised a plan that I thought was feasible. I used research to enhance the part of the plan.

Having served in a leadership role in education on many occasions and currently but the last four years, I truly understand the importance of having the necessary skills essential for being effective in leading others. As a leader, I would never want them to have a mentality that shows that I have all the knowledge and, therefore, I am in authority alone to make decisions. I believed in shared or distributive leadership; unnoted collective ideas and decisions bring together the voices that are important to address the organization's needs. I also believe it is important to understand the rules of those who work with me to effectively serve their needs as a leader.

Analysis of Self as a Scholar

I am a lifelong learner and believe that learning should be a lifelong process. This doctoral journey has taught me to be scholarly in my daily practice as an educator. It is safe to say that I have learned how to live a scholarly life by attaining knowledge throughout the past few years and identifying new ways to implement the knowledge to

enrich my practice and advance others' practice. As I reflect on my doctoral journey, I know my purpose for entering the doctoral program at Walden University was twofold: to set the academic high for my nephew, and my future generations, and secondly was self-actualization and academic self-efficacy. As the son of a farmer and growing on a farm, I want to prove to the young people of my community that anything is possible in life. My doctoral mission was not selfish, as I wanted to grow academically and at the same time be able to contribute to the education system.

As I began the doctoral journey, there were numerous challenges I knew that to envisage. I had recently migrated to take up a teaching job in middle school mathematics in Bermuda, finances, time, adjusting to a new environment and work, having no immediate family around were all on the mind. I enrolled in the doctoral program online because of the flexibility of the program. I had to quickly adjust to the new ways of presenting assignments and projects. I soon realized that a doctoral program realized more application of knowledge to synthesize information to produce academic papers.

The initial discussion post for week one on the doctoral journey was the hardest stumbling block to get over because I was not sure of the expectations. Learning online and online classes was easy for me because I did my Master's Degree at Walden University online; hence, I know the platform. However, because of my language barrier and expressive writing issues, I had many challenges in preparing my assignments. I quickly learned how to use simple sentences and Grammarly software to help me with my academic writing. I created a schedule to help me create a balance between my

academic journey and professional life. During this doctoral process, I have learned that you need to create a daily routine to read and work on your academic papers.

During this doctoral journey, I had no family support because we all live in different countries, and at the time, I feel like a loner. It was my determination and commitment to my studies kept throughout this academic journey. My students were my biggest motivation because they always wanted to see the grades I receive on my assignments. I can look back and clearly say that I am resilient and will get to the end of my doctoral journey.

In the many years of my teaching career, I worked as a primary school teacher, then a high school or secondary school mathematics teacher. I have also worked as a mathematics lecturer full-time, a consultant to aeronautical engineering school, and a middle school mathematics teacher. I have served as head of department mathematics in one high school and currently serving as a content leader for mathematics at middle school. I am also teaching virtually in the Faculty of Education at the University of Guyana Berbice Campus. I am transferring my doctoral knowledge at all levels in the education system. As a practitioner in education, I will incorporate what I have learned as a learner and educator to persevere to make a positive impact for other learners and educators.

Analysis of Self as a Practitioner

As an educator, I always practice as a reflective practitioner. A reflective practice helps me identify an area that I need to grow in to become better at the craft of teaching. I have welcome feedback either through observations or peer reviews from the

administration and to improve areas of weaknesses identified in the feedback. After 24 years of teaching and 18 years as a mathematics teacher, I feel like I am a successful practitioner in mathematics education. This doctoral journey has propelled me to more than just a teacher practitioner, but a researcher-practitioner as well. I want to use my research experiences as a stepping stone to explore more research on the impact of teaching and learning of mathematics at the middle school level and across the education spectrum. I can communicate more scholarly with my peers, and my classroom practice is more intentional with a student-centered focus. My reflection is more refined and direct towards my growth in mathematics education.

I was often asked if going back to school to get a doctoral degree worth it, and my answer would remain the same, yes, because it is an investment in my personal growth in the field of education. My actual career started as a farmer and business in the cash cop industries, and I have always had a quest for knowledge and am a firm believer that a sound education is a passport to a successful life. My parents and my two siblings have a limited educational background, but I beat the odds and became doctoral students. My grandfather was very instrumental in ensuring that I was taken to school by him every day regardless of the weather condition or situation. He was very firm in his belief in education. My mother would stay up late at night to ensure that assignments were done. I saw education as a journey of leaving the farmlands into a bigger and better thing in life.

My love for education started and grew after being offered a teaching position at the local community school. I did well in school academically; however, due to high schools' geographical location and poverty, I was unable. I finished school in grade- nine

after completing all the required state examinations for school leaving early. During my teaching stint as an unqualified teacher at the local school, I was able to take the teacher upgrade program, which created a pathway for me to enter college. I did very well academically as a teacher in training and as a classroom teacher. After college, I worked as a qualified teacher for two tears and then entered university to read for a bachelor's in pure mathematics. After graduating with a bachelor's in pure math, I pursued a postgraduate in education majoring in secondary mathematics and then a master's degree in education majoring in mathematics.

Analysis of Self as a Project Developer

I have had an opportunity to prepare and present professional development to both small and large audiences countrywide over the last 24 years of my education career. I have led out on many mathematics professional development countries and also conduct leadership and managing training for private and public entities. However, preparing a project for this process was a completely different process and experience. The process of collecting my data, analyzing the data, interpreting the results into themes, and then preparing a professional development to address the finding's issue was a whole new experience for me. I will look forward to the feedback of the teachers who participate in the PD, and this will outline and polish any of my future research and the project that emanates from it.

This project came together because of knowing and understanding the purpose, which was to increase teachers' self-efficacy in the teaching and learning geometry in the middle school mathematics classroom. For a project to be effective, it requires adequate

planning, goal, objectives, purpose, re-planning, outline, and expected outcomes. Planning a project is more adventitious as it allows for identifying all the necessary resources required to make the project a success. I was able to plan this project because I planned professional development for mathematics teachers previously.

In planning this project, I wanted to ensure that the project captures middle school mathematics teachers' needs. The interview provided a platform for middle school mathematics teachers' voices to be captured in the project's planning. This project can be used as an agent for change in how professional development for middle school mathematics teachers should be conducted if planned and implemented effectively. Professional Development is not a new concept to middle school mathematics teachers on the island. The project is designed to incorporate new data from the study with current research findings and my knowledge and skills in planning professional learning sessions. The project is research-based and hinged on andragogical practice and a learner-centered approach to create and foster a culture of collaborative learning among middle school mathematics teachers.

Implications, Applications, and Directions for Future Research

I would like to repeat the study in a different setting as a direction for future research. While I believe that the structures and processes that evolved from the data's themes are generalizable best practice strategies, I would like to conduct a quantitative analysis to test the theory. Perspectives of those who participated in the interviews reflect that the current PD for middle school mathematics teachers on the island is not targeted to meet middle school mathematics teachers' needs and should be designed to involve

teachers in the PD planning process. The project developed to address the study's findings was a comprehensive PD plan to address the teaching and learning of geometry at the middle school level on the island.

Future research could impact professional development using a blended approach to create a best practice climate among middle school mathematics teachers. This could help teachers make more informed decisions on blended learning models that will best fit their professional setting and learning. This study was conducted during the COVID -19 pandemic period; a more flexible approach to delivering PD is needed on the island. This project study also had the potential to help develop differentiated PD to meet all middle school mathematics teachers' individual needs.

Conclusion

Identifying the limitations obstructing teachers' self-efficacy in the effective teaching and learning of middle school geometry lessons is at the forefront of the island education agenda. The need to address this issue echoes the volumes of students' poor performance in geometry both at internal and external examinations. The department of education must be more aggressive in addressing all middle school mathematics needs to build self-efficacy and capacity in the teaching of middle school mathematics.

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Appendix A: Professional Learning Project

Introduction

Results of the findings gathered from the interview with middle school mathematics teachers guided this project's direction. Five full-time middle school mathematics teachers shared their perspectives on teaching and learning geometry at the middle school level in Bermuda. A review of the finding shows that the island middle school mathematics teachers may benefit from a greater collaboration amongst all middle school mathematics teachers, consistent and sustained professional development sessions focused on middle school mathematics concepts.

This project's premise is further defined by a literature review of current research addressing adult learners, professional development for mathematics teachers, and collaboration. The project will entail three-day zoom professional development sessions where stakeholders converge to share their knowledge on middle school mathematics and learn how to address middle school students' needs best and increase their mathematics learning. My role will be to serve as the facilitator responsible for implementing the project.

Purpose

The project aims to provide professional development opportunities for middle school mathematics teachers and develop a professional learning community to allow middle school mathematics teachers to develop self-efficacy in the teaching and learning of geometry. This project was designed to address the teachers' self -efficacy in the middle school classroom through the following:

- Engaging middle school mathematics teachers in a conversation about the strategies that can be implemented to address best practice in the mathematics classroom
- Identify the resources needed at the middle school level to deliver the mathematics curriculum effectively
- Utilizing professional development and collaboration to build system capacity for middle school mathematics teachers
- Being proactive in addressing the needs of middle school mathematics teachers to increase learning opportunities.

The project will serve as a deliberate approach to help the island rethink how students' learning might be improved through the support given to mathematics teachers.

Goal and Objectives

This project's overall goal is to develop a comprehensive professional learning community on the island where mathematics teachers can share their knowledge and skills in creating a culture of learning. This project's underlying goal is to increase teachers' self-efficacy in the teaching of mathematics in the middle school classroom and increase students' overall academic performance in mathematics. Additionally, this plan aims to create a cohesive learning community that fosters collaboration, engagement, and input from all middle school mathematics teachers on the island of Bermuda.

Targeted Audience

The session has been developed to include all middle school mathematics teachers as the middle school mathematics teachers are responsible for delivering the mathematics

curriculum to students at the middle schools across Bermuda. Participation in sustained professional development should help mathematics teachers build capacity in content knowledge and best practices in delivering mathematics at the middle school level.

Project Design and Timeline

The three-day zoom teaching and learning session will encompass Knowles' (2012) tenets, whereas adult learning is focused on collaboration and solution to problems affecting them directly. The sessions will focus on identifying and addressing issues that affect middle school mathematics teachers through collaboration. This will be active learning through a professional development opportunity with best practices and interactive sessions focusing on effective teaching and learning practices for middle school mathematics teachers. The timetable for the zoom sessions is as follows.

Professional Development Zoom Session

Agenda

Agenda Day 1	
08:30 am-09:00 am	**Registration and Networking**
09:00 am- 09:30 am	Opening of the General Session by the Commissioner of Education
09:30 am- 09:45 am	Breakout Sessions • M1 Mathematics teachers • M2 Mathematics teachers • M3 Mathematics teachers
09:45 am - 10:00 am	**Break**
10:00 am - 12: 00 am	Examining the mathematics curriculum at each year level
12:00 am - 1:00 pm	**Lunch**
1:00 pm - 2:00 pm	Discussion on Geometry unit at each level
2:00 pm - 3:00 pm	Sharing out of individual groups and discussion

Agenda Day 2	
08:30 am-09:00 am	**Registration and Networking**
09:00 am- 09:30 am	Breakout Sessions • M1 Mathematics teachers • M2 Mathematics teachers • M3 Mathematics teachers
09:30 am- 09:45 am	Discussion Assessment pre-test and post- test
09:45 am - 10:00 am	**Break**
10:00 am - 12: 00 am	Looking at assessment for Middle School Geometry content
12:00 am - 1:00 pm	**Lunch**
1:00 pm - 2:00 pm	Discussion on Geometry assessment
2:00 pm - 3:00 pm	Sharing out of individual groups and discussion on year level assessment

Agenda Day 3	
08:30 am- 09:00 am	**Registration and Networking**
09:00 am- 09:30 am	Breakout Sessions • M1 Mathematics teachers • M2 Mathematics teachers • M3 Mathematics teachers
09:30 am- 09:45 am	Discussion on Self - Efficacy
09:45 am - 10:00 am	**Break**
10:00 am - 12: 00 am	Understand how mathematics self- efficacy can affect students learning
12:00 am - 1:00 pm	**Lunch**
1:00 pm - 2:00 pm	Looking at collaboration and how it can help to promote best practice amongst mathematics teachers
2:00 pm - 3:00 pm	**Self Reflection and Evaluation**

Materials and Equipment

The following materials and equipment will be needed to conduct the zoom session:

- Electronic sign sheet
- PowerPoint presentation
- Agenda
- Laptop
- Electronic copy of handout

PowerPoint Presentation

Increase Classroom Participation in Geometry

Presesenter: Mr: Tamashwar Budhoo

Break up in Group Discussion

Cambridge Lower Secondary 1 Stage 7

Cambridge Lower Secondary 1 Stage 8

Cambridge Lower Secondary 1 Stage 9

3

WHY COLLABORATION?

- Collaboration in the workplace is a sign of effective team
- It allows for the harness of best ideas
- It allows for sharing of best practice in education
- It contribute to school improvement and student success
- Allows for building of professional relationships

4

Geometry Curriclum
Cambridge Lower Secondary 1 Stage 7

- Identifying Geometry Objectives at the Stage 7 level and Plan learning Units for students
- Participate in Group Discussion on key objectives identified.
- Discussion on Lesson Plans for each objectives on the Stage 7 objectives

5

Cambridge Lower Secondary 1 Stage 8

- Identifying Geometry Objectives at the Stage 8 level and Plan learning Units for students.
- Participate in Group Discussion on key objectives identified.
- Discussion on Lesson Plans for each objectives on the Stage 8 objectives

6

Cambridge Lower Secondary 1 Stage 9

- Identifying Geometry Objectives at the Stage 9 level and Plan learning Units for students
- Participate in Group Discussion on key objectives identified.
- Discussion on Lesson Plans for each objectives on the Stage 9 objectives

7

Geometry Curriculum

Cambridge Lower Secondary 1 Stage 7 covers topics in Space and Shapes:

- Types of Shapes
- Area and Perimeter of regular and irregular shapes
- Properties of the circle; area and circumference
- 3 dimensional shapes –properties, surface area and volumes
- Angles, Line and triangles
- Transformation geometry

8

Cambridge Lower Secondary 1 Stage 8

Cambridge Lower Secondary 1 Stage 8 covers topics in Space and Shapes:

- Types and properties of Shapes
- Area and Perimeter of regular and irregular shapes
- Properties of the circle; area and circumference
- 3 dimensional shapes –properties, surface area and volumes
- Angles, Line and triangles
- Transformation geometry

9

Cambridge Lower Secondary 1 Stage 9

- Area and Perimeter of regular and irregular shapes
- Properties of the circle; area and circumference
- 3 dimensional shapes –properties, surface area and volumes
- Angles, Line and triangles
- Pythagoras Theorem
- Transformation geometry

10

LUNCH BREAK

LUNCH BREAK

11

Curriculum Standards Stage 7

MA07- GE01

MA07- GE02

MA07 - GE03

MA07- GE04

12

Curriculum Standards Stage 8

MA08- GE01

MA08- GE02

MA08 - GE03

MA08- GE04

13

Currilcum Standards Stage 9

MA09- GE01

MA09- GE02

MA09 - GE03

MA09- GE04

14

Questions for future discussion

15

BREAK

16

Round table discussion on Geometry

17

End of Day
One Group
Reporting

18

Day 2

Welcome

Registration

Break – out – Groups

19

Discussion on Assessment pre-test and post- test

Addressing Pre-Test and Post-Test for Middle School Mathematics classroom

Discussion on the data collected from Pre-Test and Post-Test

Identifing key objectives in the Geometry Unit for Pre-Test and Post-Test

20

Video Link on Pre-Assessment

- https://youtu.be/F1Cwoc4MO-M

21

Discussion on Video

- Why is Pre- Test and Post- Test is important?
- What are key component in creating quality assessment?

22

[No Title]

23

Looking at assessment for Middle School Geometry content

- Preparing Diagnostic, Formative and Summative assessment questions for Cambridge Lower Secondary:Stage 7, Stage 8 and Stage 9 in groups.

24

25

Test Development on Geometry Content

- Writing Sample questions on Diagnostic, Formative and Summative assessment questions for Cambridge Lower Secondary:Stage 7, Stage 8 and Stage 9 in groups.
- Discuss the questions in groups

26

Day 2 Collaboration Reporting

- Sharing out of individual groups and discussion on year level assessment

27

Day 3

WELCOME REGISTRATION MEETING BRIEFING

28

Day 3

What is Self- Efficacy?

Why is Self-Efficacy important in the learning of mathematics?

Discussion on Self - Efficacy and teaching of mathematics at the middle school.

29

30

Self- Efficacy and Students' Learning

Discussion how mathematics self- efficacy can affect students learning.

31

32

Looking at collaboration and how it can help to promote best practice amongst mathematics teachers on the Island of Bermuda.

33

Completing Self-Reflection

34

Completing Evaluation

35

Thank You

36

Evaluation

The project evaluation is an integral part of the ongoing development and success of teaching and learning practices on the island. The essential element in developing the evaluation plan has the right questions to guide decisions based on the evaluation. The instrument used to collect data on the three-day professional development session's effectiveness via zoom will include open-ended and Likert-scale questions. Data from the evaluation will be analyzed to identify and plan for additional professional development learning opportunities.

Professional Development Learning Evaluation

The aim of this evaluation is to capture feedback regarding your participation in the three-day professional development sessions via zoom.

Directions: Using the scale below, indicate how you would rate the following:

0 = N/A 1= Strongly agree 2= Agree 3 = Disagree 4 = Strongly Disagree	
	Scale Number
1. The Zoom professional development sessions meet my expectations.	
2. PD goals and objectives were clearly identified and met.	
3. The Presentations were well organized.	
4. I benefited from the resources and materials shared in the sessions.	
5. The facilitator was knowledgeable of the content presented.	
6. I was able to ask questions and engaged discussions.	

7. I would like more of these sessions.	

1. Describe your take- away from participating in the professional learning sessions.
2. What would you consider was most effective about the professional development sessions?
3. What area of the professional development sessions would you consider least effective?
4. What suggestions do you have for future professional development sessions?

Year-Long Support

The success or failure of any project depends on the support and sustainability of the project. The success of this project is dependent on the sustainability of the follow-up professional development throughout the year. Professional development is a part of the island academic calendar; however, it needs to be streamlined, focusing on middle school mathematics teachers. Professional development sessions on the island are held during the mid-semester break and common planning time to avoid disruption to the school. Due to COVID - 19 pandemic, all professional development sessions are done via Zoom and are recorded for future references. Collaboration and best practice sharing can happen weekly at the middle school common planning time for mathematics teachers.

Conclusion

The professional development zoom sessions were designed to enhance middle school mathematics self-efficacy and promote a culture of collaboration. The development session focuses on the growth and development of middle school

mathematics teachers on the island. Participants will engage in professional learning sessions based on the year group they teach at the middle school level. The project can be seen as a means to assist the island with its focus on education reform and create a professional learning community culture for increased student achievement in mathematics.

Appendix B: Interview Protocol

Interview Project Guide: Teacher Efficacy in Bermuda Middle School Geometry Classrooms

Name of the Interviewer: Tamashwar Budhoo

Code name of Interviewee:

Date of Interview:

Time of Interview:

Place of Interview:

Type of Interview:

Teaching Position of the Interviewee:

Questions:

1. What is your current teaching position at the middle school you are attached to currently?
2. Describe your teaching experience including grade level (s) taught and years of teaching experiences in mathematics?

3. How many years have you been working as a middle school mathematics teacher?
4. Tell me about a typical geometry lesson that you would have implemented in the mathematics classroom.
5. What are some of the strategies do you use to challenge students to justify the solution to their problem?
6. How would you describe your self – efficacy regarding your middle school geometry mathematics instructional practice?
7. How would you describe your confidence level in teaching geometry to middle school students with a focus on problem-solving and justifying solutions?
8. What mathematical instructional strategies in geometry are least confident in using to engage students in problem-solving and justifying solutions? Why?
9. (a) What professional development workshop for mathematics, with a focus on, geometry have you attended?

   (b) What type of professional development workshop do you find effective in providing support and information about teaching mathematics that challenges students to provide justifications to the solutions of their geometry problems?
10. What kind of professional development is available to you for geometry outside of school building? What professional development sessions or conferences have you attended as it relates to mathematics and geometry?

Appendix C: Member Check Form

Date: ……..

Dear_____,

Your participation as an interviewee in the qualitative study as a middle school mathematics teacher to identify factors that contributes the teacher self-efficacy and support needed for the teaching and learning of geometry at the middle school level. Anne closed you will find a brief synopsis of the finding after study based on the analysis of the comments captured from your interview. please review and confirm that the findings accurately reflect a summary of your input. E- mail me at _____ or call me _____ Should you desire to add modify or delete anything. also notify me if there are questions or concerns regarding the findings.

thank you for participating in this case study.

Sincerely,

Tamashwar Budhoo

Appendix D: Identified Codes

Summary of Themes

Theme	Description
1.	Personal experiences of middle school mathematics teachers
2.	Professional experiences of middle school mathematics teachers
3.	In the Geometry mathematics classroom in middle schools
4.	Methodology for teaching Geometry in middle schools classroom
5.	Confidence Level of middle school mathematics teachers
6.	Professional Development for middle school mathematics teachers