2020

Primary Teachers' Mathematical Practices and Self–Efficacy In Implementing Realistic Mathematics Education

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This is to certify that the doctoral study by

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Walden University
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Abstract

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MSc, Walden University, 2014

BEd, Shortwood Teachers' College, 2008

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

This qualitative case study was focused on Year 1 teachers' instructional practices and perceived self-efficacy related to their teaching of mathematics using the Realistic Mathematics Education (RME) framework in 4 primary schools in a British Overseas Territory (BOT). At the time of this study, the territory had adopted the RME inquiry-based approach to improve the teaching and learning of mathematics. Data retrieved from school reports indicated that some teachers' instructional practices did not reflect the RME framework. This case study was conducted to provide insights into Year 1 teachers' pedagogical practices, perceptions of their self-efficacy competence, and motivation in using the RME instructional model for teaching mathematics. Research questions addressed components of the RME instructional model and Bandura's self-efficacy theory. A purposeful sample of 7 Year 1 teachers were selected for interviews and lesson plan review. Data were analyzed through coding and theme development. Findings indicated that teachers possessed varying levels of confidence and competence in implementing the RME framework. Other themes that emerged from the analysis included that constant change in curriculum requirements and unfocused professional development affected teachers' efficacy perceptions of their confidence and competence in implementation of the RME. An E-Math Learning Lab project was developed for teachers to improve their skills and confidence in teaching mathematics. Social change may occur as teachers use Lab components to strengthen their pedagogical skills, develop student critical thinking skills, and close mathematics achievement gaps in this BOT.

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Acknowledgments

The successful completion of this study would not have been possible without the aid and contribution of so many incredible individuals. I am extremely grateful for all those who have stood with me and have contributed so that I was able to see this study to its end.

I want to highlight that the study would not have been possible without God, who gave me the power and resilience to persevere in times when certain stages of the study felt overwhelming and tedious.

I express my deepest thanks to the Educational Council for their provision of financial support to cover the costs associated with the completion of this study. I also would like to extend sincere gratitude to Chair Dr. Karen Hunt and second committee member Dr. McCraney. The patience, kindness, and guidance of these individuals were profound in directing me in the right path. Dr. Mary Howe, thank you for meticulously reviewing my final manuscript. The support and guidance that I got from members of the Writing Center and Form and Style personnel were extraordinary. As such, I want to note how thankful I am to all of you.

The vision I had in mind for this study would not have been possible to execute if I had not been given permission from school executives. Consequently, I must express my gratitude to members of the Ministry of Education, Department of Education Services, and principals for granting the permission for me to conduct the study within their schools. Most importantly, the study could not have been done if it were not for all the teachers who participated. Thank you all for opening your hearts and minds and for your willingness to share your teaching ethics, strategies, lesson plans, and answering interview questions. I am extremely thankful, as without your feedback I would not have had access to firsthand sources. Hence, I want to note how extremely grateful I am that the participants took time away from their daily schedule to contribute to the study.

I must emphasize the remarkable level of moral support I had from my family. Thanks to my niece, Chantellee, for taking the time to proofread sections of the study. Special thanks my sister Debbia, my friend Vanessa, Pauline and Renee for always reminding me that I was Dr. P on those days when I just could not cope and on days when my determination was lacking. Thanks to my sisters Denise, Rosalee and Mama G for their prayers and encouragement.

Finally, thanks to my wonderful husband, Oliver, and my two awesome girls, Rohae and Oniellia, who have made the greatest sacrifices over these many years. I really do appreciate all the ways in which they offered me support and courage to rally on so that I could see the study through to its end.

Kind regards,
Pearlyn Henry-Burrell.

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Section 1: The Problem

The purpose of this study was to examine seven Year1 teachers' current pedagogical practices, perceived self-efficacy, competence, motivation, and persistence in engaging children in Realistic Mathematics Education (RME), an instructional model. Section 1 includes the definition of the problem, the rationale, purpose, significance, and four guiding research questions. An integral component of Section 1 is the literature review. The systematic review of the literature includes a description of self-efficacy and RME. In this study, I used self-efficacy as the conceptual framework and RME as the instructional model, to frame the problem. The literature review also includes a description of the challenges teachers may face as they build conceptual understanding and problem solving through inquiry-based learning.

Definition of the Problem

At the time of this research, a group of primary teachers in a British Overseas Territory (BOT) in the Caribbean was unevenly implementing the RME instructional model (Office of Education Standards, 2018). The employment of the RME instructional model required teachers to employ instructional practices with which many teachers may not be comfortable (Lattimer, 2015). Lattimer's proclamation was in line with the reality of some of the teachers' in the BOT. Some teachers in the local school district reported that while they love the shift in the teaching of mathematics, it was not without challenges.

After the then numeracy specialist examined the teaching of mathematics in all of the public primary schools in the BOT in the Caribbean, he discovered that some teachers lacked the skills needed to successfully lead mathematics instructions, using the RME model (mathematics specialist, personal communication, January, 2017). Current school inspection reports also supported the claim that more needs to be done to raise mathematics achievement and teaching standards at the primary level (Office of Education Standards, 2019-2020). Overall, the implementation of the RME model within the local school setting was inconsistent (mathematics specialist, personal communication, May, 2018).

RME is a practical pedagogical approach adopted for teaching mathematics by the Education Ministry in the BOT. Though the term RME was not widely used across the primary schools, the instructional practices of the mathematics classrooms were in line with the key practices of the RME framework. Real-life experiences, orchestrating mathematical discussions, and the use of concrete objects to build deep conceptual understanding and problem-solving skills are the bedrock of this instructional practice (Saleh, Prahmana, Isa, & Murni, 2018).

It is important to note that the principles and practices of RME are in line with some aspects of the power mathematics resources that teachers are currently using to support the implementation of mathematics at the primary level. The RME framework also upholds the critical components of the advancing children's thinking (ACT) framework (Fraivillig, Murphy, & Fuson, 1999). Saleh et al. (2018) argued that mastery of the RME approach could improve students' attainment and problem-solving skills.

Research done in Kenya and other parts of the world suggested that the persistent underperformance in mathematics at the secondary, elementary, and prekindergarten levels may be linked to inefficient teaching and inadequate curriculum (Lattimer, 2015; The International Mathematical Union, 2014). Likewise, Lattimer argued that teachers' instructional practices have a significant impact on students' attainment and progress. Therefore, improving teachers' pedagogical practices in mathematics is an international priority, especially at the lower elementary level (Lui & Bonner, 2016). Baron (2015) and Saleh et al. (2018) contended that shifting from a didactic approach where teachers are the depositor of knowledge to a practical inquiry-based model called RME, is a critical factor in enhancing children's problem-solving skills. In this paradigm, children operate as part of a learning community and engage in collaborative problem solving (Gull & Shehzad, 2015).

Members of the National Council of Teachers of Mathematics (NCTM) (2011) posited that in addition to active learning, children must engage in cognitively challenging tasks that force them to think and present different solutions to problems. Some members of the NCTM argued that high expectations should be encouraged among learners, from prekindergarten to university. This transformation of instruction was evident in a small BOT, which adopted aspects of the RME instructional model for contextualizing mathematics, advancing children's thinking, and building a conceptual understanding of the prekindergarten (PreK) and elementary levels (Kazempour & Amirshokoohi, 2014; Mligo, Mitchell, & Bell, 2016).

Some international, as well as some Year 1 and elementary teachers in the featured BOT, do not possess the instructional practices, self-efficacy, and foundational understanding that supports the effective teaching of mathematics using RME as an inquiry-based learning model (Chen, McCray, Adams, & Leow, 2014 ; Gningue, Peach, & Schroder, 2013; Smith & Stein, 2011) In discussing possible reasons why teachers may be ineffective in their teaching, Malinauskas (2017) suggested that the exploration of teachers' perceived self-efficacy could provide some insights into the matter. Hence, in this study, I explored teachers' beliefs about their abilities to implement RME and be successful in the teaching of mathematics.

A mounting body of research confirmed that a teacher's perceived self-efficacy is aligned to student success (Briley, 2012; Hechter, 2011; Gulistan, Hussain, & Mushtaq, 2017; Lumpe, Czerniak, Haney, & Beltyukova, 2012; Turgut, 2019). Researchers also support the view that teachers' perceptions of their ability influence their willingness to undertake new pedagogical practices, such as inquiry-based learning (Althauser, 2018; Gutierez, 2015; Palmer, 2011). Notably, teachers with good efficaciousness are quite often risk-takers who allow students to be engineers of their learning, as required by the RME inquiry-based learning model (Fogelman, McNeill, & Krajcik, 2011).

It has been apparent for years that the effective implementation of RME can increase student achievement, build problem-solving skills, and close achievement gaps (Cotabish, Dailey, Robinson, & Hughes, 2013; Yuanita, Zulnaidi, & Zakaria, 2018). Saleh et al. (2018) attested that there is a significant difference in the reasoning skills of those who were taught using the RME approach and those who were taught using the traditional approach of drill and practice. However, even the best instructional practices can be ineffective if teachers do not possess the skills to move the RME instructional model into practice (Yilmaz, 2020). Yilmaz was also concerned that teachers may not accept that their pedagogy and content knowledge are below the expected standard required to implement the RME instructional model.

Examining the reciprocity between students' achievement gap and teachers' pedagogical practices and self-efficacy is now a critical part of addressing students' underperformance (Akram & Palinussa, 2013). The primary reason for the exploration of teachers' perceived self-efficacy is that there is a correlation between teachers' perceived self-efficacy and students' attainment (Briley, 2012; Hechter, 2011). As a consequence, instructional specialists are continually gathering data on teachers' perceived self-efficacy and pedagogical practices. Research findings helped researchers to validate that there is a statistical relationship between teachers' beliefs and their instructional practices (Briley, 2012; Hechter, 2011; Lumpe et al., 2012).

Notably, teachers who possess a firm belief in their ability to be successful are more likely remain motivated and committed to trying new instructional practices with struggling and achieving students (Baleghizadeh & Shakouri, 2017; Palmer, 2011). Given that teachers featured in this study were unevenly implementing the RME model in their mathematics lessons, I made an efforts to scrutinize and understand their instructional practices, motivation, persistence, competence, and perceived self-efficacy towards teaching using the prescribed curriculum. Briley (2012) and Gulistan et al. (2017) were strong proponents of the exploration of the relationship between teachers' self-efficacy and their students' attainment. Hence, my quest to explore the self-efficacy and instructional practices of the primary teachers in the BOT was not new to the field of education.

RME is a mathematics instructional practice that was developed by the Dutch (Ardiyani, Gunarhadi, & Riyadi, 2018). Teachers who employ the RME model harness the power of realistic scenarios and problem posing to build conceptual understanding (Yuanita et al., 2018). Yuanita et al. argued that teachers contextualized mathematics using concrete materials as they move children through varied levels of problem-solving, and reasoning. RME is closely aligned with inquiry-based learning, in that students take charge of the learning experiences as they figure out complex problem based situations. In this qualitative case study, I explored a group of primary teachers' current teaching practices, motivation, competence, and perceived self-efficacy for teaching using RME.

In the RME approach to teaching, teachers contextualized mathematics using concrete materials as they build conceptual understanding, problem-solving, and reasoning (Yuanita et al., 2018).

The Local Problem

Owing to the close colonial ties of the BOT with England, the featured schools' mathematics curriculum is in line with the British educational framework. Hence, the pedagogical practices for teaching mathematics are more in line with that of the British model rather than the Caribbean approach of drill and practice. However, stakeholders identified a local problem in the public schools in this small BOT in the Caribbean. Some primary school teachers in the public schools have adapted the RME framework teaching approach that is in line with the central tenants of an inquiry approach to active teaching and learning, but student achievement in some schools has been slow to improve (Klynveld & Marwick, 2015; Office of Education Standards, 2019-2020).

Even with the adoption of critical aspects of the RME framework in 2013, growth in student achievement has been well below national projections, and some teachers still have underdeveloped pedagogical skills in teaching mathematics (Ministry of Education, Employment, & Gender Affairs, 2017; Office of Education Standards, 2018, 2019, 2020). At the time of this study, the national expectancy was that students should achieve national curriculum Level 4 or above upon leaving primary education. The actual performance of the students in the 2016 Year 6 cohort indicated that more than 50% of students were performing below their projected target and cognitive abilities in mathematics.

Figure 1 shows the comparison of the public school system's results for Year 6 Cognitive Achievement Test (CAT) estimates with actual outcomes from 2013-2016 Data for the local school districts show similar substandard performance in mathematics when compared to the CAT projections.

Year	Description	Mathematics Level 4+
2013	Year 6 CAT 4 estimate	84%
2014	Year 4 actual attainment	52%
2015	Year 6 CAT estimate	75 %
	Year 4 actual attainment	75%
2014	Year 4 CAT 4 estimate	76%
	Year 4 CAT attainment	48%
2013	Year 6 CAT 4 estimate	75 %
	Year 4 actual attainment	40 %

Figure 1. Comparison of year 6 CAT estimates with actual outcomes (2013-2016). Adapted from "Education Data 2016," by Ministry of Education, Employment and Gender Affairs and Department of Education Services, 2016. Retrieved from

http://www.education.gov.ky/portal/page/portal/mehhome/education/nationaleducationdatareports/The-National-Education-Data-Report-2016.pdf

While student achievement in mathematics has been increasing, the progress has been slow (mathematics specialist, personal communication, October, 2017). In general, some students in the local district are performing well below their CAT 4 predictions of the national curriculum target (Ministry of Education Employment, and Gender Affairs, 2016).

School inspections form a regular part of the quality assurance process, both private and public schools regularly inspected by personnel from the office of education standards. School inspectors are persons who undertake the overall analysis of the quality of teaching, learning, assessment, and management of educational institutions (Office of Education Standards, 2019-2020).

In 2015, school inspectors scrutinized teaching and learning in the BOT. School inspection reports showed that the teaching of mathematics was at a low level, with the needs of most learners not being met (Klynveld & Marwick, 2015; Office of Education Standards, 2018-2019). Given that school inspectors are mandated to ensure quality provision of education in the BOT, they engaged in regular inspection of schools. After an overview of the local education system in 2018, the inspectors from the Office of Education Standards reported that while other factors may have contributed to the students' underperformance, uneven instructional practices was one of the significant reasons. Furthermore, inspectors from the Office of Education Standards highlighted the teaching of mathematics as an area for concern in many primary schools (2019). Hence, the unmet projected CAT levels.

Evidence that instructional practice may be unevenly enacted includes the minimal number of students who met their predicted CAT projected levels (Ministry of Education, Employment, and Gender Affairs, 2017). The uneven teaching and application of the RME framework and inquiry-based learning mathematics instruction appeared to be affecting students' performance, as only 52% of the students met their projected CAT scores (Ministry of Education, Employment, and Gender Affairs, 2017). Consequently, mathematics instructional practice needs to be scrutinized and adjusted in order to ensure the effective application of the curriculum (Office of Education Standards, 2018).

School inspectors asserted that effective implementation of the curriculum is one way of ensuring that students are being taught at high levels (Office of Education Standards, 2017). Hence, those who lead curriculum change must understand that teachers' perceptions of their students' ability play a pivotal role in the way they teach. Likewise, teachers' persuasion of their competency to teach mathematics will significantly influence how they lead curriculum change and pedagogical shifts (Gulistan et al., 2017; Zimmerman, Knight, Favre, & Ikhlef, 2017). The latter statement holds for both preservice and in-service Year 1 teachers.

Furthermore, inspectors argued that mathematical understanding and competencies amongst some elementary teachers in the district are generally weak (Klynveld & Marwick, 2015; Office of Education Standards, 2018-2019). The inspectors also highlighted that a few educators have sound knowledge, understanding, and abilities in Mathematics, and proficiency in teaching the subject, while others lack confidence and effective teaching strategies (Klynveld & Marwick, 2015).

In response to the findings of the school inspection, the local authorities and school leaders developed a post-school inspection School Improvement Plan of Action for academic years 2015-2016 and 2017-2018 (Ministry of Education, Employment, and Gender Affairs, 2015, 2018). "The Plan of Action was a one-year operational plan with targeted strategies designed to bring about improvement in all government schools" (Ministry of Education, Employment, and Gender Affairs, 2016, p. 5). Numeracy was one of the priority areas for development. Consequently, there were appointments of new school-based mathematics leaders within each primary school. These mathematics leaders supported in-service teachers in developing competency in teaching mathematics using the current framework. The emphasis was on using assessment to drive instruction and achievement (Ministry of Education, Employment, and Gender Affairs, 2017). The overall expectation was that teachers should implement the RME framework with fidelity.

The RME is an active, inquiry-based pedagogical practice, which focuses on using realistic concrete experiences to build conceptual understanding and problem solving (Hirza, Kusumah, & Zulkardi, 2017; Prahmana et al., 2018). In this model, teachers introduced children to concrete high-level instructional tasks that are cognitively challenging (Smith & Stein, 2011). Teachers also engaged children in contextual learning experiences, which encouraged them to work independently and collectively. Through social constructivism, students construct their learning through cognitively engaging cross-curricular learning experiences (Ministry of Education, Employment, and Gender Affairs, 2017).

The then local numeracy specialist affirmed the thinking of Vygotsky (1978), that children attain high levels of thinking and reasoning by engaging in complex cognitive mathematical tasks where they actively construct knowledge and communicate their ideas (numeracy specialist, personal communication, January 16, 2017). However, there is a noticeable gap in practice, as some primary teachers are unevenly implementing the RME model, which required teachers to provide children with cognitively challenging realistic mathematics experiences that are within their previous knowledge (numeracy specialist, personal communication, January 16, 2017). Another area of concern was that some teachers have not mastered the art of questioning and what it means to facilitate whole-class interactivity (numeracy specialist, personal communication, October, 2017; Office of Education Standards, 2018) This gap in practice defies the Ministry's curriculum vision to build critical thinkers who can problem solve (Ministry of Education, Employment, and Gender Affairs, 2016).

As teachers move towards mastery of the RME model, the school inspectors observed that some teachers successfully adopted aspects of the mathematics framework as they explore Strand 1 of the National Curriculum-Using and Applying Mathematics (Office of Education Standards, 2018). Hence, these teachers were able to introduce children to engaging cognitive problems, invite them to explore different solutions and orchestrate productive mathematical discussions (numeracy specialist, personal communication, 2017; Office of Education Standards, 2018).

On the other hand, the inspectors noticed that some lessons were weak, even though teachers were supported by preplanned units provided by the numeracy specialist and his team (Office of Education Standards, 2018). The then numeracy specialist argued that some teachers have not moved beyond the show and tell phase to build conceptual understanding that is important in mathematics and for future learning (numeracy specialist, personal communication, January 16, 2017; Office of Education Standards, 2018).

Local lesson observation data also revealed that some teachers are experiencing difficulties supporting and extending children's thinking in order to lift the mathematical horizon (numeracy specialist, personal communication, January 16, 2017; personal communication, February 19, 2017). Congruently, a follow-through inspection of students' achievement and the teaching of mathematics in one primary school revealed that some teachers have sound mathematical knowledge. These teachers benefited from professional development offered by the Ministry of Education team. However, the benefits garnered from the professional development did not automatically propagate into increased students' achievement.

At the end of the primary years, Year 6, the achievement was low as there had been little improvement over recent years (Office of Education Standards, 2018). Only 50% of the students achieved within the benchmark in the year 2017 (Office of Education Standards, 2018, p. 5). The new outlook for one local primary school predicted to be similar to the low achievement trend noted in current years (Office of Education Standards, 2018). Hence, there was a need to explore the implementation of the RME framework in the local setting. An exploration of the RME framework unearthed some critical details about the teachers' instructional practices.

The implementation of RME, an inquiry-based methodology, could improve student achievement and enthusiasm towards mathematics (Ardiyani et al., 2018; Josic, 2015). While this is so, teachers, mainly those teaching young children, may not have the skills needed to implement inquiry-based learning (Yinjing & Pope, 2017). Additionally, Bartell, Bieda, Putnam, Bradfield, and Dominguez (2015) affirmed that there is an interplay between practitioners’ pedagogical skills, belief in their ability to teach mathematics and students’ achievements. Therefore, in this study, I explored primary teachers’ practices, perceived self-efficacy for teaching, and perceived competence to implement RME in an inquiry-based learning mathematics classroom. I paid ardent attention to how teachers orchestrated productive mathematics discussions using the five practices put forward by Smith and Stein (2011) to extend children’s problem solving and mathematical thinking (Fraivillig et al., 1999).

Rationale

In this descriptive qualitative case study, I delved into a group of Year 1 teachers’ current pedagogical practices, self-efficacy competence, motivation, and persistence regarding their ability to implement aspects of RME—an inquiry-based learning framework for teaching mathematics. This inquiry became necessary as some educational leaders, principals, parents, news media and other stakeholders believe that some primary children are underperforming in the Key Stage 2 mathematics examination (Muckenfuss, 2018; Office of Education Standards, 2018). Furthermore, inspectors from the Office of

Education Standards (2018) highlighted that some primary teachers, including Year 1 teachers, are ineffectively executing the mathematical strategies.

While there is a steady growth in the number of children achieving the required Level 4 passes and above in mathematics at the end of Key Stage 2, at the time of this study a significant majority of students in the district were achieving below the required benchmark (End of Key Stage 2 Achievement Data, 2018). Since there is a relationship between teachers' perceived self-efficacy competence, motivation, and persistence towards teaching mathematics and students' achievement (Dybowski, Sehner, & Harendza, 2017) there was a need to understand better a group of Year 1 teachers' current instructional skills, perceived self-efficacy competence, motivation and persistence regarding their ability to implement RME—an inquiry-based framework for teaching mathematics.

Given that no formal data were previously available about Year 1 teachers' perceived self-efficacy competence, motivation, and persistence, undertaking this case study sheds some light on understanding the gap in practice regarding why some primary teachers were unevenly implementing the RME model. Moreover, the outcome information provided local baseline data to mathematics coaches, school principals, and instructional leaders, about teachers' perception of their readiness to support the implementation RME model. Key education players could use this study as a baseline study to guide any follow-up studies on teachers' implementation of other mathematics initiatives.

Definition of Terms

This study includes instructional strategies and conceptual ideas within the learning arena, primary age children, specifically those in Key Stage 1. The following operational definitions define specific terms within the context and scope of this study in order to ensure clarity of communication and the removal any ambiguity on vague or interchangeable terms (Jakic & Novakovic, 2011).

Cognitive Abilities Test Fourth Edition (CAT4): is an assessment that is designed to measure developed abilities and is used to determine children's progress and likely achievement. Students' CAT4 results are used to predict their performance at the end of Key Stage 2 examination (GOV.UK, 2017).

Inquiry-Based Learning (IBL): IBL, as used in this study, refers to an interactive and child-centered way of teaching mathematics where students engage in question development and posing, justifying their thinking, documenting their work, diagnosing problems, and collaborating to solve cognitively challenging problems (Dorier & Maab, 2012; Pedaste et al., 2015; National Council of Teachers of Mathematics, 2000).

Key Stage 1: When used in the British Education and this study, refers to the first three primary grades- Years 1 and 2 (GOV.UK, 2017).

Key Stage 2: Key Stage 2 when used in the British education, and this study, refers to the last four primary grades- Years 3, 4, 5, and 6 (GOV.UK, 2017).

Lower Primary: Teachers- Early Childhood Level (ECE): Generally Key Stage 1 encompasses grades 1 & 2. Age 6 through age 7 (National Association for the Education of Young Children [NAEYC], 2010).

Realistic Mathematics Education (RME): Realistic Mathematics, referred to as RME, when used in this study, means an inquiry-based instructional approach in teaching mathematics. In this model, teachers use problem solving strategies, engage children in real to life situations, and invite children to engage in applied problem solving, compare, and discuss solutions through small groups and whole class interactivity. Ultimately, the children practice mathematical concepts independently and collaboratively (Freudenthal, Institute, 1983; Palinussa, 2013; Van den Heuvel-Panhuizen & Drijvers, 2008).

Reception class: Reception class when used in this study refers to the foundation stage in a primary school before Year 1. Students in this class must be four years old before September (GOV.UK, 2017).

Reception Teachers: are those teachers in the British education system who teach 4-Year-Old students in the year immediately preceding Year 1 (GOV.UK, 2017).

Self-Efficacy: Self-efficacy is a construct related to one's perceptions of competence, motivation, and persistence to perform a task, even when the situation is challenging (Bandura, 1977).

Year 1 Teachers: In this study, Year 1 teachers refer to teachers who work with children in Year 1 of the formal education in the British system (GOV.UK, 2017).

Significance of the Study

This descriptive qualitative case study was designed to delve into a group of Year 1 teachers' current pedagogical practices, self-efficacy competence, motivation, and persistence regarding their competence to implement adopted aspects of the RME—an inquiry-based instructional model for teaching mathematics in the classroom. The findings from this study contributed to understanding the gap in practice regarding why some Year 1 teachers were unevenly implementing the adopted RME instructional model. Data from this research also provided baseline information to local mathematics coaches, school principals, and instructional leaders, about the teachers' current pedagogical practices, perceived self-efficacy, motivation, and competence in adopting the RME instructional model in their classrooms. Finally, the authorities could choose to use this study as a baseline for future research and to decide the level of professional learning that needs to take place across the school districts.

I used the findings from this study as the source for developing an E-Math Learning Lab (Appendix A). School leaders could use the E-Math Learning Lab to organize in-school support system for primary teachers across the system. School leaders could use the book study aspect of this project study to strengthen teachers' perceived self-efficacy in the implementation of the RME instructional model. Overall, the data collected from exploring teachers' pedagogical practices and perceived self-efficacy provided an understanding of why there is a gap in practice and how this may affect academic attainment. High quality implementation of the mathematics curriculum could build confidence in the public system among parents and other stakeholders.

This case study also has the potential for positive social change. Implementing inquiry-based learning is essential for the power of inquiry-based learning is substantive and far reaching in building problem solving and reasoning in children (Lerkkanen et al., 2016). Lerkkanen et al. argued that through inquiry learning, children can recognize and show appreciation for various viewpoints as they collaborate and learn together.

Consequently, if teachers have a sound pedagogical practice and self-efficacy to teach mathematics using the inquiry-based approach, they may develop a sense of self-efficacy and competence as inquiry-based learning support the development of confident, competent learners.

As previously stated, this project study is also potentially significant because the proposed professional learning project may improve teachers' instructional and mathematics skills. Improved instructional practices in mathematics may lead to greater confidence in teachers' ability to succeed and teach. Considering that there is a correlation between teachers' self-efficacy and students' attainment, ultimately, attainment may improve (Bandura, 1977).

Research Questions

This qualitative case study helped me to gain a deeper understanding of the Year 1 primary teachers' current pedagogy, perceived, competence, motivation, and self-efficacy towards implementing the RME instructional model. Recent school inspection and interview data showed that some teachers are still struggling to teach mathematics using the RME instructional model (Office of Education Standards, 2019). Furthermore, students' mathematics achievement in some primary schools is below the targeted levels (Office of Education Standards, 2019). Therefore, it is significant to note that like this project study, other educational research highlighted that quite often teachers lack the theoretical knowledge needed to develop the realistic experiences needed to implement the RME instructional model (Guler, 2018). Consequently, some teachers may lack the motivation, competency, and self- efficacy needed to teach using the RME framework (Mulbar & Zaki, 2018). Some contributing factors are:

- Given that the RME framework is in with the IBL and the constructivist approach to teaching mathematics, some teachers may lack the conceptualization and conceptual understanding of the RME instructional model (Badie, 2016; Mulbar & Zaki, 2018).
- Teachers' perceptions of teaching mathematics (Bandura, 1997).
- Teachers are not well supported to develop practical skills and a sound knowledge of RME (Goos, 2016; Gutierez, 2017).
- Some teachers lack an understanding of how students develop mathematical knowledge (Ekstam, Korhonen, Linnanm, & Aunio, 2017). Some teachers lack pedagogical, content knowledge, and theoretical knowledge about how to develop and teach realistic mathematics problems (Guler, 2018; Kang & Keinonen, 2016; Mligo, et al., 2016)
- No clear curriculum goals or guidelines (Revina & Leung, 2018).
- Repeated failure, which leads to learned helplessness (Gürefe & Bakalım, 2018).
- Some teachers dominate the lessons.

Moreover, there is a gap between the expected RME framework and the reality in the classroom (Mulbar & Zaki, 2018). The literature highlighted that the above factors could adversely affect primary teachers' pedagogical practices, competence, motivation, and perceived self-efficacy towards implementing the RME instructional model in their everyday mathematics lessons. In turn, teachers' low self-efficacy towards the teaching of mathematics can impede children's learning and mathematics achievement (Looney, Perry, & Steck, 2017). Some teachers may also become demotivated after repeated failure.

Hattie (2012) highlighted teachers' motivation and pedagogical practices as crucial factors that affect children's achievement and learning. Hence, some researchers guided how to address the issue of low self-efficacy among teachers (Ekstam et al., 2017). Through this project study, I was able to collect data related to the local teachers' competence, motivation, and perceived self-efficacy towards implementing the RME instructional model. My research was the first of its kind.in the BOT. I used four research questions to guide the data collection and analysis processes.

Research Questions

RQ 1: What teaching strategies, embedded in the RME instructional model, do Year 1 teachers currently use?

RQ2: What are Year 1 teachers' perceptions of their competence, motivation, and persistence to use the RME instructional model to improve students' achievement in mathematics?

RQ3: What experiences, resources, and factors do the Year 1 teachers perceived support their self-efficacy competence, motivation, and persistence to teach mathematics through IBL as aligned with the RME framework?

RQ4: What professional development workshops Year1 teachers find most useful in supporting their self-efficacy in teaching mathematics using the RME instructional model in an inquiry-based learning model?

Review of Literature

Introduction

This segment of the project study includes related literature regarding RME used within a mathematics curriculum framework. Coined in the discussion and organization of this section is a plethora of information about self-efficacy and its impact on effectively implementing the RME instructional model in primary schools. The organization of this section provides a variety of viewpoints from scholarly articles and books on the challenges and opportunities that primary teachers face as they seek to employ RME. The literature highlights issues related to the primary and secondary research questions in this project study of primary teachers' challenges and self-efficacy towards implementing the RME instructional model in an inquiry-based learning mathematics classroom. The review of literature begins with the explanation of the guiding conceptual framework —Bandura's viewpoint of self-efficacy and the RME instructional model.

The Eric Database and The Education Research Complete database, available through the Walden Library, provided most of the articles cited in this study. The search terms Realistic Mathematics Education, inquiry-based learning, and self-efficacy yielded a vast number of articles. Other search terms included challenging, implementing inquiry-based learning, self-efficacy and mathematics, the impact of RME on classroom practice, how teachers teach mathematics, teachers' feeling about the RME framework, the new mathematics, pedagogical reformation in mathematics, and orchestrating mathematical discussions. Gateways to other articles were provided through the reference lists of some of the relevant articles. I also linked Google Scholar to my Gmail account. The link filtered articles with the search term RME and IBL in mathematics to my Gmail account. Another useful search was the Open Access Journal website, which provided access to many peer-reviewed articles and journals.

The critical review of literature recorded the broader problem of primary teachers' inconsistent implementation of the RME instructional model in their mathematics classrooms. I examined all perspectives for their relationship to the exploration of a group of primary teachers' pedagogical practices, and perceived self-efficacy regarding their competence to implement the RME—an IBL instructional model for teaching mathematics in the classroom. I discussed the databases and related search terms under each subheading below.

Conceptual Framework

A conceptual framework and an instructional model—the RME (Freudenthal Institute, 1977) and self-efficacy theory (Bandura, 1977), guided this case study that explored teachers, current pedagogical practices, competence, motivation, and perceived self-efficacy towards implementing the RME instructional model. RME was the model practice through which the primary teachers featured in this study teach mathematics. The second theory was self-efficacy, a situational theory that involves personal perceptions of competence, motivation, and persistence to achieve goals despite repeated failure (Bandura, 1977).

Realistic Mathematics Education (RME)

This is an instructional model developed by the Freudian Institute (1977). The local school district featured in this research adopted this instructional model to address children's underperformance in mathematics. Hence, in this study, I examined the Year 1 primary teachers' current pedagogical practices through the lens of the RME instructional model. It is imperative to note that some teachers did not possess the instructional skills, self-efficacy, competence, motivation, and persistence needed to implement this instructional model effectively.

The RME instructional model hinges on the understanding that children should be active participants in the learning of mathematics (Cattaneo, 2017; Lerman, 2014; Yilmaz, 2020). Active learners of mathematics must have many opportunities to develop conceptual understanding in an environment that encourages active learning and critical thinking (Cattaneo, 2017; Lerman, 2014). To this end, Batlolona and Leasa proposed that children should enter in the learning experiences through realistic mathematical scenarios that are supported by mathematical models. Mathematical models and realistic experiences are important areas of the RME (2018). Hence, in this study, I focused on how Year 1 teachers supported the learners through planned, realistic experiences.

Batlolona and Leasa (2017) and Saleh et al. (2018) supported the view that any inquiry about the implementation of RME should observe if students get opportunities to use real experiences to comprehend and be active participants in their learning. Saleh et al. also argued that active learning could help boost children's confidence and problem-solving skills. Furthermore, Ardiyani et al. (2018) stated that all RME instructions should be centered on recreating and capturing realistic experiences to make the learning of mathematics meaningful to the learners. Moreover, Ardiyani et al. stated that teachers must have immaculate knowledge of how to skillfully use mathematical models and cognitively challenging questioning to improve children's learning. Nevertheless, Ekstam, et al. reasoned that some teachers are attempting to implement the RME instructional model without enough knowledge of how to move instruction from theory to practice (Ekstam, et al., 2017). Undoubtedly, teachers must understand the fundamental principles and practices of the RME instructional model (Ardiyani et al., 2018; Ekstam et al., 2017).

One critical aspect of the RME framework that teachers in the local setting and others who employ the RME instructional model must understand is the use of mathematical models (Febrian & Astuti, 2018). Evidence from Febrian and Astuti (2018) and other research, endorsed the use of learning models as entry pathways into mathematical development and conceptualization (Prahmana et al., 2018). This understanding is the bedrock upon which Lerman (2014) and Cattaneo (2017) postulated that the use of models provide children within the RME approach, a gateway through which children enter the world of mathematics in an informal and nonthreatening way. In this paradigm, learning mathematics follows multiple unfolding pathways, moving from the known to the unknown (Cattaneo, 2017; Lerman, 2014).

The core purpose of RME-a heuristic approach to teaching and learning is to develop learners who are curious, competent, and confident in solving mathematical problems (Mulbar & Zaki, 2017). Notwithstanding the work of Prahmana et al. (2018), Isik, Tutak, and Kalkan (2020) postulated that concrete and realistic experiences were critical in building sound conceptual understanding. However, conceptual understating must be encouraged through active learning and in-depth problem solving.

Critical thinking and problem-solving skills are two other fundamental skills that drive the RME instructional model (Mulbar & Zaki, 2017). Hence, teachers challenge their students to use a familiar experience as a springboard for developing the conceptual understanding needed to solve new mathematical problems. In this regard, Wardono, Mariani, and Candra (2016) argued that when children engage in using the RME approach, they are challenged to think and find advanced solutions to posed problems or scenarios realistically. In this model, children face challenges with a more opened mind and are less likely to avoid difficult tasks. Students' willingness to undertake the cognitively challenging task may resulted in improved student achievement in mathematics (Hirza, et al., 2014). However, Mulbar and Zaki (2017) believed that some teachers still find it challenging to capture the critical components of the RME framework in their teaching.

Fundamental to the RME model is the shifting from the teacher dominated to a student centered classroom (Lessani, Yunus, & Bakar, 2017). Whereas some teachers may have pedagogical practices and an understanding of how to navigate the inquiry-based classroom, others may lack the instructional know and self-efficacy to do so

(Gürefe & Bakalım, 2018). Teachers' lack of self-efficacy towards implementing the RME framework may hinder them from leading a student centered classroom, planning challenging learning experiences, and embracing the RME instructional model.

Lessani et al. (2017) argued that the call to plan realistically, cognitively engaging learning experiences must be evident within the context of the RME framework. For this reason, educational researchers seek to understand if the instructional strategies of those who employ the RME framework are in line with the expected practices (Saleh et al., 2018). All RME learning experiences must embrace whole class interactivity where the students actively engage in accountable talk, as they defend their thinking. In capturing the central components that are essential in the RME classroom, Treffers (1987) proposed five elements of RME, namely: Phenomenological exploration:

1. The use of realistic experiences.
2. The use of models and symbols; children's finding their strategies.
3. Using models and symbols for progressive mathematization.
4. Whole class Interactivity.
5. And Intertwining: The students make connections with other learning topics and strands.

The preceding prescribed steps to the RME framework highlight the pedagogical pathway that teacher must follow. Even though there is a logical process to the RME, the onus is on teachers to ensure that students design their learning. Hence, the data that I gathered from document analysis and interview protocols, which are in line with the

RME instructional model, provided factual data that could help stakeholders to begin to understand the gap in practice.

Self-Efficacy Theory

The conceptual framework presented in this section is self-efficacy. A copious number of research covered the topic of self-efficacy (Althauser, 2017; Bandura, 1977, 1978, 1982, 1983, 1984; Epps, 2018; Gulistan et al., 2017; Güngör & Özdemi, 2017; Malinauskas, 2017; Seals, Mehta, Berzina-Pitcher, & Graves-Wolf, 2017; Unlu, Ertekin, & Dilmac, 2017; Yoo, 2016). However, most scholarly works found the classical work done by Bandura (1977). Bandura (1977) defined the construct of self-efficacy as one's perceptions of competence, motivation, and persistence to perform a task (Bandura, 1977).

Bandura first coined the term self-efficacy in 1977. Perceived self-efficacy can be defined as the persuasion that one has in self that he can be successful at a given task or undertaking (Walter, 2015). Walter avouched that perceived self-efficacy is situational, and so teachers may feel confident in teaching one subject and a sense of trepidation about another. Research-based evidence also supports the view that teacher quality and self-efficacy for teaching are the foundation for generating high quality instruction (Chen, et al., 2014).

Bandura (1977) further postulated that teachers with elevated self-efficacy and creativity quite often create a cognitively challenging environment. Predominantly, persons with high levels of self-efficacy are usually those who have purposed to preserve with a given task regardless of the challenges that they may face in the past (Bandura, 1997; Schwarzer & Hallum, 2008). Hence, persons with a high level of self-perceived capability usually face obstacles and repeated failures, with the determination to be successful (Bandura et al., 1997). Alternatively, Schwarzer and Hallum, argued that those with low beliefs about their ability to succeed tend to give up after experiencing repeated failures. The feeling of high self-efficacy is domain specific.

Furthermore, Yilmaz (2020) argued that most teachers only tend to teach areas of mathematics in which they feel competent. Yilmaz's postulation supported Baleghizadeh and Shakouri (2017) and Schwarzer and Hallum (2008) belief that teachers may feel strong self-efficacy in one area and lack thereof in another. For this reason, those who plan professional learning activities for teachers must know the specific area or areas where each teacher needs support (Bonghanoy, Sagpang, Alejan, & Rellon, 2019). The articulation of Malinauskas (2017) adds to Bonghanoy et al.'s postulation that professional learning support can be useful in enhancing teachers' perceived self-efficacy.

Bandura (1977) and Güngör and Özdemir (2017) studied the correlation between teachers' perceived self-efficacy, and their willingness to undertake a new or challenging task. Bandura (1977) theorized that self-efficacy is the driving force that keeps persons confident, motivated, and persistent in times of challenging situation. Furthermore, self-efficacy is the impetus that motivates persons to be resilient in adverse situations, even in the classroom (Demir, 2020).

Additionally, Baleghizadeh and Shakouri (2017) argued that in an era where children with social and emotional disorders often enrage teachers, it is assuring to know that teachers with high self-efficacy could manage these children. Baleghizadeh and Shakouri view is critical to teachers who are implementing the RME classroom. In the RME classroom, children are in charge of their learning. If the teacher lacks confidence, he or she may feel overwhelmed or anxious if the things do not work as planned (Althauser, 2017). Hence, as teachers' instructional practice improves, so will their self-efficacy.

Alternatively, persons who lack a sense of self-efficacy may face challenges with a sense of incompetence and hopelessness when faced with challenging situations (Bandura, 1993). Researchers also argued that teachers' self-efficacy could significantly affect their motivation, teaching styles, as well as their students' achievement (Baleghizadeh & Shakouri, 2017; Chao, Forlin, & Ho, 2016; Klassen, & Tze, 2014). Given the correlation between teachers' self-efficacy and students' attainment, Bandura's theory of self-efficacy provided a lens through which the local teachers' disposition and perceived mathematics self-efficacy towards implementing the RME instructional model, was examined. The quest became necessary, as the primary students in the local school district were beleaguered with repeated low achievement in mathematics.

Self-efficacy, when related to mathematics, can be defined as having self-assurance in one's capability to complete tasks and problems that are related to mathematics (Hackett & Betz, 1989; Malinauskas, 2017). The foregone explanation of the relationship between mathematics and self-efficacy is relevant in most areas of teaching. Like other areas of self-efficacy, a teacher's belief in his ability to teach mathematics can influence the way that teachers approach the teaching of mathematics, especially when their students are repeatedly underperforming. Not only will teachers become discouraged, but also their students may begin to believe that they, too, are failures. The reciprocity between teachers perceived self-efficacy and students perceived self-efficacy is also evident in the literature (Alkharusi et al., 2017).

Perceived self-efficacy as put forward by Bandura (1984) means the way people see themselves and their ability to be successful at a given task. The ability to perceive oneself as being competent and capable often comes from experiencing success, watching others succeed at the task, being motivated by others, or by cultivating the inner courage or belief that one will be successful despite repeated failures (Bandura & Adams, 1977).

In examining perceived self-efficacy, Schwarzer and Hallum (2008) reasoned that there are those persons who possess general self-efficacy. Persons with general self-efficacy are usually positive and possess the necessary skills and abilities needed to be successful in a variety of challenging situations (Malinauskas, 2017). Teachers with general perceived self-efficacy usually choose to be persistent towards achieving goals despite challenges encountered (Gulistan et al., 2017; Malinauskas, 2017; Schwarzer & Hallum, 2008).

The argument on teachers perceived self-efficacy about teaching directs how they approach teaching and learning as well as their perceptions of competence, motivation, and persistence to achieve goals despite repeated failure (Malinauskas, 2017). Since the psychological well-being and self-efficacy of a teacher influence his ability to teach, stakeholders must plan professional development activities that help teachers to feel more confident.

The interplay between the principal elements of self-efficacy, motivation, persistency, and competency influences how teachers perform in the teaching and learning arena (Dybowski et al., 2017). It was therefore imperative that I gather information about the primary teachers' perceived self-efficacy using Bandura's self-efficacy theory. I used Bandura's theory as the basis for examining the primary teachers' motivation, persistency, and perceived self-efficacy towards implementing the RME framework. Data gathered provided some insights into why the teachers may be unevenly implementing the RME framework.

Review of the Broader Problem

The current line of thought in the RME discussion is that the Realistic Mathematics Education instructional model uses realistic experiences (Saleh et al., 2018). The use of realistic experiences and mathematical models are often in line with students' real-life experiences. Along this line of thought, Zakaria and Syamaun (2017) postulated that RME demands that students' interface with concrete models and experiences that serve as scaffolds for later mathematization. For this reason, Zakaria and Syamaun, postulated that the teacher must skillfully select learning experiences and simplify the usually abstract concept of mathematics through realistic mathematics experiences. Nevertheless, research on the implementation of the RME framework presaged that a few practitioners may not possess the perceived self-efficacy and skills needed to implement the RME framework (Ozkaya & Karaca, 2017; Yuanita et al., 2018).

If someone believes that he/she cannot accomplish a task, he/she may give up when faced with adverse situations (Bandura, 2000). However, schools must have a teaching staff with high self-efficacy (Demir, 2020). The line of reason that persons with low self-efficacy may lack the tenacity and the will to persevere in times of failure was affirmed by Demir. Demir also argued that the understanding that there is a correlation between teachers' self-efficacy and their students' performance is the main reason behind the drive for schools to secure teachers who believe in their ability to be successful. Furthermore, teachers' self-efficacy, whether high or low, is transferred to teaching and ultimately to their students' learning (Watler, 2015). While self-efficacy is situational, the idea that it influences students' achievement is consistent across all curriculum areas (Dybowski et al., 2017).

Notably, persons with high self-efficacy possess the conviction that they have the skills and ability to persevere even after experiencing multiple failures (Bandura, 2000). Then, the mathematics fraternity would benefit more from teachers with strong self-efficacy to implement the RME framework, motivate students to learn, and improve students' achievement.

Teachers' Lack of Readiness to Support the RME framework.

Considering that the process of mathematization and problem solving originated from the teachers' ability to plan realistically and cognitively engaging activities (Ozkaya & Karaca, 2017), it is imperative that teachers who are implementing the RME framework have a working knowledge of the process and how to transfer it into practice. When teachers have good instructional practice, they are more likely to cater to the learning needs of all learners (Achurraa, & Villardón, 2013).

Mulberry and Zaki (2018) concurred that students, including low-level learners, can benefit from RME as it provides an opportunity for them to enter at the low level-horizontal level and afford a gateway for them to begin to engage in horizontal mathematization. This finding is welcomed since some students may not have the prerequisite to enter formal mathematics immediately. However, the prevailing problem is that a wide body of researchers confirmed that while RME is recommended as an effective instructional strategy, there is a need for continuous professional development in order for teachers to develop learning experiences and implement the framework with fidelity (Ardiyani et al., 2018).

Gravemeijer (1994) stated that the informal experiences and models provide children with opportunities to engage in what he termed horizontal mathematization. Horizontal mathematization refers to the lowest level of conceptualization, where children interface with contextual problems. Another area for consideration is vertical mathematization.

Vertical mathematization refers to the more sophisticated level of mathematization, which leads from the horizontal concrete level to the more abstract form using symbols. The spiraling of the process of RME meant that teachers should be able to move the students from entering the learning experiences to making meaning connections between key mathematical concepts (Lestari & Prahmana, 2017). Mastery of each stage of the process can be difficult for some teachers (Akram, 2017). Akram argued that the struggles that teachers face in the implementation of the RME framework should not be overlooked.

Researchers reasoned that there is a constant interaction between the lower and higher levels of the RME framework. Navigating the sophisticated platform of the RME framework demands dexterity and preparation on the path of the teacher, as the teacher must prepare high-quality learning experiences (Guler, 2018; Jordaan, Laubscher, & Blignaut, 2017). Hence, teachers must have pedagogical and content knowledge about mathematics in order to be ready to lift the mathematical horizon to a level where students can skillfully move through the levels of the RME framework. Then, Jordaan et al. (2017) avouched that implementing the RME framework would demand teachers to be well informed about teaching and assessment for learning, while shifting from the traditional teaching of mathematics. To date, the question of teacher readiness is still a concern (Ozkaya & Karaca, 2017).

In a study proposing the use of the RME framework, Ozkaya and Karaca (2017) articulated planning support is essential when developing high-quality learning environments and activities. When Ozkaya and Karaca, asked the participants in the research to develop realistic learning scenarios, some participants created activities that were more in line with the conventional way of teaching mathematics rather than the RME framework. Similarly, Yuanita et al. (2018) posited that while RME has the power to motivate and challenge learners of mathematics, teachers must create realistic experiences that evoke a sense of reality in the students.

According to Yuanita et al., realistic experiences may require teachers to shift from traditional to a more constructive approach. Considering that the RME framework is aligned with IBL and the constructivist approach to teaching mathematics, some teachers may lack the self-efficacy to understand the RME framework and adequately support the children through the learning process (Badie, 2016; Mulbar & Zaki, 2018). Consequently, there may be a need for focused coaching that is aimed at improving instructional practice (Biccard, 2019).

One of the basic, yet critical components of an effective mathematics classroom is a confident, self-assured teacher who possesses a strong belief in his ability to be successful in the teaching of mathematics (Güngör & Özdemir, 2017). Having strong confidence is essential to meeting the demands of using the RME framework to bridge the gap between the quite often abstract mathematical ideas and problem-solving. The looming question is, how prepared are teachers to undertake the demands of implementing the RME framework? The question of teachers' readiness and preparation to support the execution of the RME framework remains a matter for consideration (Ozkaya & Karaca, 2017). For this reason, policymakers who support primary teachers should consider their ability to use RME to support children's conceptual understanding and problem solving.

Effectively Implementing the RME Framework

A review of primary and secondary literature on EBCOST and ERIC database, using the search term, the effectiveness of RME revealed that mathematics proficiency is imperative, as students will be called upon to solve problems in their daily lives. Hence, this section will involve delving into how RME can ignite a passion for mathematics and learning (Yuanita et al, 2018). Overall, mathematics education seeks to ensure that the current generation of students possesses the innovation and critical thinking skills needed to meet the demands of the 21st century. Ongoing research suggested that mathematics and instructional pathways such as RME, that can be used to develop proficient young mathematicians who can think critically and work collaboratively with their peers to present multiple solutions to cognitively challenging mathematical problems (Su, Ricci, & Mnatsakanian, 2016; Yuanita et al., 2018).

According to Lerman (2014), Indonesia had a low education quality before embracing the RME. The problem was that the students had underdeveloped problem solving skills. Notably, before the introduction of the RME, the students were able to engage in the recall activities but were unable to solve higher order questions (Zulkarnain, 2013). Similarly, Wardono et al. (2016) conducted a study on the implementation of problem based learning via the assisted e-Learning Edmodo. When Wardono et al. scrutinized the quality of learning within a primary classroom; they concluded from the study that children who are a part of the RMEI demonstrated the ability to be good problem solvers, even though they may still demonstrate attrition in some areas of problem solving. Hence, it could be argued that the implementation of the RME in the local setting should lead to increase attainment and problem solving skills.

In keeping with the mantra of RME, Yuanita et al. (2018) articulated that RME builds mathematical thinking and critical thinking skills that this generation needs to prepare them for everyday challenges. Similarly, research done by Mulbar and Zaki (2017) confirmed that RME is in line with the shift in paradigm to change mathematics education from one that is passive to an active approach. In this model, children explore meaningful learning experiences that challenge them to think beyond the recall level in the realm of critical thinking and application. Then, there is a need for stakeholders to provide professional development (PD) that addresses any pedagogical inadequacies among primary teachers. Mulbar and Zaki also articulated that the positive effect of the RME framework might not become a reality if teachers lack a high level of competency, motivation or the perceived self-efficacy needed to implement the framework effectively (Mulbar & Zaki, 2017). Nevertheless, teachers' instructional practice and confidence could be bolstered through targeted PDs.

Notably, RME serves as a medium for attaining deep, meaningful learning that is cognitively challenging and meaningful to the learners (Laurens, Batlolona, Batlolona, & Leasa, 2017). Hence, educators must judge the attainment of the RME approach using the following success criteria proposed by Mulbar and Zaki (2017):

- students' activities in realistic mathematics education,
- students' learning completeness classically,
- students' response to realistic mathematics education design. In the experiment class,
- the indicators of students' learning completeness classically and students' responses indicators of the design meet the criteria of effectiveness (p. 7).

Evidence from the literature supported the viewpoint that RME is an essential tool that can change mathematics learning. The shift in mathematics could see students moving from to meeting their targets (Aydın, 2014; Kaylak, 2014; Kurt, 2015).The intentional teacher recognizes that RME education provides a fun-filled and meaningful way to lead children from the vertical level to the horizontal, through a series of realistically constructed scenarios or experiences (Nagarjuna, Jamakhandi, & Sam, 2013). With this understanding, the teacher gently guides the students for from the lower level of the process to the elaborate stage of mathematizing, where students make meaningful connections to other concepts and procedures (Ozkaya & Karaca, 2017). To this end, most research affirmed that students' exposure to the RME approach helps them to rise to the challenges that come with in-depth problem solving (Laurens et al., 2017). Consequently, researchers see RME as a method for successfully building, problem solving, and improving students' achievement (Wardono et al., 2016).

Teachers must consider the challenges of implementing the RME five essential practices when leading productive mathematical discussions. Smith and Stein (2011) proposed five essential practices for ensuring quality mathematics discussions-anticipating, monitoring, selecting, sequencing, and connecting. Smith and Stein contended that these essential practices are critical in an inquiry-based classroom where children engage in highly sophisticated whole class discussions. Through strategic and intentional eliciting, teachers using the RME framework scaffold children's mathematical thinking, build critical thinkers and provide an avenue where children learn to think through mathematics as opposed to applying memorized formulae (Su et al., 2016).

In executing the RME framework, the purposeful teacher uses high level instructional tasks to lead students through the launch, explore and discussion phases of the mathematics lesson (Smith & Stein, 2011). Notably, teachers' knowledge of the RME will influence how they move the students along the learning continuum. However, Saleh, et al. (2018) argued that many teachers find it challenging to select realistic experiences that are cognitively challenging and engaging. Further to this end, some teachers have not made the instructional shift from the director of learning to the facilitator, who uses strategically coined higher-level questions to raise the mathematical horizon and cultivate critical thinking (Alwarsh, 2018; Mulbar & Zaki, 2018). Like Wardono et al. (2016), Alwarsh, Mulbar and Zaki highlighted the need to critically examine teachers' instructional practices to see if they are in line with the RME instructional model. The belief that teachers' instructional practices may contain residue of the drill and practice approach is evidence enough that teachers may not have fully adopted the RME framework.

The passive reception of knowledge does not only prevent students' understanding, but their ability to learn and think collaboratively, as their peers share multiple solutions to stated scenarios (Ardiyani et al., 2018). Therefore, the implementation of RME requires that teachers craved students' engagement in their learning. Students who are actively engaged in their learning are more likely to demonstrate greater mastery of the required mathematics standards (Mulbar & Zaki, 2018). Besides, engaged students often take a hands on, minds on approach to learning.

Pedagogical Reformation in Mathematics

The transformation of mathematics teaching from traditional rote learning of the new math approach in the late 1980s was not only an educational venture but also a political paradigm shift (Oxford University Press, 2016). The dialogue surrounded the belief that children are not adequately equipped for the demands of society (Lattimer, 2015; The International Mathematical Union, 2014). The diminishing of the industrialized era gave way to a technological one where creativity and problem solving becomes the central pillar of learning (Cipriani, 2015).

Shifting from the traditional approach of repetition and memorization to an interactive approach will ensure that students will become innovators and critical thinkers (Aljabut, 2017; Darling, 2017). The impact of RME is far reaching as it supports innovative and critical thinking in more able and struggling learners (Barnes, 2005; Yuanita et al., 2018). Yuanita et al. stated that mathematics learning that is supported by the RME is structured to ensure that students participate in the learning process. The effectiveness of the RME approach is strengthened when students purposefully worked through the process of mathematizing (Treffers, 1987; Yuanita et al., 2018). Therefore, students must be actively engaged in studying mathematics if they are to be competent learners who are adequately supported to meet the demands of this era (Darling, 2017).

The math war in the 1980s gave birth to new ways of viewing mathematics instructions (Cipriani, 2015). Hence, the critical focus of mathematics is currently aligned with the central tenants of the constructivist theory of learning (Caswell, 2017). Since educators are pivotal in leading instructional change, they are called upon to employ instructional strategies that challenge children to become competent learners who engage in cognitively challenging learning experiences (Althauser, 2018; Su et al., 2016)

RME Pedagogical Shift

Under the implementation of the RME framework, the focus of learning is on building mathematical, conceptual knowledge and not a regurgitation of facts (Yuanita et al., 2018). Hence, the landscape of mathematical learning has shifted from one that is teacher-directed to a student centered approach where children are the architect of their learning (Darling, 2017). Consequently, students put forward multiple solutions to carefully designed problems. Laurens et al. (2017) affirmed that RME starts with choosing a problem or scenario that is in keeping with the students' previous knowledge and experience. While the students work on solving the cognitively challenging task, the teacher facilitates their learning and development through varying levels of questions. Specifically, students who were exposed to the RME instructional model usually develop problem-solving skills and conceptual understanding using real life contexts (Mulbar & Zaki, 2018).

According to findings from studies conducted by Ozkaya and Karaca (2017), realistic RME affects the students' attitude and is more likely to develop their self-efficacy towards solving mathematics problems more than traditional curriculum. RME is a framework that can change students' attitudes towards mathematics, while advancing students' while improving their overall achievement (Mulbar & Zaki, 2018).

Overall, the professional literature shows that RME can build children's conceptual understanding and love for mathematics. However, some skills must be present if RME is to make a difference in the way mathematics is learned and taught. Most of the literature cited in this section showed that teachers need to have the pedagogical skills, motivation, competence, and perceived self-efficacy needed to execute the RME instructional strategies (Karaca & Ozkaya, 2017; Mulbar & Zaki, 2018).

Teachers' Perceived Self-Efficacy and Mathematics

In searching for literature on teachers' self-efficacy in mathematics, the professional literature supports the view that teachers with low self–efficacy are more likely to quit, while those with high self-efficacy may persevere even after the disappointment and repeated failures (Bandura, 1997). On the other hand, Bandura argued that teachers with low self-efficacy for teaching mathematics might give up after repeated failures. Then, Won (2015) concluded those teachers' perceptions of their competency, perseverance, motivation, and self-efficacy for teaching mathematics in this case, is a catalyst for fueling creative and critical thinking. Concurrently, research done by Voet and De Wever (2017) indicated that teachers' higher sense of efficacy might be associated with their willingness to adopt new instructional methods within their classrooms.

In academia, the belief in one's self is an essential element in forecasting academic success (Bates & Khasawneh, 2007). Hence, in America, Chen et al. (2014) carried out a nonexperimental quantitative study to address a gap in the literature as it relates to self-efficacy in the teaching of mathematics. The Early Math Beliefs and Confidence Survey (EM-BCS) was used to gather information on 345 public preschool teachers' beliefs and practices about inquiry-based learning. The Likert scale was the measurement instrument for interpreting the findings. The conclusion suggested that teachers' self-efficacy towards a particular subject area should play a critical role when planning professional development to improve the pedagogical skills in that area, this body of knowledge may be a useful part of any investigation that examines professional development aimed at improving teachers' competency and self-efficacy for teaching (Chen et al., 2014; Lui & Bonner, 2016).

Fundamentally, there is a need to have a foundational knowledge of how primary teachers' perception of their ability to implement the RME framework effectively. In consequence, researchers and local school authorities must seek to capture the essence of primary teachers' current pedagogical practices, motivation, competency, and perceived self-efficacy towards implementing the RME framework. Briley (2012) believes that knowledge of how teachers' perceive self-efficacy is essential when examining motivation and competence in employing new pedagogical practices.

Another critical point of view is that of Bandura (1997). Bandura postulated that it teachers are responsible motivating and supporting all learners. Bandura further argued that high-level teaching and learning are dependent upon the teachers' skills and perceived self-efficacy. Self-efficacy influences motivation and the courses of action they pursue. Consequently, teachers' self-efficacy weighs heavily on how they approach teaching and learning as well as their perceptions of competence, motivation, and persistence to achieve goals despite repeated failure (Dybowski et al., 2017). This standpoint is relevant to both school administrators and persons who support the implementation of the RME framework. It goes without contradictions that teachers' perceptions of their ability to succeed greatly impacts the teaching and learning of all subject areas.

Current and classical researchers indicated that teachers' perceptions of their self-efficacy were related to student's academic attainment (Armor et al., 1976; Ashton &

Webb, 1986; McLaughlin & Marsh, 1978; Moran & Woolfolk Hoy, 2001). McLaughlin and Marsh (1978) were the first researchers to show the connection between teachers' perceived self-efficacy and student achievement. Relevant to this discourse is the understanding that motivation is a component of self-efficacy. Therefore, teachers' self-efficacy, motivational, and persistence for learning might positively affect students' academic attainment in most curriculum areas (Dybowski et al., 2017). Dybowski et al. conducted a study in which he articulated the need to examine the teachers' current pedagogical skills and perceived self-efficacy towards implementing RME.

Teachers' Self-Efficacy and Inquiry-Based Learning

Based on a quantitative exploratory study involving mixed cultural first grades, Harari, Vukovic, and Bailey (2013) explored the stress that is associated with traditional mathematics. The results showed that traditional approaches in mathematics caused stress and anxiety in young children. Then, teachers need to be cognizant of the various pedagogical practices that can help children to develop problem solving skills without experiencing elevated cortisol levels (Lessani et al., 2017).

Additionally, Caswell (2017) postulated that the inquiry-based learning approach encourages children to explore, investigate, and take ownership of their learning. Therefore, some educators and theorists embrace inquiry-based learning as a teaching strategy that supports active inquiry and problem solving (Lerkkanen et al., 2016). Nevertheless, not all teachers possess the skills or perceived competence to relinquish the task of being a depositor of knowledge to facilitator of learning (Lessani et al., 2017). Inquiry-based learning requires a shift from the behaviorist approach to teaching to the widely embraced constructivist approach, and not every teacher has attained the required skills to do so (Lessani et al., 2017; Yunus & Bakar, 2017).

The findings and scenarios from research done by Harari et al. (2013) stressed the importance of students being active in their learning, as is evident in inquiry-based learning. In like manner, Su, et al. (2016) argued that inquiry-based learning is a methodology that improves cognitive thinking skills and empowers students to be able to solve problems. Similarly, Ewing (2017) postulated that there is a need to teach mathematics in a way that captures students' attention and challenges them to problem solve. Being able to think critically and solve complex problems are essential, as children need to move beyond their current level of failure (Ewing, 2017; Gürefe & Bakalım, 2018).

A barrier to success that educators face in embracing inquiry-based learning in the mathematics class is that they do not always possess the strategies needed to implement inquiry-based learning (Miller & Wakefield, 2014). Hence, researchers at the National Council of Teachers of Mathematics (NCTM, 2013) stated that some students are not acquiring the mathematical skills they need to solve complex mathematical problems. This problem is further compounded by teachers' low self-efficacy for teaching problem solving; since there is a direct link between teachers' belief in their ability to be successful and students' numeracy achievement (2016).

Teachers' Self-efficacy, Motivation, and Competence with using RME

Growing evidence from the literature suggested that while RME, an inquiry-based approach, can increase students' achievement and ability to solve complex problems in mathematics, some early childhood teachers have shown lack of competency and confidence in teaching mathematics (Chen et al., 2014). The disbelief in self may ultimately result in teachers shying away from using inquiry-based learning and the RME framework (Saleh, et al., 2018).

Bandura (1977) propounded that while incentives are essential to the effective completion of a task, self-efficacy is a strong determinant of the kind of task one might undertake and perseverance shown in challenges. Furthermore, Clement and Sarama (2017) postulated that some educators do not possess the competency and passion needed to teach mathematics effectively. Likewise, Tschannen-Moran, Wolfolk, and Hoy (2001) believed that strong self-efficacy is a powerful indicator of teachers' success. In addition, strong self-efficacy fuels the professional to preserve and yield high academic attainments in their students. Consequently, purposeful professional development is essential in ensuring that teachers' personal feelings towards the teaching of mathematics are supported (Malinauskas, 2017).

Through training and development, some teachers become more confident in employing the RME framework in an inquiry-based approach learning model (Maass, Swan, & Aldorf, 2017). Maass et al. reasoned that, as with all other areas of teaching and learning, teachers' perceptions of inquiry-based learning will significantly influence how they approach the adaptation of such learning model within the classroom. Consequently, examining teachers' motivation, competence, and self-efficacy towards using the RME framework in an inquiry-based learning model are essential to understanding why some teachers are using the instructional model inconsistently (2017). Teachers' perceptions of their ability to employ inquiry-based approach learning are critical to their performance and students' academic outcomes (Kang & Keinonen, 2016). For this reason, there is a renewed attention to the interplay between teachers' perceived self-efficacy and the teaching of mathematics (Maass et al., 2017).

Inquiry-Based Learning Model

Children are naturally wired to develop the essential skills that are associated with the field of science and technology (Clements & Sarama, 2016). With this being said, it can be conjectured that inquiry-based learning was put forward as an instructional method that ensures that encourages children to draw upon their innate abilities, as they co-construct knowledge with their peers (Maass, et al., 2017). Undoubtedly, this approach to learning supports the constructive approach where children are active learners who possess the skills to "author their ways of problem solving" (Smith & Stein, 2011, p. 2). Not only are the children free to think and solve problems, but they discover what will and will not work as they seek to make connections to real life experiences (Fyfe, Mitchell, & Nathan, 2017). This complex problem solving and discovery is one of the essential components of inquiry-based learning.

A typical inquiry-based lesson uses high level instructional tasks as the springboard for learning (Green & Kent, 2016) In this model, students learning takes center stage, while teachers skillfully assume the role of a facilitator of learning, who encourages critical thinking and discovery (Su et al., 2016). Given that humans learn best by solving complex situations, inquiry-based dictates that the power of learning belongs to the students who lead the process under the guidance of a confident and competent facilitator (Smith & Stein, 2011).

The nature of inquiry-based learning is one where questions are posed and answered by both teachers and students. Students consciously engaged in accountable talks where they justify their solutions to cognitively engaging tasks (Kang & Keinonen, 2016). This high-level discussion-based practice demands careful preparation on the part of the teacher. Nevertheless, teachers must recognize that inquiry-based learning is best implemented when teachers recognize that moving into an inquiry approach is a learning journey (Murphy, Abu-Tineh, Calder, & Mansour, 2018). Teachers must be willing to make changes, fail, and exercise tenacity in the face of adversity (Harris, 2017).

Challenges with Implementing Inquiry-based Learning

Cognitively demanding instruction is critical to the improvement of students' mathematics achievement, but teachers' self-efficacy is a vital ingredient in the process (Won, 2014). Likewise, teachers' tenure of teaching, their philosophy of teaching and learning, as well as professional learning opportunities are all associated with teachers who execute cognitively challenging teaching with high self-efficacy (Chapman, 2013).

If a teacher believes that he/she lacks the skills and confidence needed to execute the guiding, teaching framework to advance children mathematical thinking, then he or she will have little interest in implementing the framework. To this end, there is a need to examine the viewpoints and feelings of teachers towards implementing the RME framework. Bandura (1997, 2000) highlighted that effective enactment of a task involves the mastery of the necessary skills and the confidence in one's capability to employ them.

In examining the application of inquiry-based learning, Ramnarain (2014), postulated that many teachers are unevenly implementing IBL into their practice. Hence, while inquiry-based learning is a vital tool to address low student achievement and progress, teachers' lack of readiness and self-efficacy has dampened its impact (Silm, Tiitsaar, Pedaste, Zacharia, & Papaevripidou, 2017).

A shared concern over the inaccurate implementation of an inquiry-based oriented curriculum has led Johnson, Caughman, Federicks, and Gibson (2013) to conduct a case study to explore the experiences of a group of mathematicians at the tertiary level. Data collection sources were interviews, videotapes, and firsthand commentaries. The researchers looked at the combination of pedagogy and the goals for students' achievements. Moreover, the data collected helped me understand the drawbacks and prospects of implementing a child centered curriculum.

Caughman, et al. (2013) discovered that mathematicians have diverse beliefs and practices about what must happen in an inquiry-based classroom. Hence, this study highlighted the need to scrutinize teachers' beliefs, self-efficacy, and pedagogical practices within the classroom. Likewise, Ramnarain (2014) emphasized the need for teachers to take part in authentic professional development that equips teachers on how to use the inquiry approach in a mathematics lesson. One fundamental point to consider when examining practice is the level of confidence and confidence displayed by teachers (Nguyen et al., 2015). For this reason, Chen et al. (2014) and Leow (2014) embarked on a research to collect and report information related to teachers perceived self-efficacy.

Through a quantitative survey study, including 346 teachers representing 46 public schools in the Midwest region, Chen et al. (2014) collected information on the confidence, competence, and feelings teachers have about teaching mathematics. The authors explained that some teachers lacked the necessary preparation and confidence needed to teach mathematics effectively. They also articulated there is a need for greater focus on the teaching of mathematics in the early years. The key findings from the study conducted by Chen et al. were in line with those highlighted by Walter (2015). The central thought was that teachers are not confident in their own ability to teach mathematics using the inquiry-based approach.

In analyzing the relationship between teachers' attitude and students' achievement, Voet and De Wever (2017) argued that teachers' attitudes towards the teaching of inquiry-based learning must be improved if they intend to see increased student attainment. Recognizing that there are many known barriers to the effective implementation of a child centered curriculum, Alsharif (2014) conducted a quantitative study in order to understand the feasibility and practice of implementing a child centred approach in the teaching of mathematics at the primary level.

Alsharif (2014) collected data by surveys, questionnaires, and observations. The researchers collected data from 50 preservice Teachers' College students and 100 inservice teachers from 35 primary schools. Data on the teaching practices and beliefs of teachers about constructivism were analyzed. The results showed that a significant level of relationship between teachers' beliefs about constructivism and their actual implementation of the practice. The authors also postulated that some teachers lack the skills and self-efficacy needed to implement a child centered approach to teaching mathematics. This study provides understanding into the problem of the pedagogical challenges that mathematics teachers may face when changing teaching strategies to inquiry-based learning. Therefore, the uneven implementation of the RME model in the BOT is in line with evidence from the wider field. Nevertheless, Son (2015) that stakeholders must try to strengthen teachers' instructional practices though targeted PDs.

Teachers' grasp of mathematical knowledge and instructional skills are essential to the implementation of inquiry-based learning (IBL) (i.e., the proper understanding of the processes, facets, and assessment and learning strategies) that is associated with implementing IBL. The implementation of IBL can be challenging for seasoned teachers and more so novice teachers (Miller & Wakefield, 2014). Hence, Miller and Wakefield expressed that there may be a need for a support system for teachers who do not have the strategies and experience needed to implement IBL effectively.

The reality is that most teachers face challenges as they seek to implement IBL (Gutierez, 2015). In a one year longitudinal qualitative case study involving 30 primary school, elementary science teachers from the Philippines, Gutierez used multiple qualitative measures to collect information about the difficulties that these teachers faced in employing inquiry-based learning. Similar to Miller and Wakefield (2014), Gutierez asserted that collaborative learning could be an avenue for teachers to engage in discussion about their practices and analyze their thinking and doing. Miller and Wakefield propounded that during paradigm shifts, teachers should reflect on their practices in order to improve.

The results from Gutierez's (2015) study significantly highlighted that there is a gap in practice as some teachers are unevenly using IBL in their mathematics classrooms. Additionally, there is a need to support teachers as they change from the known to the unknown. Stakeholders in the BOT could use Gutierez's proclamation to understand better, why teacher struggle with implementing the RME framework and how they could be supported. It also be recognized that challenges could also provide avenues for opportunities (Stephan et al., 2016).

Researchers supported the argument that there is a need for teachers to have a thorough knowledge of what IBL is and how to implement it in their classrooms (Radišić and Josic, 2015). In a qualitative case, study conducted by Radišić and Josic the experiences of a teacher implementing IBL. This investigative action led to the conclusion that teachers must possess a thorough understanding of the process of inquiry if they were to lead children along the learning continuum. Since most teachers often perceived IBL as three main entities: student centred learning, being active, and finding things out. This ideology may represent an inadequate understanding of IBL (Baştürk, 2016).

IBL, when applied to the field of mathematics, manifested itself through critical thinking, creative problem solving, examining multiple perspectives, justifying responses, identifying logical errors, and collaborating with peers in order to build critical thinking and metacognition (Su et al., 2016). Then, there may be a need to build a shared understanding among teachers about what constitutes inquiry-based learning, if success is the goal (Goos, 2016).

Teachers' Beliefs About Teaching Mathematics

In a six-month research project focused on seven essential components of reflective practice, Boron (2015) prompted teachers to assess their thinking. Boron aimed to understand better the teachers' beliefs and practices. Boron further postulated that it is essential for teachers if they are to make a conscious pedagogical change. Boron concluded that reflective practice is critical when attempting to change beliefs and practice. Boron's conclusion reinforced Gutierez's (2015) claim that preservice and inservice teachers need support as they transit from a traditional way of mathematics instruction to one where children are architects of their learning. Hence, in this project study, the teachers' perspectives of their abilities to implement the RME framework were of paramount importance.

Understanding the teachers' perspectives of their competence, motivation and self-efficacy may yield valuable information as to why some teachers have not mastered the task of delivering the RME framework. The RME model requires teachers to engage children in fruitful mathematical discussions as they delve into cognitively challenging mathematics problems (Fraivillig et al., 1999). However, teachers need to develop an elevated level of motivation, competency, and self-efficacy in the teaching of mathematics if they are going to raise students' achievement. Important to note is the postulation of Nurlu (2015) that students will not develop essential mathematics skills and become self efficacious if their teachers display high self-efficacy towards the teaching mathematics.

Teachers' Abilities to Orchestrate Meaningful Mathematics Discussions

Mathematical discussions play a pivotal role in mathematics instruction as it helps students to articulate their thinking and help the teachers to understand their thinking (NCTM, 2000). Furthermore, like technology, articulating one's point of view is essential in advancing the students thinking in a collaborative learning atmosphere. Hence, in line with the core purpose of mathematics, orchestrating purposeful classroom discussions equip children with a safe place to be, analytical, systematic, critical, and creative in their thinking (Mulbar & Zaki, 2018).

Creating a classroom climate where learners engage in accountable talk and meaningful discussions is a critical component of RME - an inquiry-based model (Laurens et al., 2017). Mathematical discussions allowed teachers to elicit, support, and extend children's mathematical thinking and problem solving in a nonthreatening way (Nabb, Hofacker, Ernie, & Ahrendt, 2018). Nabb et al. argued that cognitively challenging discussions help children learn multiple pathways to solving problems.

Moreover, classroom discussions provide a window through which teachers can view children's mathematical thinking (Kosko, 2015). Kosko, 2015 also put forward the notion that while high-quality discussions support inquiry-based learning and knowledge construction, teachers must create a social atmosphere where students feel safe to share their thinking. Likewise, Vygotsky theorized that children learn complex issues as they construct meaning through socialization with their peers (1978). Hence, Kosko stated that teachers must ensure that students' feel assured and supported during classroom discourse.

Like Kosko (2015), Smith and Stein (2011) highlighted the need to foster productive discussion in the mathematics classroom. Smith and Stein put forward five practices for orchestrating productive mathematics discussions: anticipating, monitoring, selecting, sequencing, and connecting. According to Smith and Stein, each practice forms the core of ensuring that the inquiry-based approach meets the needs of diverse learners. In the anticipating section of the lesson, the teacher considers how children might seek to solve cognitively challenging tasks and the pitfalls or challenges that children might face. Teachers must possess strong pedagogy and content knowledge to anticipate children's thinking and problem solving approaches (Muir, Wells, & Chick, 2017).

Monitoring is the process of critically analyzing children's actions and responses to the understanding of their thinking and problem solving progress. Ultimately, the teacher decides whom or what to be highlighted (Smith & Stein, 2011). During the selection phase, the teacher chooses those students with viewpoints that she wants to highlight. The objective of the lesson often guides the selection process. However, all students are recognized for their contribution to the discussion (Lestari & Prahmana, 2017).

Sequencing coordinates how information is presented by the students (Smith & Stein, 2011). Hence, after eliciting children's responses, the teacher decides the order of presentation (Smith & Stein, 2011). The final practice is connecting. Through connecting, the children learned to deflect responses. Ultimately, children can be supported to recognize the connection between solutions. Smith and Stein contended that these five practices could provide some structure for mathematical discussions during child centred inquiry-based learning (IBL). Hence, the five practices of orchestrating mathematical discussions should be an integral part of teacher development.

Professional Learning Communities

Almost all literature on the implementation of the RME framework mentioned the importance of professional learning in ensuring that teachers are adequately supported to meet the demands of the RME framework-inquiry-based learning (Gutierez, 2015). One of the key considerations when developing professional learning is the coining of targeted professional learning activities that build collaboration and support (Learning Forward, 2011). Through the professional Learning Forward Standard document, the authors highlighted the need for teachers to take the lead in deciding what they want to learn and when. Furthermore, most teachers have enough collaborative skills to work with their colleagues around professional learning activities (Antinluoma, Ilomäki, Lahti-Nuuttila, & Toom, 2018).

The exploration of the importance of building a supportive community of practice is imperative in ensuring that teachers' skills are enhanced (Cansoy & Parlar, 2017). In countries that embrace the use of the RME framework, great emphasis is on teachers possessing the skills needed to support the orchestration of mathematical discussion (Yilmaz, 2020). Most importantly, the teachers should have strong instructional skills to move the children through different levels of learning.

Yilmaz (2020) argued that professional learning is one sure way of addressing the needs for improved instructional skills. Similarly, Brown, Horn, and King (2018) explained that professional learning communities are most effective when they are expertly planned. As such, all professional learning must be well planned in order to be impacting (Chauraya & Brodie, 2018).In adding to the discourse on the suitability of professional learning for teachers, Bonghanoy et al. (2019) posited that mathematics for teachers needs to be transformative.

Transformative professional learning are professional learning activities are those learning experiences that are geared towards changing practice (Bonghanoy et al., 2019). According to Bonghanoy et al., changing instructional practices through professional learning means examining the issues that teachers faced in their mathematics lessons as well as their beliefs and values. An added dimension for assessment is the teachers' experiences and willingness to change (Biccard, 2019). Most importantly, the support provided should be closely aligned to those that the teachers expect their learners to do (Biccard, 2019). Then, coaching and modelling may need to be critical elements of professional learning provision (Biccard, 2019). Lesson study was put forward as a strategy for improving practice and building the mathematical knowledge needed to support the effective teaching of mathematics (Appelgate, Dick, Soto, & Gupta, 2020).

Overall, a plateau of support and professional learning opportunities are available to support teachers to teach mathematics effectively (Appelgate et al., 2020; Biccard, 2019; Bonghanoy et al., 2019). Teachers often make acceptable use of the available support. However, some factors mitigate the impact of planned professional learning offered to teachers. These factors could be poor planning, lack of input from teachers, and teacher's lack of skills needed to make quality contributions to the planned learning experiences (Jackson, Hauk, Jenq Jong Tsay, & Ramirez, 2020). Two significant ways of overcoming the pitfalls of ineffective planned professional learning are to align training and support with the needs of the teachers and involve teachers in the planning process (Biccard, 2019). Following a planned approach to the scheduling of professional learning can help to support teachers in the implementation of the RME framework (Althauser, 2017).

Implications

The literature explored in this research provided a bedrock for understanding and interpreting the teachers' current pedagogical practices, perceived self-efficacy, and competence in adopting the RME framework in their classrooms. The information gained from the field study and supporting literature highlighted critical information about the teachers' perceived self-efficacy and challenges when implementing the RME framework in an inquiry-based classroom.

Hence, a targeted professional learning prospect was proposed for the practitioners in the local school district-an E-Math Learning Lab. The introduction of an E-Math Learning Lab is in line with Learning Forward's Standards (2011) for Professional Learning (Morales & Sainz, 2017).

An E-Math Learning Lab provides opportunities "to shift from traditional one-shot professional development to ongoing professional learning" (Morales & Sainz, 2017, p. 37). Aligned to Learning Forward's Standards for Professional Learning (2011), the E-Math Lab will allow practitioners to engage in continuous professional learning that can help to strengthen their pedagogical skills and ultimately their self-efficacy towards the teaching of mathematics. Also, the results from this study may help stakeholders to see the relationship between teachers' perceived self-efficacy and their willingness or unwillingness to implement the RME framework.

Stakeholders may be more inclined to implement the E- Math Learning Lab to build teachers' self-efficacy in the implementation of the RME framework. The idea of an E-Math Learning Lab is new to the local setting. However, the content of the E-Math Learning Lab derived from the findings of this research. The participants' desired PDs that were easily accessible, in line with their professional learning needs, and help teachers connect their learning to local scenarios. Hence, the E-Math Lab introduced an online database with suggested local scenarios, book study sessions, model lessons, and an RME rubric. The hybrid approach to the Learning Lab allowed for both face to face sessions and online access to a virtual learning community of practice.

Furthermore, the findings from this project study may become a springboard for further academic research into understanding primary teachers' challenges and self-efficacy towards implementing different aspects of the mathematics curriculum. Hereafter, I hope that further analysis and understanding of Year 1 teachers' self-efficacy and challenges may lead to a systematic review of the mathematics framework and the development of professional learning communities where mathematical skills are refined, and best practice shared through lesson studies. This collaborative culture may lead to improved pedagogical skills and self-efficacy, increased students' attainment, and positive social change. Ultimately, by increasing teachers' self-efficacy, they will feel more confident to undertake a wider variety of instructional tasks (Bandura, 1997).

Summary

The focus of this research was on the challenges that some Year 1 primary teachers faced as they implement the RME framework. Furthermore, local authorities affirmed that some teachers lack the competency needed to implement the RME framework, in an inquiry-based model effectively. I selected the problem in this study after perusing both local and scholarly literature. Section 1 also highlighted the significance of the research as well as the guiding research questions.

A recapitulation of literature provided a background in the theoretical framework. Researchers attested to the line of reasoning that teachers' beliefs about their ability to teach mathematics significantly affect their students' achievement (Achurraa, & Villardón, 2013). Not only does teachers' perceived self-efficacy about mathematics affect student's achievement. Achurraa and Villardón argued that it affects teachers' motivation and students' motivation towards mathematics. Insights into why teachers may struggle to implement the RME framework, a contemporary approach to teaching mathematics that is in line with the central tenants of inquiry-based learning. The final segment of section 1 shed light on a proposed project that may help teachers in the BOT to develop the confidence and competence needed to implement the RME framework effectively.

The following section of this project study, section 2, consists of the research design, data collection, and analysis of data collected. In section 2, I strategically outline the data collection process, the instrumentations, the role of the researcher, ethical considerations, and ways of ensuring credibility and trustworthiness.

Section 2: The Methodology

Introduction

Section 2 of this research details the research methodology I used to explore a group of BOT teachers' pedagogical practices, motivation, competence, and perceived self-efficacy toward implementing the RME instructional framework in the Year 1 class. The methodology of this research aligns with the central tenets of a case study approach. I used a case study to explore and acquire an in-depth understanding of a group of Year 1 teachers' perspectives of their competence, motivation, and self-efficacy. I sought valuable information to understand why some teachers have not mastered the task of delivering the RME instructional model in its natural context (Yin, 2014).

A good understanding of the teachers' pedagogical skills, perceived competence, and self-efficacy towards employing the RME is essential in the BOT as the education system moves forward towards raising students' achievement in mathematics. Section 2 also includes the research design, participants' selection, and how data was collected and analyzed. I communicated the participation procedures and requirements to the participants in order to ensure that they were treated ethically. Likewise, the procedures for showing the credibility and trustworthiness of the research outcomes and explanations are outlined.

Qualitative Case Study Research and Design

Since 2013, the public school system in the BOT has revamped the traditional method of teaching mathematics and initiated a new way –RME framework. The RME framework involves the orchestrating of productive mathematics discussions where children routinely engaged in cognitively challenging problem-solving learning experiences. In this paradigm, teachers elicit, support, and extend children mathematical thinking.

Fundamentally, all primary teachers must possess the skills to create high levels of discussion oriented learning experiences that support complex problem solving. Hence, there was a need to explore a group of local primary teachers' perceived self-efficacy, motivation, and pedagogical practices as they implement the RME framework in their classrooms. The data gathered increased my understanding as to why some teachers may struggle with adapting the RME framework.

In this qualitative descriptive case study research, I explored the existing curriculum, lesson plans, and current teaching practices. I collected data through interviews and document analysis. The purpose of gathering data from these sources was to help me to understand better the current pedagogical practices, perceived self-efficacy, motivation, and competency of a group of local primary teachers from four public primary schools, as they seek to implement the RME framework. Four essential research questions guided this exploration:

RQ1: What teaching strategies, embedded in the RME framework, do Year 1 teachers currently use?

RQ2: What are Year 1 teachers' perceptions of their competency, motivation, and self-efficacy to use RME to support children's conceptual understanding and problem solving?

RQ3: What experiences, resources, and factors do teachers perceive support their confidence, motivation, and competence to teach mathematics through inquiry-based pedagogy using the RME framework?

RQ4: What professional development workshops doYear1 teachers find most useful in supporting their self-efficacy in teaching mathematics using the RME Framework in an inquiry-based learning model?

A qualitative method was appropriate for answering the research questions. Case study research allows participants to give unbiased responses when a researcher poses questions that are diverse and open (Creswell, 1998; Kenny, 2012) to gain knowledge about a situation (Shank, 2006). I chose a qualitative approach to explore a group of Year 1 teachers' current pedagogical practices, competence, motivation, and perceived self-efficacy toward the implementation of the RME instructional model. This approach provided an opportunity for deep analysis, including both documents and archival material (e.g., lesson plans, existing curriculum, and training manuals) and people, (i.e., Interviews) (Hancock & Algozzine, 2017; Merriam, 2009).

This case study is descriptive and was designed to allow me to gather valuable information about a group of Year 1 teachers' current pedagogical practice, self-efficacy competence, motivation, and persistence in teaching mathematics using the RME framework. The featured instructional model challenges students to solve problems and justify their solutions. Merriam (2009) postulated that a case study is an essential tool for researchers to use when seeking to affect policy and practice change. Furthermore, case study research can yield valuable information about a phenomenon related to the implementation of the RME instructional model and ultimately lead to policy development and informed decision making (Hancock & Algozzine, 2017).

A case study provides an opportunity for me to examine an existing phenomenon as it unfolds in every day; this is essential when seeking answers by what means and why inquiries (Yin, 2014). This research followed a case study approach to take a close look at a group of Year 1 teachers' current pedagogical practices, self-efficacy competence, motivation, and persistence concerning the teaching of mathematics using the RME. The featured instructional model challenges students to solve problems and justify their solutions. Case study is an essential tool used when seeking to effect practice change (Merriam, 2009).

I explored the idea of using a mixed-method design when considering an alternative research design for this study. I considered the use of mixed methods as it relates to the instrumentation of the research. However, after careful analysis of the critical features of the mixed method approach, I decided that it might be too time-consuming for a novice researcher without an in-depth understanding of both qualitative and quantitative approaches (Creswell & Clark, 2007; Lodico, Spaulding, & Voegtle, 2010). In addition, I may have challenges deciding which method should take priory during the data gathering process (Creswell, 2012).

A quantitative design was not considered. It was deemed unsuitable for the exploration of a group of Year 1 teachers' current pedagogical practices, motivation, competence, and perceived self-efficacy towards implementing the RME framework. Through this research, I have gained an in-depth understanding of the personal perceptions and underlying motivation of the participants (Yin, 2014). Hence, I rejected a quantitative approach because it does not provide opportunities for deep immersion and interactions with the participants during the data gathering process (Creswell, 2012).

Quantitative research often used to systematically investigate phenomena to form, confirm, or reject a hypothesis (Creswell, 2012). In so doing, the data collected are statistically and mathematically analyzed. In this research, I sought to gather rich data beyond numeral values, which is an essential component of qualitative research (Merriam, 2009). Consequently, qualitative research was used as the preferred approach.

While quantitative research design can yield valuable information about events studied, numbers will not capture or give the rich, vivid information about the real-life experiences, instructional practices, and personal articulation of the self-efficacy of the primary teachers as they seek to implement the RME. After critically examining the two alternative designs, I concluded that this study does not fit the central tenets of mixed or quantitative designs. The fundamental purpose of this descriptive qualitative case study was to collect rich data on a group of Year 1 teachers' pedagogical practices, and perceived self-efficacy regarding their competence and motivation to implement RME, an inquiry-based framework for teaching mathematics in the classroom.

This study may contribute to understanding the gap in practice regarding why some primary teachers are unevenly implementing the newly adopted RME framework. Second, this study provides baseline data for native mathematics coaches, school principals, and instructional leaders, about the Year 1 teachers' current pedagogical practices, perceived self-efficacy for teaching using IBL, and perceived competence in adopting the RME framework in their classrooms.

Context

This study took place in a BOT. The BOT consisted of three small islands. "The compulsory education system in the British Overseas Territory is comprised of primary and secondary levels divided by year groups and key stages" (Ministry of Education, Employment, and Gender Affairs, 2017, p. 2). The education system serves approximately 2,500 secondary and 2,600 primary students from 1 further education center, 3 high schools, 10 primary schools, one special school. The education services employ over 700 staff in these and several specialist support areas (Ministry of Education, 2018). Due to the small size of the islands, there are only eight public primary schools on the largest of all three islands.

Schools in the most significant section of the largest section of the BOT extend from the Eastern District to the Western District. The Ministry of Education is primarily concerned with the Education, Youth, Sports, Agriculture, and Lands outcomes desired by the Government, and delivers interventions to achieve these. Senior school improvement officers (SSIOs) supervised and supported all schools, under the headship of the director of education services. SSIOs work out of the Department of Education Services (DES). DES is lead and managed by the director of education services. DES is the operational division of the Ministry of Education, Youth, Sports, Agriculture, and Lands, with the responsibility of instituting the strategic policy direction for education (Ministry of Education, 2018).

Voluntary participation was required for this study. From the volunteers, I purposefully selected eight participants. The participants were public school primary teachers who were exposed to strategies that are associated with the RME instructional model. The final participants were drawn from eight primary schools in the largest section of the BOT. Initially, eight Year 1 teachers from four schools agreed and participated in the study. However, only seven participants from four schools went through the process.

Participants

The participants in this research were Year 1 teachers employed in the public education system in a BOT in the Caribbean. These teachers were exposed to the RME framework and were practicing its implementation within their classrooms. The purpose of this research was to explore and understand the teachers' current pedagogical skills, perceived competence, and self-efficacy towards employing the RME instructional model.

School Selection Procedures

The director of education services was contacted in order to gain permission to access the public primary schools. After gaining permission to research the public schools, all eight public primary schools in the largest section of the BOT were contacted via email, to gain school level consent from at least four schools. The principals were asked to respond to the email granting or not granting permission to use their primary schools as a research site. I secured permission from four schools. An information sheet outlining the purpose and research methodology was sent to the Year 1 teachers. Those who were interested responded to the email with the phrase “I Consent.” Those who do not wish to participate in the study ignored the invite.

The schools in the largest section of the BOT are all governed by the same policies and carry similar academic programs. Hence, the criteria used to select schools within the largest section of the BOT were the same. All selected schools have Year 1 teachers who have been exposed to the RME framework in an IBL mathematics classroom. Furthermore, the participants were also exposed to the facilitation of whole class interactivity during mathematics lessons. Because this study focused on instruction in regular education classrooms, teachers who were supporting children in specialized programs such as mathematics recovery were not considered for participation.

Gaining Access to Participants

After gaining institutional approval from the director of education services and the Walden University Institutional Review Board (IRB), the principals of the schools were consulted for their approval to conduct the study in their schools. Upon gaining the approval of the principals, the study information was sent to staff through their school emails. Prospective participants contacted me directly through emails. Teachers were sent the research information and consent details. Participants who understood the project well enough indicated their consent by responding with the phrase “I consent.” They also stated the date, time, and place that they were available for an interview. Agreed participants received an Outlook meeting invitation for their actual interview.

Participants Selection

The focus of a qualitative case study is best suited if it is small in order to give the researcher more time to delve deeper into the phenomenon under exploration (Mohd, Bakar, & Yazid, 2014). Moreover, if the sample section is not adequately thought out, it will affect the quality of the data collected (Mohd et al., 2014). Considering these underlying issues and the participatory aspect of this case study, I followed the procedures of purposeful sampling.

Patton (2014) contended that purposeful sampling allows researchers to gain a detailed and fundamental understanding of the case to be studied. Similarly, Creswell (2012) put forward the notion that crucial considerations must be given to the sample type. Sample type is crucial as purposeful sampling can yield data from convenience, availability, political importance, marginalized individuals, or typical ordinary people. Consequently, Year 1 teachers who were carrying out their ordinary daily duties of teaching mathematics were purposefully selected.

Through purposeful sampling, study researchers can select ordinary participants who met the criteria stipulated by the purpose of the research (Merriam, 2009). The participants were teachers who were working within Year 1 classes in public primary schools in the BOT. At the time of the study, the teachers were using the RME instructional model in their mathematics lessons.

Guidelines for the size of the sample followed the guidelines of Creswell (2012) and Mohd, Bakar, and Yazid (2014). When carrying out qualitative case studies, Creswell suggested that the sample size might consist of a small number of participants. Similarly, Mohd et al. stated that since the findings from qualitative research are not necessary for the generalization but to gain knowledge of the phenomenon; hence, the sample should be carefully selected to reflect that phenomenon. The number of participants who agreed to participate in this study was seven Year 1 teachers drawn from four schools.

After gaining permission from the principals, participants were presented with the purpose of the study and the data gathering process, procedures, and protocols. A definition of and description of the RME framework and inquiry-based instruction in mathematics was presented and described to the prospective participants. A letter outlining further details of the research was also sent to prospective participants. Samples of each correspondence were also sent to principals.

Information relating to the study was sent to the participants through their school emails. Interested participants contacted me directly through emails. Participants who understood the project well enough indicated their consent by responding with the phrase "I consent." They also stated the date, time, and place for their interviews in the response email. Participants who agreed to participate received an Outlook meeting invitation with the date for their actual interview.

Ethical Protection of Participants

This study took place outside the United States. However, in preparation for data collection, I had to ensure that I met the requirements stipulated by the Walden and my local review boards. Therefore, I completed the Office for Human Research Protections (OHRP, 2018), to ensure that I had an in-depth understanding of the obligations and ethical principles that I needed to adhere to as I interacted and collected data from human subjects. I completed the required paperwork for the local education authority who gave local permission after reviewing my proposal and data collection instruments. The gatekeepers granted institutional permission to interview the participants. In this case, the gatekeepers were the director of education services and principals. However, they were not privy to the names of the participants. Both Walden and the local authority had strict requirements that I had to fulfil before this research was approved. The Walden University's approval number for this study is 10-30-19-0358526 with an expiration date of October 29, 2020.

I adhered to all ethical considerations from the outset of the research (Abed, 2015). Throughout the research, I upheld all ethical practices and processes. Like Abed, Creswell (2012) highlighted the importance of paying attention to ethical principles and practices during the research process. This qualitative descriptive case study followed the ethical procedures and disclosures as stipulated by Walden's IRB and the local educational requirements. The ethical issues and privacy of the participants were considered and upheld. The use of pseudonyms and full disclosure of the purpose and content of the research ensured clarity. All data were stored in a password protected drive on my laptop computer. All data will be kept in my home for five years beyond the completion of this study and then destroyed.

Ethical considerations during and after the research. Hancock and Algozzine (2017) provided guidance on how to address ethical issues during and after data collection. During interviews, the ethical and legal requirements involving human subjects were observed. Participant consent was attained before the interview process.

After gaining informed consent, all participants selected an appropriate time and place to do their interviews and discuss the specifics of the research. After the interview, I scrutinized the information to ensure the preservation of the participants' identity. I avoided all leading, biased questions, and comments during the interview (Yin, 2014).

The most significant ethical consideration is maintaining the confidentiality of the participants (Yin, 2014). Privacy was essential, especially for some teachers who are expatriate contract workers. Hence, as previously stated, privacy was maintained through the use of pseudonyms and proper storage of transcripts and audio recordings on locked computers and cabinets outside of the research site, in my home. As suggested by Hancock and Algozzine (2017), I debriefed the participants about the research before and after the research. All participants were unanimous as I intended to share my findings with stakeholders beyond the participating schools. Though not all schools participated, stakeholders could use the findings of the research to plan teacher support for all teachers. The E-Math Learning Lab project could be a starting point.

Ethical considerations during review of documents. Additional information about the teachers' support system, curriculum, and instructional practices was gathered using a researcher-developed document review protocol (Appendix C). Yin (2014) argued that documentation provides a stable, unobtrusive, specific, and broad way of collecting data that covers an extensive period of events in a setting. As a result, I used a document review protocol (Appendix C) to gather information on the current curriculum, professional development offered, and teachers' current pedagogical practices as related to the teaching of mathematics using the new mathematical strategies that are aligned to the RME Instructional framework.

The critical questions put forward by Hancock and Algozzine (2017) were used to guide the document review planning process. Consequently, I sought answers for the following guiding questions during the pre-collection and decision-making process:

- Who has the information?
- What part of it is needed?
- Where is it?
- When was it prepared?
- How will it be collected?
- What type of answers will be available of the document is used?
- What sources?
- How will information be selected from all that is available?
- How will documents be represented as answers to research questions?
- What ethical concerns are relevant to the documents (Hancock & Algozzine, 2017, p. 57 & 59)?

After careful consideration of the research questions and the purpose of the study, I took the decision to examine the participants' lesson plans, professional development presentations/manuals, and existing mathematics curriculum. These data sources were examined to find answers to the research questions.

RQ 1. What instructional strategies as embedded in the RME framework are the Year 1 teachers currently using?

RQ2: What are Year 1 teachers' perceptions of their self-efficacy competence, motivation, and persistence to use the RME framework to improve students' achievement in mathematics?

RQ3: What experiences, resources, and factors do the Year 1 teachers perceived support their self-efficacy competence, motivation, and persistence to teach mathematics through IBL as aligned with the RME framework?

RQ4: What do professional development workshops the Year1 teachers find most effective in supporting their self-efficacy in teaching mathematics using the RME Framework in an inquiry-based learning model?

Data collected from these sources were triangulated with the data collected from interviews.

The teachers who participated in the study did their curriculum maps yearly, and lesson plans weekly, or biweekly. Hence, each of the seven teachers submitted two lesson plans. The lesson plans helped to shed light on the teachers' planned approach to teaching mathematics using the RME framework. The lesson plans also highlighted the teachers' current pedagogical practices, as shown in their lesson plans. Even though documents are not human subjects, ethical principles and guidelines must be adhered to when collecting documents for analysis (Hancock & Algozzine, 2017). Pseudonyms were assigned to collected lesson plans.

Yin (2014) postulated that a research protocol is essential in a case study as it keeps the researcher focused on the essentials. The use of a document review protocol also ensured consistency and objectivity during data collection and analysis. Therefore, a document analysis protocol (Appendix C) was used to guide the analysis of the documents collected and reviewed during this research. The document review protocol was aligned to the RME framework, research purpose, and questions. Most importantly, the document protocol (Appendix C) ensured that my biases were minimized, and the key focus remains on details as they emerge from the data.

Lesson plan analysis was completed after the interviews. Crosschecking of information helped me to recognize the symbiosis between what was expressed and what happened in practice. Furthermore, the lesson plans provided further information and clarified which elements of the RME framework the Year 1 teachers were having difficulties executing. In this case study, information about perceptions of self-efficacy was collected in the interviews, instead of the document reviews. Data about the RME framework were collected through interviews and document reviews.

Role of the Researcher

It is almost impossible to eradicate a researcher's bias during the data collection and data analysis processes (Clark & Veale, 2018). Nevertheless, Clark and Veale averred that qualitative researchers must seek to understand and express their own biases as this will affect the direction and outcome of the research, given the qualitative research is interpretive. Therefore, key consideration must also be given to the fact that I once served as a classroom teacher who had my own challenges, pedagogical practices, perceived motivation, competence, and self-efficacy in implementing the RME framework.

I believe some teachers lack the self-efficacy, motivation, and self-efficacy needed to execute the RME framework. Hence, there was a need to ensure that the findings were not colored with my own biases. For this reason, protocols were developed and adhered to in order to keep me grounded and focused on observation rather than perception (Clark & Veale, 2018). Besides, a peer reviewer was used to review all the data collected and checked for the logical development of themes and findings. Further description of the peer reviewer and the responsibilities are described under the Credibility and Trustworthiness section.

I have worked in the public education system for five years. During this period, I have served as a Reception class teacher and Special Education Needs Coordinator in three of the schools in the proposed study. As a mean of control, participants were not selected from my current school. Eliminating all familiar persons and place minimized all unforeseen bias that may have resulted from my employment in the system.

Researcher-Participant Working Relationship

I was the only researcher in this study so under the guidance of my committee member and second committee member I designed, implemented, analyzed, interpreted, and reported the findings of this study and the entire research. Furthermore, I developed a project aimed at supporting teachers in the implementation of the RME framework (Appendix A). This project will be discussed further in this research.

One of the hallmarks of a qualitative study is the researcher's capability needed to maintain an excellent collegial relation with the participants (Miller, Strier, & Pessach, 2009). Building a quality relationship is essential if the participants are feeling relaxed and open with a researcher. According to Miller et al, a relaxed atmosphere ensures that participants feel a sense of comfort in order to express themselves freely and honestly.

Once participants feel a sense of belonging, their perceptions may change from resistance to collaboration. In this model, the participants make meaningful input to the research project (Miller et al, 2009). Therefore, I focused on relationship building with the participants, through open dialogues that emphasized that we are all colleagues and equals. I also explained that I am just seeking to better understand their current pedagogical practices, competence, motivation, and perceived self-efficacy towards implementing the RME instructional model. I am not at a higher level than the teachers are. There is no status quo in the research environment.

Researcher's Experiences

I am an educator with impeccable knowledge of the local education system that I explored in this research. I possess eight years of teaching experiences that span both the public and private education systems in the jurisdiction. As a teacher who had experience in three separate schools across the system, I am acquainted with doing document analysis as part of a school inspection training. I am also trained in implementing the RME mathematical strategies. I have used the RME framework as a Reception Teacher. Still, being the sole researcher in this research, I had to ensure that my personal biases did not interfere with the authentic data gathered from the participants.

Data Collection

In this qualitative descriptive case study research, the data collection process and instruments used were guided by strategies from Creswell (2012), Merriam (2009), Patton (2014), and Yin (2014). The data collection included gathering data from primary and secondary sources. The key data sources were interviews and document analysis- lesson plans, and curriculum guides. These data collection strategies are in line with the central tenets of qualitative research. Data collection stared with interviews followed by document analysis.

Merriam (2009) postulated that interviews and observations are rich primary sources from which valuable information can be gathered during qualitative research. Interviews (Appendix B) were the main data gathering tool used to collect data needed to answer RQ3 to which answers were the researcher sought to understand the experiences, resources, and factors that the Year 1 teachers' perceive support their self-efficacy competence, motivation, and persistence to teach mathematics through IBL, as aligned with the RME framework. Data collected through the process aligned with RQ4. RQ4 was structured to collect data that led to the understanding what professional development workshops do and what the Year 1 teachers find most effective in supporting their self-efficacy in teaching mathematics using the RME Framework in an inquiry-based learning model.

Data regarding RQ 1, what instructional strategies as embedded in the RME framework are Year 1 teachers currently using? were gathered through interviews and lesson plan analysis (Appendix C). The lesson plan analysis also provided an opportunity for me to see if the teachers' perceptions of their self-efficacy aligned with their current instructional practices as laid out in their lesson plans.

Another source of data collection was the retrieval of documents for analysis. It should also be noted that although the documents were not primary sources of information, they could yield valuable information and add to the triangulation of data sources (Merriam, 2009). Data were gathered from secondary data sources such as lesson plans and curriculum guides. Data for research question 1- the implementation of the RME was collected using the lesson plan, curriculum guide, and document analysis protocol (Appendix C).

The use of the previously mentioned protocols guided the collection process. The researcher developed the protocols. Hancock and Algozzine (2017) suggested that researcher-created instruments provide a strategic way of collecting information that is specifically related to the developed research questions. Assigned first and second committee members validated the appropriateness of these instruments. These reviewers ensured that the instruments were in alignment with the critical elements of the study. Notably, data related to the constructs of self-efficacy was collected using the interview protocol (Appendix B). The document analysis protocol (Appendix C) guided the retrieval of data from the documents selected for analysis.

Semistructured Interviews

The data collection process began with semistructured interviews. The data collected from interviews yielded answers for RQ 1, 2, 3, and 4. Using the guiding principles of Merriam (2009), each participant engaged in one face-to-face semistructured interview. The interviews were guided by the interview protocol (Appendix B), which comprised of 25 open-ended questions. In keeping with the viewpoints of Yin (2014) and previously conducted case studies, data were gathered from a single interview, lasting approximately 45-60 minutes.

Interviewing participants in a case study is a powerful data gathering source that provides targeted, personal, insightful perspectives, and perceptions (Yin, 2014). Yin argued that interviews are one of the most important sources of case study evidence. In this case study, interviewing the participants proved to be a pivotal move towards understanding the participants' perceptions of their self-efficacy, competence, motivation, and perseverance towards implementing the RME framework.

Given the nature of the case study, the interview questions were crafted carefully to capture the interviewees' sense of meaning, challenges, and interpretation of their current pedagogical practices, perceived self-efficacy, motivation, and competence in implementing the RME framework in an inquiry-based focused mathematics classroom. The interview questions were based on the concepts/construct of the framework and related literature.

The interview protocol (Appendix B) was reviewed by the committee members who checked for readability, clarity, alignment with the problem, framework, and purpose of the study. All interviews were audio-recorded with participants' permission in order to ensure the authentic representation of their data. Initial authentic data helped to ensure that data analysis and findings accurately represented the reality of the participants (Seidman, 2013).

Document Review

Document retrieval was the final stage in the data collection process. Document review supported the process of gathering data for RQ 1 and 4. The document review process involved the analysis of lesson plans; followed by the review of professional development manuals, and handouts. Curriculum guides were the last to be reviewed. Some documents were retrieved from public search while school leaders and participants provided others. The review of documents took place off campus, as requested by the participants and school leaders. Given that the national mathematics curriculum and most professional development manuals were circulated nationally, these documents were readily available for perusal.

The sample size was relatively small; hence, data collection lasted for one month; this is in keeping with at the trends noted in similarly designed qualitative research (Yin, 2011). To guarantee the accuracy of data, all participants engaged in member checking of the draft findings. The aim of the member checking process was for participants to check for the accuracy of the researcher's interpretation of their data used in the findings (Merriam, 2009). Merriam stated that the process of member checking helped with affirming the accuracy of the data collected from the participants. Participants engaged in member checking and sent their feedback to me. All participants confirmed that the analysis and findings accurately captured their viewpoints. The second member feedback also affirmed that the analysis and findings extracted from the raw data were in line with the participant's original articulations and perspectives.

Post Data Collection Procedures

After the data were collected, the following procedures were followed to ensure that the data were secured and ready for analysis:

- Interview data were audiotaped then transcribed.
- The data were then transcribed from the audiotape to a Word document.
- Once transcribed, the transcripts were checked against the audiotape for accuracy and then stored in an electronic password secured computer.
- Document review protocols were used to review all written documents.
- All documents were coded using a priori codes derived from the RME framework
- All data were coded through an open coding process.
- The coded data were analyzed for common themes using axial coding.
- All participant data were checked to ensure that pseudonyms were used instead of participants' real names.
- Paper copies were stored following the policy of Walden University.

Data Analysis

Case study qualitative research requires the researcher to engage in a rigorous, systematic process during data analysis (Creswell, 2012). Consequently, three data analysis methods were used for coding the data collected from various sources (Gibbs, 2007; Saldana, 2015; Yin, 2014). All analysis followed the process of a priori coding, followed by open coding, and finally axial coding. All codes were then analyzed for theme building. Interview data were analyzed first, followed by lesson plans, analysis of the written curriculum, and finally the analysis of training resources.

Thematic analysis is closely aligned with qualitative study design; for this reason, I analyzed the data using thematic analysis. Thematic analysis is a systematic process for finding, scrutinizing, and presenting patterns/themes within the data (Attride-Stirling, 2001; Braun & Clarke, 2006). Thematic analysis is indicative and the method in which the researcher seeks to generate codes and themes as they emerge from the raw data (Saldana, 2015). The themes and codes are usually closely related to the dataset. Emerging themes usually accurately capture the quiddity of the participants' feelings and experiences from the original data. So thematic analysis was chosen as the preferred method for data analysis. Braun and Clarke deemed thematic analysis as an effective method that can be used to capture and report the lived realities of participants.

Furthermore, through thematic analysis researchers can ensure that the richness of the data is maintained, and the output accurately reflects the content of the original data (Braun & Clarke, 2006). Essentially, the employment of thematic analysis ensured that the analysis is data-driven as the researcher searches across data sets to identify recurring themes (Patton, 2014). I employed Braun and Clarke's six phases guide for the thematic analysis approach was within this project study:

- Phase 1: Familiarizing myself with the data corpus
- Phase 2: Generating initial codes through a priori coding followed by open coding
- Phase 3: Axial coding to establish the relationship between codes and develop categories
- Phase 4: Reviewing categories and codes to form themes
- Phase 5: Defining and naming themes

- Phase 6: Producing the report

An in-depth summarizing of the data was ensured through the adoption of the six phases. Data analysis began with the interview data followed by document analysis. I manually analyzed the data. Manually analyzing the data helped me to get a firsthand look at the emerging details. Precoding of all data sources began before the official coding process. Layder (1998) recommended that it is in good taste to begin precoding by circling, building, or highlighting essential parts or quotes from information collected from participants. Hence, I carefully searched the information collected and highlighted the information that was in line with the a priori codes.

The creation of the a priori codes was guided by the RME framework and information cumulated from the literature. Additionally, preliminary jottings were done as I collected the data within the field. Preliminary jottings provided me with opportunities to make jottings of my initial codes or ideas while the data collection is in an active process. In adopting the process of using preliminary jottings, I followed the format of Liamputtong and Ezzy (2005) to create a three column page where jottings were made. The first column - the raw data, column 2 had preliminary codes, and the last column had the final code.

As I went through the coding process, the following questions were adapted from Emerson, Fretz, and Shaw (1995) and used to guide my thinking and analysis:

- What are people doing and what are they trying to accomplish?
- How, exactly do they do this? What specific means and strategies do they use?

- What assumptions are they making?
- What do I see going on here?
- What did I learn from these notes?
- Why did I include them?
- How is what going on here like or different from other incidents or events recorded elsewhere in the field notes?
- What is the broader import or significance of the incident or event? What is it a case of? (p. 177).

Interview Analysis

Data analysis began immediately after the first interview data was collected. Early analysis of the data prevented a large amount of data to be analyzed. After returning from the field, I played each recorded interview and typed the data into a Microsoft document. I manually transcribed the interview data from the audio recordings. The transcriptions were compared with the audio recording to ensure accuracy. The data were reviewed several times in order to understand and begin to make sense of the overall data collected (Creswell, 2012).

I reviewed the interview for early commonalities relating to the purpose of the study. Before the initial coding and further analysis, I recorded my initial thoughts and feelings. After actively scrutinizing the entire transcribed data individually, I took notes of ideas for further coding and highlighted texts electronically using blue for initial review.

In Phase 2 of the interview analysis, I began highlighting the a priori codes red. The a priori codes used in the analysis of all data sources were the following preset codes:

- Students share their strategies.
- Students engage in problem solving.
- Lesson studies.
- Opportunities for collaboration.
- Conferences.
- Sample lesson plans.
- Realistic experiences (contextualization).
- Use interactive teaching tools for progression.
- The teacher models (guided reinvention).
- Teacher support.
- Lacks content knowledge.
- Needs more support.
- Needs activity bank.
- More professional development.
- Modelling of best practice.
- Peer observation.
- Students practice.
- Teacher and class practice together.

- The teacher supports student at the point of difficulties.
- Whole class interactive teaching.
- Problem-solving approach.
- Use of questioning.
- Use of practice books
- Confident learners.
- Use of realistic experiences.
- Use of models and symbols.
- Children are finding their strategies.
- Using models and symbols for progressive mathematization.
- Intertwining: The students make connections with other learning topics and strands.

After the a priori coding, I continued scrutinizing the data through an open code process. Only a limited number of new codes emerged during the open coding process. The transcripts were given early codes as I scrutinized and familiarized myself with the document and not only from predetermined coding frames. After going through the individual interview responses and notes for each participant, I developed a worksheet for each participant. Participants' data were color coded so that they were recognizable when combined.

During the analysis process, I kept a reflective journal in which my observations, questions, interests, and ideas that I found essential to the research were recorded. Additionally, I crosschecked information against the original transcripts in order to ensure the originality and accuracy of details. Initial codes were copied and pasted into a Microsoft document for further code building and categorizing (Saladana, 2014). Afterwards, I transferred and organized the data into an Excel sheet.

After the open coding was completed, I began axial coding of the interview coding process. In the process of axial coding, I scrutinized and reexamined the list of codes that I have arrived at the open coding phase. I examined the initial codes for relationships and commonalities through axial coding. Axial coding for relationships among the codes and data led to the formation of categories (Saldana, 2015).

Categorizing of similar codes was taken from all interview transcripts that were previously coded along with new codes that came from recoding the data. Categorization of the data was completed per the research questions and strategies suggested by Hatch (2002).

The categories that supported the classification of the codes were:

- How teachers perceived their ability to teach mathematics using the RME framework.
- Teachers' perceived challenges in implementing the RME framework.
- Teachers' current instructional strategies.
- What keeps teacher motivated.
- The support that is available to teachers.
- How teachers perceived their level of persistence.
- Teachers' perceived impact of the professional development opportunities.

- All codes and corresponding texts were copied and entered the Excel data codebook.

In Phase 3 of the analysis process, I reviewed the categories developed in phase 2 and began to search for preliminary themes. The codes were looked at and the frequency and their relationship to the self-efficacy and the RME framework. The following information was taken into consideration:

- The relationship between the codes.
- The frequency of the codes.
- Underlining concepts based on the combination of codes.
- Does the category or theme generate address the research question?

I used seven sticky notes in Microsoft Word for each participant. Formal development of themes from the data set (Saldana, 2015) was the next step. All codes aligning to the categories below were placed on the sticky notes:

- Teachers' perceived challenges in implementing the RME framework.
- Teachers' current instructional strategies.
- What keeps teacher motivated?
- The support that is available to teachers.
- How teachers perceived their level of persistence.
- Teachers' perceived impact of professional development training.

The categories and related codes were once again scrutinized in order to gather the deeper meaning that they represent. Codes from each participant's worksheet were entered unto the sticky notes in order to answer the question on each sticky note. The entire data for each participant was rechecked.

Primarily, I analyzed the previously established categories and considered how different categories might be combined to form overarching themes. A two column table was constructed; one column had the identified themes and the other with the related codes/categories. Before putting the categories into thematic tables, I reviewed the themes against the original dataset and gave a brief description of the criteria for including each category into specific themes.

After a final review of the preliminary themes, five final themes emerged from the data corpus: (a) perceptions of competence and confidence; (b) current instructional practices; (c) training and support in the use of RME; and concerns and commendations about existing professional development model. These themes were identified at both the manifest and latent levels during the analysis process. In constructing the themes, I ensured that they were more than just nouns or incomplete phrases. Packer (2011) echoed the need for longer phrases or complete sentences used by the researcher to capture the deeper meaning of the data.

In Phase 4, I reviewed the themes for accuracy and relevance. The theme table developed in Phase 3 was scrutinized to restructure the themes if needed. Considering that there was a need to ensure that all themes were useful and relevant to the key purposes of the study, I reviewed the code sheet and categories from the raw data to see if the themes were synchronized with the original data corpus. Only codes that were mentioned frequently and had similarity were joined together to form themes. Themes were modified as needed. Codes that deviated from the common pattern of thinking were highlighted and those that deviated.

The generated themes covered the construct of self-efficacy and the RME framework. Hence, the themes were directly related to the teachers' perception of their competency, persistency, and motivation towards teaching mathematics using the RME approach. Details of the teachers' current instructional practices and professional development support were also explored. I copied all data relevant to each theme and pasted them under each theme in a Microsoft Word document (Bree & Gallagher, 2016). The copied data represented direct quotes from participants. I reexamined the theme table for alliance with the overall data corpus.

In Phase 5 of the thematic analysis, I scrutinized the themes for the final phase to determine if they fully capture and define the meaning of each theme (Braun & Clarke, 2006). I identified and discussed all subthemes and their connections to the main theme. The description was also provided as to reciprocity and relationships between each theme. I used a thematic map to depict the relationship among the themes. I scrutinized the original data to ensure that they were connected to the research questions and identified themes. Efforts were made to guarantee that no data fit into more than one theme. Most importantly, all the generated themes were scrutinized in order to ensure that they were conceptually congruent themes that accurately captured the data and provided answers to the research questions.

In Phase 6, the data generated from the analysis was written up and presented in support of the findings for the exploration of the quest to understand seven Year 1 teachers' mathematical practices and self-efficacy in implementing realistic mathematics education. I used narration to present the overall findings of the research. The final themes were ordered into essential groups. Quotations from participants were used to represent and substantiate identified themes (Creswell, 2012). The thick descriptive summary presented in this study was done in order to gather key information.

Document Analysis

The document analysis process was done in the following order: lesson plans, analysis of the written curriculum, and finally the analysis of professional development manuals/resources. The analysis process was a priori coding, open coding, and then axial coding. A priori coding was completed in line with the RME framework as captured by Treffers, (1987) (Appendix C). The analysis process for the professional development manuals and lesson plans followed the procedures laid out in the lesson plan and document analysis. I used a hybrid approach to arrive at the codes. The coding analysis, both lesson plans and training manuals began with a priori coding followed by open coding and then axial coding of the data corpus.

A priori codes helped to provide structure and direction to the code building process (King, 2004). The a priori codes that I developed were in line with segments of RQ 1, 2 and 3 and the RME framework. Consequently, the preestablished or a priori codes for lesson plans were:

- The lesson began with realistic experiences
- Teaching strategies used in mathematics lessons encouraged whole class interactivity

- Student engagement encouraged
- Use of learning models
- Critical thinking encouraged
- Student practice
- Lesson promotes fundamental concepts
- Opportunities to examine the mathematical structure
- Multiple pathways to learning sort
- The precision of mathematical language
- Student talk encouraged
- Opportunities to practice
- Teacher models, concepts
- The teacher uses student questions
- Students were involved in the communication with their peers

The above codes served as preliminary a priori codes and were cross-checked against the key components of the RME framework. I examined all lesson plan data against the protocol with the a priori codes. I highlighted all a priori codes found in each lesson plan. The protocol page for each participant was checked. A checkmark was given if the codes were found in the lesson plan. A priori codes that were missing from the lesson plan were also noted on each participant's protocol sheet.

In order to capture the codes, present in the lesson plan dataset, I used open coding to analyze the data further. All codes highlighted during the open coding process were added to the bottom of each participant's protocol sheet. Each participants' code was added to a table showing the overall codes found using a priori and open coding process. I entered the cumulative list of all preliminary codes into a three column Microsoft Word document. The labels of the Microsoft Word document were components of the RME framework as listed in the a priori codes and those established during the opening coding and the related texts from the data.

Category building was arrived through axial coding. The previously identified codes from cycle two were reexamined step by step for similarities and then clustered together through axial coding (Nowell, Norris, & Moules, 2017; Saldana, 2015). During this analytical process, I began to search for relationships between the codes and begin developing categories with related codes. The generated categories taken from the lesson plan data were analyzed in relation to RQ1: What teaching strategies, embedded in the RME framework, do Year 1 teachers use? Considering that RQ1 focused on teachers' current pedagogical practices, the categories were organized in tables, codes, and examples of lesson plans (Bogdan & Biklen, 2007; Yin, 2014). The data were entered into the Excel Codebook under the category instructional practices.

The final segment in the raw data analysis was the coding of the data collected from training manuals, curriculum, and handouts. Using a document review protocol, I sought to garner information to answer segments of research question RQ3 as it relates to resources that support teachers in developing the knowledge and skills needed to implement the RME framework. Hence, the following questions as aligned with the central ideas of the RME framework were used to guide the final document analysis during the a priori coding process:

- The process, the designed professional development manual, handouts, and written curriculum framework reflects the mathematical teaching methods recommended by the RME framework?
- The designed professional development manual shows a well-developed support plan for teachers as they move towards the implementation of the RME framework?
- The designed professional development document/s, or curriculum outline/show teachers should support the whole class interactivity the mathematics classroom?
- Does the designed professional development manual show that teachers will or received training in the “reality” principle the RME?
- Does the designed professional development manual show that teachers will or received training in how to execute the ‘level principle’ of the RME framework?
- Does the designed professional development manual show that teachers will get/ got support in how to design mathematics lesson plans based on the RME approach?
- The professional development manual/ materials or written curriculum clearly show the five elements of Realistic Mathematics Education, namely: -

  Phenomenological exploration?

  The use of realistic experiences?

  The use of models and symbols; children’s finding their strategies?

  Using models and symbols for progressive mathematization?

  Whole class Interactivity?

And intertwining?

Each document was analyzed individually against the protocol. Data that fell outside of the research questions were coded during the open coding process. The presence of the above preset codes was manually highlighted. Those documents that were available electronically were also highlighted using Track Changes with comments and codes. Open coding was then selected as the final analysis of the data corpus related to the training manuals and curriculum.

The analytical process continued with open coding. All documents were coded through an open coding process. Some new codes emerged during the open coding process. The codes found using a priori and open coding were entered into the already constructed Excel codebook as related to document analysis.

Using the suggested categorization from Clark and Veale (2018), I constructed a table with all the categories previously developed from all data sources. One column of the codebook has the central tenets of the RME framework (a priori codes) and the other column with the categories that emerged through axial coding. Given that themes were developed by identifying ideas, patterns, and threads of meanings from categories (Braun & Clarke, 2006), the categories were scrutinized for similarity and connections to each other in order to prepare the data for theme building later.

The data were prepared for initial theme building by once again looking at the codes and aligning data. The categories were revisited to see if they were rigorously developed from the data up. Accurately capturing the participants' viewpoints was critical to the analysis process; as it is essential that all codes and categories were fully grounded in the data and not forcibly developed (Giardini, 2016). Being grounded in the data ensured that the findings that emerged from the research were meaningfully relevant to and be able to explain the participants' behavior, opinions, and lived experiences in teaching using the RME framework. Ultimately, revisiting the base data was to prevent tacked on categorization of codes gathered during the data analysis process (Saldana, 2015).

All codes and categories collected from all three data sources - lesson plans and documents - were entered in an Excel codebook. The codes and quotes from each participant's interview protocol were all entered in the Excel codebook. The data in the Excel codebook were reexamined as a whole. The overall examination on the data corpora followed the procedures put forward by Braun and Clarke (2006). Hence, the data were systematically analyzed. The analysis process moved from reviewing to an understanding of the data corpora as coded and categorized.

Theme Building

The process of theme building began with reexamining the codes and created categories. The codebook with categorized codes was scrutinized. The overall process was guided by the following postulation of Saldana (2015):

- Look for the relationship among the codes.
- The frequency of the codes.
- Underlining concepts based on the combination of codes.
- Consider if the category generated address the research questions that guided the research.

After combing through codes and categories, similar codes were merged for theme building. The themes were defined and relevant texts from the data copied beside each theme in the newly developed codebook (King, 2004). Evidence from the data sources was aligned with each theme developed from scrutinizing the categories, extracting underlying meanings, and interpreting words and practices (Salanda, 2014). The initial themes were examined for any interrelatedness among them and relevance to the research questions (Nowell et al., 2017). All identified relationships between codes were visually represented for deeper analysis.

Arriving at Emergent Themes

During axial coding of all data sources, I rechecked codes and categories for emergent themes and data linkages. Themes were derived by using the scrutiny-based techniques proposed by Ryan and Bernard (2003) ─ compare and contrast, querying the text, and examining absences.

Ryan and Bernard (2003) proposed that formal analysis of word frequency could be done by creating a list of all the unique words in a text and counting the number of times each occurs. Therefore, I manually reviewed all the codes and categories during the axial coding process. I scrutinized the codes using word-based techniques. Hence, I look for repeated words or phrases. Key indigenous terms and key words emerged during the axial coding process. I scrutinized the words and phrases for relationships among things. In keeping with the postulation of Ryan and Bernard, I generated a list of all repeated words and phrases. The repeated words and phrases were used as emerging themes. The themes helped me to understand the participants' collective viewpoints, instructional practices, and support system.

Another strategy that was used was looking at how key words were used. Therefore, in an effort to unearth the participants' beliefs about their self-efficacy, I searched the data corpus for how the participants talked about their perception. When looking at the participants' understanding of the key terms and instructional practices that are associated with the RME framework I systematically examined the codes and associated data corpus to see how participants expressed their understanding of these terms. I then copied the texts associated with each term. Themes were identified by scrutinizing and manually categorizing the examples into meaning themes. I paid intense attention to details and nuances.

During the emergent process, codes and categories were also compared and contrast. Glazer and Strauss (1967) proposed the idea of the compare and contrast approach. The idea is based on the notion that themes characterize similarities and differences in ideas. Considering this, I did careful code by code analysis. I then asked myself questions as to what is being presented by the data and how the new ideas relate of differ from what was already discovered or that to come. The emerging themes were also cross checked against all data sources in order to ensure depth and comprehensiveness. Furthermore, I focused on the data corpus and emerging themes instead of preset codes or preconceived ideas (Charmaz, 1990).

Social change is a significant part of this case study. For this reason, I was interested in understanding how the data corpus and codes irradiate the need for social change. Hence, I searched the codes and data corpus aligned with the interviews for evidence of social conflict, contradictions, change they want to see, their professional learning needs, and things that the participants do in managing, and solving problems. As I searched the codes and corresponding texts, social themes emerged. Emerging themes were examined and recorded in order to present an in depth understanding of the social landscape of the participants' relationships.

While searching for emerging themes was important, there was also a need to examine what information was missing. Hence, while the interview data was scrutinized and used for authentic theme building. Gal (1991) argued that information that is withheld during an interview might indicate what persons may be unwilling or afraid to discuss. Considering this, I compared the interview codes and associated data with those collected from -documentary evidence ─lesson plans, training manuals, handouts, curriculum plans, school inspection reports, and local newspaper reports. Through this process, I discovered and affirmed themes related to the participants' confidence, competence, and instructional practices.

The broad emergent themes were typed into a Microsoft table for further multidimensional scaling, cluster analysis, and subthemes development.

Triangulation of Data Themes

Theme building is essential in qualitative research (Braun & Clarke, 2006). The theme building process was augmented using theme building matrices for the interview protocols and document reviewed (Glesne, 2011). The themes from all data sources were logged into one Excel document for easy access and analysis. Themes related to each data source were compiled around a central theme. The key purpose of the research was to answer the research questions. Consequently, the emerging themes, as presented by the overall data, were once again examined for relevance. I compared what teachers said during their interviews with what was evident in the plans as related to the RME conceptual framework. I then looked at the codes and developed themes as they emerged from both the lesson plans and interviews. The overall theme captured the teachers' current instructional practices in implementing the RME framework.

For self-efficacy, participants' perception of their competence, perseverance, and motivation were examined from their viewpoints captured during the interview process. The codebook containing all related codes and texts from each participant was once again examined in order to develop overarching themes. I cross checked to see if there were any interrelatedness between perception of, competency, motivation, and perseverance. The codes as well as raw data were copied into a table that I labelled *Themes and Related Quotes*. The overall themes were directly related to the conceptual framework as represented by the participants' responses during the interview process.

Finally, I looked at what participants said in terms of change and support. The information for team building was taken from combining codes of the interview data related to RQ4. What professional development workshops do Year1 teachers find most effective in supporting their self-efficacy in teaching mathematics using the RME Framework in an inquiry-based learning model?

The data gathered from the interview responses were also crosschecked against those gathered from the Mathematics curriculum, training manuals, PowerPoint presentation, and handouts. This triangulation is essential to the trustworthiness and credibility that are essential in a qualitative research study (Hancock & Algozzine, 2017). The final themes encapsulated the codes from all previously named data sources related to support and change. It is imperative to note that emerging themes that bore no relevance to the research questions were examined and classified deviant cases.

To further narrow the themes collected and analyzed from all data sources, the themes were represented visually using Microsoft Excel. Themes were reexamined for precision and overall relevance to the research (Creswell, 2012). I also copied the details about the themes from previously developed into Microsoft worksheets. Efforts were made to ensure that the readers understood the details that were associated with each theme and why they were important to the overall research (Braun & Clarke, 2006). Hence, the final themes were: (a) perceptions of confidence and competency; (b) levels of motivation and persistence; (c) current instructional practices; (d) training and support in the use; and (e) concerns and impact about the existing professional development model.

In this final stage of the analysis process, I took an overall look at the themes and considered how each theme fits into the overall story about the entire dataset in relation to the research questions and purpose (Braun & Clarke, 2006). Evidence from the data was used to support the overall themes. In line with the thinking of King (2004), the themes were only finalized when the raw data were reexamined and deemed clear and succinct.

The data from the professional development documents, curriculum, and lesson plans were further triangulated with the information collected from interviews. The purpose of the triangulation and cross checking of data sources was to gather answers for the research question: What instructional strategies as embedded in the RME framework is the Year 1 teachers using? Information gathered from the professional development training manual also help me to develop a deeper understanding of the kind of training that supports the RME framework and if teachers are using the professional development content. Likewise, the triangulation of data sources also served to cross check information to answer the research question related to professional development support.

After scrutinizing and analyzing the final theme table, essential themes were organized according to each framework and research questions (Creswell, 2012). To ensure authenticity of the themes, direct quotes from participants and excerpts from observations and documents reviewed were used as examples for the themes identified. Ultimately, the findings were compared to the existing literature on each topic.

A thematic approach was used for the presentation of findings in addition to providing answers to the research questions. The themes presented included a rich descriptive analysis that sought to ascertain the primary teachers' pedagogical practices and perceived self-efficacy towards implementing the RME framework within their classrooms. The central tenants of the RME framework and self-efficacy guided the coding, synthesizing, and summarizing process.

A critical step in the overall analysis was to address the broader contextualization and the description of the case study. This stage included bringing the key findings into focus through themes in order to determine if the themes and patterns yielded valuable data that answer the key questions and meet the goal of the study. The data were then interpreted and presented in tables and narratives. Themes and findings were supported by the larger body of literature. Positioning the findings in literature helped me to critically analyze and represent what was learned from conducting the case study. Data from all data sources were crosschecked for consistency (Hancock & Algozzine, 2017).

Limitations

This study has a few limitations. First, this study took place in only some schools since the researcher worked in the other schools. In addition, this study took place only in the autumn semester; hence, time may be a limitation. Next point for consideration was the fact that only Year 1 teachers from one section of the island participated in the interview and document presentation processes, with only 7 participants volunteering to participate. For this reason, the findings/results are not transferable to other schools or any other grade levels. Hence, transferability was addressed through thoroughly, describing the context. Another limitation could have been the reluctance of the teachers to share their true feelings or thoughts.

Data Analysis Results

Data for this qualitative research were collected from three separate data sources-interviews, lesson plans presented by participants, and professional development documents gathered through open online searches from lead mathematics teachers and school leaders. The analysis process followed the principle of thematic analysis. Hence, the process started with preparing the data for analysis and then systematically moved into understanding and explicating the more profound meaning from the data (Creswell, 2012).The organization and representation of the data were done using two Microsoft Office applications-Excel and Word.

The participants were Year 1 teachers drawn from across four public primary schools in a BOT. These teachers were currently using instructional strategies aligned with RME. Teachers' current pedagogical practices perceived self-efficacy competence, motivation, and persistence in engaging children in RME were ascertained through semistructured interviews. Lesson plans and professional development manuals. Document analysis provided an insight into the teachers' current instructional practices and supporting systems.

Data Collection began by interviewing the participants. Once consented, I sent participants the interview protocol before the interview. I used the interview protocol to guide the interview process. Each interview lasted for approximately 60 minutes and was audio recorded using a Digital Voice Recorder. I audiotaped the interviews in order to ensure accuracy of data during transcriptions. Furthermore, the use of a Digital Voice Recorder allowed me to transfer all interview data to a locked computer.

Participants were identified using pseudonyms Participant 1 or Participant 2 on the stored recordings. The participants' actual identity data and pseudonyms were recorded on separate blank interview protocols and stored in a locked computer. I later used the blank interview protocols to record the transcribed data for each participant.

Each interview recording was played twice before transcribing. Listening to the audio thoroughly gave me an overall sense of the data before transcription (Saladana, 2014; Vaismoradi & Snelgrove, 2019). The data were then manually transcribed into the interview protocol, previously labelled with the participants' data. The transliterated data were matched against the audio in order to ensure accuracy. The data were also sent electronically to the participants for verification. Participants were encouraged to send any review using Track Changes. If no changes were required after reviewing, the participants were instructed to send an email with the phrase "No changes required." Ultimately, no changes were made to the transcripts.

Each participant submitted two mathematics lesson plans for analysis. I removed all personal identifiers from the lesson plans and assigned pseudonyms. All lesson plans were analyzed using a priori coding, as presented by the lesson protocol. The lesson protocol was developed in line with the RME framework (Appendix C). Final analysis of the lesson plans was completed through open coding. A similar process was followed for the analysis of professional development documents.

Data Recording and Organization

Data collected from the various sources were systematically arranged in Microsoft tables and an Excel Codebook. How to effectively use these two Microsoft Office applications was already within my control. The use of Microsoft Word helped me to bring the data into an organized focus before entering the codes and related texts into the Excel Codebook. Data from the interview were typed into the Microsoft Word protocol sheets, assigned to each participant. Track Changes were used to add comments and codes. Codes, categories, and related texts, as extracted from the interviews were entered in the designed Excel codebook. The Codebook has a worksheet for each participant.

Lesson plan data were recorded in a Microsoft matrix table. The table had columns, one for the contents of the protocol, and one for each participant. Each lesson plan was crosschecked against the lesson plan protocol. The codes gathered through the a priori and the open coding processes were entered into the Excel Codebook. The spreadsheet for the lesson plan was labelled for easy identification in the Codebook (Saldana, 2015).

Each document was analyzed using a document analysis protocol (Appendix C). All documents were read several times and the information arranged into smaller sections. Reflective thoughts were written in the margin of each document. Evidence from the training manuals, curriculum, handouts, and PowerPoints presentations was recorded on individual Microsoft sheets. The title of each document was entered into the Codebook, and related evidence copied in the spreadsheet. All codes gathered through the a priori coding and open coding processes were recorded in the Excel Codebook.

In preparation for theme building, the data corpus was examined as a whole, and a new code sheet with all codes developed. The newly developed code sheets contained the codes from all data sources. The codes and categories were scrutinized and combined into themes. At this time, the Codebook was extensive but provided a structured way of viewing all data in one place (Saladana, 2014). I reviewed all codes in order to ensure that themes accurately represented the meaning of the data (Packer, 2011).

After scrutinizing the overall codes and categories, themes were based on recurring ideas, participant’s original ideas, likeness, and differences, as well as any dissimilarity of ideas (Ryan & Bernard, 2003). In keeping with the suggestion made by

Smith and Osborn (2008), I created a three column Microsoft thematic worksheet. The middle column was used to record document analysis and interview data; the left column was used as a work area for any recoding and notes, the right column was used for the final themes. Essential quotations that supported the themes were copied from a Microsoft table to the Codebook (Creswell, 2009).

The overall Codebook consisted of data arranged according to participants, a priori codes, open codes, emerging categories, research questions, and themes. Each spreadsheet was clearly labelled for easy identification. The spreadsheet also contained supporting details from the original dataset. Adding an original dataset to the spreadsheet helped to ensure that the data were grounded in factual data. The overall data corpus was reviewed and prepared for the presentation of findings. At this stage, the findings, as articulated by the participants, were interwoven with scholarly articles. The overall findings were presented in narrative form and arranged according to the guiding research questions and themes.

Evidence of Quality

The data collection process followed the procedures outlined in Walden University’s IRB guidelines. The adherence to these guidelines and procedures ensured that the participants were not coerced or made to undergo any undue stress. Furthermore, protecting the participants’ identity was of paramount importance. For this reason, all identifiers were removed from lesson plans and scanned into a locked computer. Additionally, participants were interviewed at a place that they deemed private. All interviews were audiotaped, and a pseudonym assigned to the stored audios and transcripts. Witten typed interview transcripts were sent to participants for verification of their responses.

Member checking in this case study was completed by sending the draft findings to participants for them to check and verify if their data used in the findings captures their perceptions regarding their self-efficacy for teaching mathematics and their use of pedagogical practices outlined in the RME (Creswell, 2012; Glesne, 2011; Merriam, 2009). Given that the purpose of member checking is to recognize inconsistencies, misinterpretations, and inaccuracies of my interpretation of participants' data used in findings, member checking occurred 14 days before the end of the study, when the draft findings were ready for review (Merriam, 2009). In this study, no significant alteration was made to the draft findings. There was only one case of discrepancy, and the reason for such deviation was unearthed and addressed. There was no need to follow up with the participants to discuss the discrepant data.

Another check on the credibility and trustworthiness was submitting all data and analysis to a peer reviewer to check on coding and logical development of themes. The peer reviewer was a doctoral student who knows coding, theme building, and the broader development and organization of qualitative research (Creswell, 2012; Glesne, 2011; Merriam, 2009). The peer reviewer signed a confidentiality agreement before reviewing all data for the logical development of codes and themes. After the dataset was reviewed, I met with the reviewer to discuss the concerns raised. Minor changes were made to the codes and the wording of the themes.

Merriam (2009) and Patton (2014) proposed that transferability is essential in qualitative research as it ensures that the process is rigorous and relevant. Transferability is the extent to which the findings from a qualitative research study can be transferred from the reader to other contexts and remain interpretive (Bitsch, 2005; Tobin & Begley, 2004). In this case study, transferability was ensured through the use of thick, rich descriptive data that capture the essence of the research setting, cultural nuances of the participants, working conditions, professional development support system, data collection, and selection process so that future appliers see the transferability (Merriam, 2009; Patton, 2014). This case study may be applicable in the context of any other British Overseas Territory that uses the RME in an inquiry-based approach.

A reflective journal also formed a part of ensuring credibility. I kept a book in which I recorded my observations and thoughts. Recording in the reflective journal began at the outset of the research. All observations, reflective notes, and personal thoughts about the study were recorded in the journal (Lodico et al., 2010). This journal also helped to capture my inner thoughts throughout the data collection and analysis process. Merriam (2009) also recommended the keeping of a reflective journal. Merriam postulated that qualitative researchers should keep rich descriptive data throughout the research process.

In my journal, I reflected and acknowledged my prejudice before the interview and data analysis. As a former teacher in the education system featured in this research, I can equate with the experiences of the teachers interviewed. Therefore, I needed to expose and acknowledge my prejudices. As a previous classroom teacher, I experienced challenges shifting to an inquiry-based learning model of teaching mathematics. It took focused support and self determination for me to make the required shift. I ultimately understood that the teaching of mathematics is to develop conceptual understanding where children see mathematics not just as mnemonics or discrete procedures to be learned (Giardini, 2016).

As I spent time reflecting on my instructional practices, I realized that a pedagogical shift from a known approach to another takes time and support. For me, my co-teacher provided a level of support, as we were able to learn and grow together. The local mathematics coach also provided support. Workshops were activity and theoretical based. I had opportunities to learn from and with other teachers who had similar challenges to those that I was experiencing. I then concluded that a community of practice was one of the ways that school leaders could address the need for teachers to be more confident in the teaching of mathematics. Researchers also support the perception that a community of practice can offer substantial support for struggling teachers (Antinluoma et al., 2018).

Having been in the position of need and support, I proposed an E-Math learning Lab. The creation of the E-Math Learning Lab emerged from my struggles with what I needed as a practitioner to support me in the teaching of mathematics. However, empirical data from the research guided the content of the E-Math Learning Lab (Appendix A).

Overall, I continuously think about how my prejudice and experience may be coloring my perception and interpretation of the data. I removed myself from the process and tried to remain as objective as possible. The sharing of my Codebook and research findings with the peer reviewer and participants also helped to ensure that the coding and theme building processes were grounded in the data. Going through the process also helped me to understand the diverse viewpoints and experiences of the teachers as they implement the RME framework. I moved beyond my limited thoughts and arrogance that have incarcerated me for years.

Triangulation of data sources is another way that qualitative researchers can ensure the accuracy of the research findings. In qualitative research, triangulation of data sources refers to the process of the crosschecking data from several data sources in order to ensure that the content of the findings provides a thorough understanding of the phenomena of self-efficacy and the implementation of the RME framework explored in this case context (Creswell, 2012; Hancock & Algozzine, 2011; Merriam, 2009; Patton, 2014). I compared all data gathered from interviews and document reviewed, with the intention confirming the information collected in order to report the accuracy of the data used in the findings.

Research Findings

In addition to lesson plans and document analysis, seven participants participated in this research. This descriptive qualitative case study delved into a group of Year 1 teachers' current pedagogical practices, self-efficacy competence, motivation, and persistence regarding their ability to implement aspects of RME - an inquiry-based learning framework for teaching mathematics. The inquiry was driven by data generated from various school inspection reports and achievement data (Muckenfuss, 2018; Office of Education Standards, 2018, 2019).

Data gathered from each participant were recorded and presented in a narrative form. Recurring thoughts expressed by participants were coded, categorized, and later led to the formation of five themes. The themes covered teachers' instructional practices, perceptions of their competency, motivation, persistence, professional support, and the participants' opinions of the current support practices and resources.

RQ 1: Current Instructional Practices.

A cornucopia amount of data formed the basis of this theme. The analyzed data were gathered in order to answer RQ 1. RQ1 was purposefully designed to yield data related to the teachers' instructional practices. Hence, the data surrounding this theme disinterred the aspects of the RME framework that the teachers used.

RQ 2: Perceptions of Competence and Confidence

This theme is directly related to RQ 2. RQ 2 was designed to yield data on the Year 1 teachers' perceptions of their competency, motivation, and self-efficacy to use RME to support children's conceptual understanding and problem solving. The teachers' levels of confidence were not well established. Teachers alluded to the constant changes in the mathematics curriculum and teachers' instructional requirements to improve student achievement scores; hence, their confidence and competency in their teaching performance were not secure but was an ever-changing construct.

RQ 2: Levels of Motivation and Persistence

This theme is also in line with the quest to collect data linked to RQ 2. Hence, quotations and data surrounding this theme provided information on the participants' motivation and competence. Most teachers trusted the RME framework and were motivated to teach it. However, they were constantly bombarded by new requirements and lack of clarity in some areas.

RQ 3: Training and Support in the Use of RME

Training and support are directly in line with information gathered from interviews and document analysis. The driving force behind the data collection process was the pursuit to find answers to RQ 3. RQ 3 centered on the available professional development and the teachers' perception of their relevance. The teachers had multiple support systems. Hence, the teachers' success could not be attributed to a single support system.

RQ 4: Concerns about Existing Professional Development Model

There was a call for the discontinuation of some aspects of the current support systems. Critical to this theme was the need for professional development to be directly aligned to teacher development needs identified though lesson observation or teachers' request. Data gathered from interview questions related to RQ 4 supported this theme.

Each theme had approximately five or more direct quotations taken from a minimum of 5 participants. The quotations were directly taken from texts highlighting teachers' perceptions of their current pedagogical practices, self-efficacy, competence, motivation, and persistence regarding their competence to implement adopted aspects of the RME. The participants shared both positive and negative experiences related to the implementation of the RME framework and the current support system. All themes and supporting details are fully discussed in the forthcoming paragraphs.

Discussion of Themes

Theme: Current Instructional Practices

The theme of Current Instructional Practices is closely related to RQ1: What teaching strategies, embedded in the RME framework, do Year 1 teachers currently use? Information related to this theme was gathered from both interview questions and review of lesson plans presented by the participants. Lesson plans and interview data revealed that many participants used a variety of instructional strategies and activities in their daily Mathematics lessons. These instructional practices included: (a) the use of mathematical models to represent abstract concepts; (b) whole class interactivity or discussion; (c) pair groupings; (d) teacher posing varying levels of questions in order to elicit children thinking; (e) the use of realistic learning experiences; and (f) providing opportunities to practice skills taught. A copious amount of data revealed that realistic experiences and whole class interactivity were the most widely used aspects of the RME framework. Other aspects of the RME framework were used sparingly.

During the interview, the participants were asked, “What aspects, if any, of the section of the RME framework do you use during your mathematics lesson?” A broad number of participants used realistic experiences and whole class interchangeably in their daily lessons. In the written lesson plans, teachers also described and explained how their lessons were executed. Essential vocabulary and sequenced activities listed in the 14 submitted plans showed a common thread of learning activities and instructional practices. These instructional strategies supported the finding that teachers use a variety of instructional strategies, most of which are in line with the RME framework and supported by the power mathematics resources.

After reviewing the data gathered from analyzing the lesson plans, I discovered that all participants used some aspects of the RME framework in the planning of their lessons. Guided reintervention, a critical area of the RME model, was evident in all written lesson plans. Similarly, all teachers used whole class interactivity and realistic experiences as part of their mathematics lessons. The use of mathematical models was also evident in the reviewed lesson plans. Intertwining of concepts was the least used aspect of the RME model. Less than half of the participants mentioned the concept of intertwining in their lesson plans.

Responses to interview question 3: "What aspects, if any or the section of the RME framework do you use during your mathematics lesson?" provided more essential details of the scope of practices in the represented classrooms. Participants1 articulated,

I used all aspects of the RME framework in my daily teaching and interactions with the children. I use realistic experiences to help the children understand and make meaningful connections and to recall previous knowledge and get a real life experience of understanding. Also, use it [realistic experiences] to give them opportunities to solve problems in different ways. To communicate to others their solutions to problems and help with mathematics jargon.

Participant 3 also postulated that interactivity helps with the assessment of the children thinking as they can observe and listen. The use of modelling was also encouraged interactivity. The skill of questioning was elevated using questioning stems and opportunities for thinking, pair, and share. This included small group teaching, sharing, and scaffolding through teacher guided support and interventions. This idea was supported through thick open ended complex questioning. “I must learn how to support them and the power mathematics resource offers that scope and sequence within the RME framework. I have also recognized that I need to connect their learning to previous knowledge.”

Like participant 1, Participants 2, 3, 5, 6 and 7 responses highlighted that whole class interactivity and making real connections and opportunities to practice are at the heart of each mathematics lesson. In further support of the theme of interactivity and realistic experiences Participant 3 stated,

> Seeing the meaningful connections between concepts is hard for some children. However, meaningful, realistic experiences provide ventures that can help children to connect their knowledge and use old knowledge to solve new problems.

I am confident that I focus mainly on interactivity, opportunities to practice, and realistic experiences. However, the other aspects are not always evident, but I tried. Creating the experience for the children to make the connection and begin to think about solving the problem. Problem solving is the heart of teaching connection and like a hook, to intrigue the children. Through small and large grouping, children work on problem scenarios. They then gave their solutions for the others to discuss while thinking about the most efficient method and purpose/s of selecting such methods. Helping children to think about real life experiences can bring them into an understanding of mathematics and how mathematics is related to real life experiences.

Further information about the teachers' instructional practices was gathered directly from participants by asking them: Walk me through the steps of a daily mathematics lesson. This request revealed that most teachers use power mathematics resources to guide their daily teaching of mathematics. As a resource, power mathematics includes whole class interactivity and the use of real life experiences. Lesson plans provided by the participants also supported the claim that whole class interactivity and real life experiences were widely used.

Interview question 8: How do you facilitate RME – an inquiry-based learning approach - in mathematics daily? Responses encapsulated the overall application of the RME framework within the participants' classrooms. The data collected from interviewees supported the subject of interactivity and realistic experiences with some applications moving deeper into mathematization and intertwining, which are the higher levels of the RME framework. When asked about the facilitation of the RME framework, participant 6 shared,

> The setup of my current mathematics resources is all about you getting the key ideas of mathematics out, so some areas are unavoidable, so the interactive the collaboration and realistic experiences and the connectivity of concepts. I think for me is the reintervention or intertwining as it is called is a bit limited in my class, but the setup of the program does not always allow. The lesson begins with a power up fluency task to sustain prior learning, consolidate number facts, and

> establish the lesson's confident, can-do tone. Moreover, then we move into the discovery stage of the lesson. Next, children share, explore, and learn from a Discover problem, presented with some focused questions to guide their thinking. Interactivity is captured in the share activity section of the lesson. During this whole-class, interactive learning phase, children share their thinking and look for the best ways to solve the problem. In supporting mathematizing,
>
> the lesson then moves into a Think Together section. "I love this!" "It begins with a teacher guided question followed by a problem for children to solve in collaboration with a partner, and finally an independent question. It develops the concrete problem through the pictorial and abstract stages, and there is clear progression within each lesson. The online guide gives fantastic scaffolding here, and the children are guided into seeing the key concepts and math in real experiences.

Concerning the theme of teachers' current instructional practices, there were some levels of consensus among the participants as to the instructional strategies that they use to support the implementation of the RME framework. One common resource was the use of power mathematics, known as power maths, which teachers used to drive their instructional approaches. According to Participant 6,

> Power maths naturally encourages active learning and have inquiry built into it. So, going through the steps of the resource power up, discover, think together, and share. These stages spiral and built on an essential question that provokes the children to think and act together then share.

Similarly, Participant 4 expressed, “In driving the inquiry process, I use power maths resources to support the whole mathematical approach. This supporting resource helps me to find strategies to encourage and engage the children in opportunities to explore and discover.” Most of the participants believed that the use of RME is evident in their everyday practice. They alluded to the fact that RME is evident through learning experiences that allow the students to engage in meaningful interactions, the use of realistic experiences, use of mathematical models, and opportunities to practice (Participants 1, 2, 3, 4, 5, & 7). During the interview, none of the participants presented any instructional practice that was contrary to the key components of the RME framework. However, not all lesson plans accurately captured all aspects of the RME framework.

Inclusively, data supporting the theme of current instructional practices showed that all participants used some aspects of the RME framework within their classrooms and spoke highly about it. One participant expressed that the RME framework “provides a foundation upon which the children can begin building on solid ground. The focus on moving from concrete to pictorial and then abstract (CPA) resources to teach concepts is deepening the children’s understanding (Participant 4).

Participant 5, in recounting the power of the RME framework within her class, expressed that “there really cannot be any math teaching without the use of the creating real world, relevant, and purposeful learning experiences . Active learning is important for children, and RME provides this structure for them”. Furthermore, the use of power mathematics resource was introduced this year, and the participants are feeling more supported in implementing the RME framework.

Perceived confidence and competence. The theme, perceived confidence and competence, was provided in the information about participants' viewpoints regarding their levels of perceived confidence and competence. Data related to this theme also shed light on RQ 2: What are the Year 1 teachers' perceptions of their competency, motivation, and self-efficacy to use RME to support children's conceptual understanding and problem solving? The background data below sets the stage for understanding why examining the theme perceived, confidence and competence is highly critical.

In early 2000, the teachers in the local public primary schools were required to change the way that they teach mathematics. This paradigm shift brought with it a movement of change for which participants said that they were not fully prepared. Notably, most participants articulated that the change in pedagogical practices was aimed at advancing students' problem solving and reasoning skills. It was also hoped that the implementation of the RME framework would increase mathematics attainment. Hence, almost all participants supported the shift to the RME framework. Participants also agreed that there were some levels of correlation between teachers' perceived self-efficacy, job execution, and student's attainment.

Many participants believed that they have wavering levels of confidence and competency. Participants mentioned that the constant change in the system and varying requirements and instructional procedures caused their levels of confidence to waver. It is difficult for them to establish a level of security in their practice as they are mandated to constantly adjusting their teaching to match what the school requires versus what the Education department may need. Furthermore, their levels of confidence and competency waver based on the topics taught and the ability of the students.

Participant 3 mentioned that she had, “some low moments and this depends on the topic that is being covered.” She further stated that she is, “pretty confident about teaching and got some good lesson feedback.” Notwithstanding the levels of success that she has experienced, she thinks that “like with an anything else, I [she] can always improve and offer more to the children.” In continuing the discourse on her level of confidence and competence, she argued that, “some children can be unsettled and do not grasp the concepts readily. This can be real stress[ful] especially because you are expected to let the children move. I am doing pretty well with the RME in spite of my challenges.”

Similarly, Participant 5 shared thoughts and experiences that indicated that she too has a wavering competence and confidence in implementing the RME framework. In response to the interview statement: Talk to me about your feelings of competency in implementing the RME framework, Participant 5 responded,

I have been in teaching for a while, but things are constantly changing in this system. Therefore, sometimes you think you are getting the hang of something, and then a new thing comes at you. Trust me; you cannot be confident if things change so rapidly. Remember, if the students are to develop mathematical proficiency, teachers must have a clear vision of the goals of instruction and what proficiency means for the specific mathematical content they are teaching. They need to know the mathematics they teach as well as the horizons of that mathematics — where it can lead and where their students are headed with it. I am like a seesaw sometimes in my confidence. Once things are settled and straight forward, I will be able to teach. I love teaching mathematics.

Participant 5’s viewpoints accurately encapsulated the levels of competency and confidence expressed by the other participants. Additionally, Participant 4 offered more insight into the participants’ levels of perceived by stating, “I am getting there. I have been given the support that helped me to feel better and more positive about how to support the children. I have little itches here and there, but I am feeling a bit more positive, and my confidence is a work in progress."

Clearly, teachers’ levels of confidence waver due to many factors. The participants highlighted some reasons for their wavering competency and confidence and asked that they be addressed. The interviewees in this research collectively echoed the need for: (a) fewer changes in the system; (b) consistency in requirements; (c) better-behaved students, and (d) targeted support. The perspectives offered by the participants confirm that teachers experienced waves of self-efficacy — confidence and competence. Consequently, there is a need to ensure that the situations that participants found overwhelming are addressed, in order to elevate their confidence and competence.

Theme: Teachers Perceived Motivation and Persistence

Not only was teachers’ confidence and competence brought into focus, but their motivation and persistence were as well. The interview prompt: Explain your motivation towards teaching math using the RME approach provided key details about the participants’ motivation and persistence in implementing the RME framework. Like the participants' confidence and competence, motivation and persistence were viewed as constructs that are conditional and situational. For example, Participant 1 postulated,

> there are still opportunities for improvement in my practice, but [for] the most part, I am motivated to keep trying and trying in order to make things right. Sometimes I feel discouraged, especially when you think you are getting there a someone tells you that's not how it goes and confusion among those you are looking to [for answers and support]. Things are getting better this year, and I am looking forward to a challenging yet rewarding year. …, I will just keep going right on.

Like Participant 1, Participants 2, 4, and 7 enjoyed high and low moments in the application of the RME framework. Their viewpoints captured a wide range of things that impacted their motivation and persistence. The articulation of Participant 6 encapsulated the dogmas of the other participants when she postulated, "Catch me a few years ago, even last year. It was crazy. Things are better now! I am motivated to think and teach math as I have the supporting resources and a clearer pathway."

Overall, participants declared that they were more motivated and persistent this year. They disclosed that they know that there will be challenges but are motivated to continue working towards improving their skills and the students' achievement. After all, they, "just have to keep pushing, and asking for help from the math coaches, lead math, and their grade level teacher for support" (Participant 5). Even when they make a low teaching evaluation, they have to improve their practice and keep going. Currently, power mathematics resource seems to be the force that keeps teachers powering forward.

Resources that Support Participants' Confidence, Motivation, and Competence

The data related to the theme: Resources that Support Participants' Confidence, Motivation, and Competence also supported RQ3: What experiences, resources, and factors do teachers perceived support their confidence, motivation, and competence to teach mathematics through inquiry-based pedagogy using the RME framework?

Participants' motivation varied depending on several factors. All participants were aware of the support systems and how to access them. In speaking about the support systems, Participant 3 spoke about the support she received; she highlighted lesson study and group planning as two supporting resources. She believed that observing an introduction of lesson study [modeled by a school coach] helped other teachers and her to teach a research-based lesson. Other participants cited the lesson study as a resource that guided how to implement the RME framework effectively. For Participant 3, "Lesson study and in school coaches provided intimate support."

Along with lesson studies and in school coaches, a common planning time, power mathematics resources, conferences, sample lesson plans, and workshops were also mentioned as sources that guided the implementation of the RME framework. Feedback from walkthroughs and formal lesson observations also provided guidance on teachers' performance and the support needed for them to improve. Participants have the privilege of engaging in both school based and system wide professional development.

To improve pedagogical skills, Participant 1 mentioned an array of resources that provided support not just for her but everyone within her school. She mentioned planning with heads of departments, mathematics leads, and grade level planning with mathematics coaches, lesson studies, and sample lessons to guide planning. Other participants also mentioned that the coaches and school leaders actively monitored the implementation of the mathematics strategy.

The monitoring of the RME framework was not just a school wide responsibility but also a system wide mandate. For Participant 2, and other participants, monitoring the implementation of the RME framework is one way that the leadership team gathered data and a way that she "gets clear and supported guidance and how to implement the RME framework." Nevertheless, one must also realize that even with the wealth of available professional development, some teachers thought that a myriad of professional development was either insufficient or unfocused.

Theme: Effectiveness of Professional Development

The data collected and analyzed showed that there is a strong connection between the theme, Effectiveness of Professional Development, and the RQ: What professional development workshops do Year1 teachers find most effective in supporting their self-efficacy in teaching mathematics using the RME Framework in an inquiry-based learning model?

Considering that participants are required to attend a given number of professional developments per year, it became clear that professional development is a part of a systematic approach to strengthening teachers' instructional skills. A considerable amount of data suggested that the participants valued the efforts that were made to provide a wide range of professional development and support as they navigate the mathematical landscape. Nevertheless, analyzed data gathered from the interviews affirmed that professional development offered was not always effective. Participants 6 echoed, “Some [professional development] is great because they were not wholesale but well thought out and met the needs of the teachers. Sometimes you go to these workshops after school, which means nothing to your current situation.” This point was noted as a recommendation to meet the professional needs of teachers.

Taking teachers’ standpoints on the value of professional development was garnered through the interview question: What is beneficial/detrimental about receiving support with implementing the RME framework in your classroom? During the interviews, participants provided several barriers and challenges to implementing the RME framework. For Participant 2, 3, 4, 5, and 7 professional development provides an avenue for them to understand and learn from each other through lesson studies and grade level workshops. In the words of Participant 7, “Collaborative workshops were of paramount importance, especially when you are in a single stream school where you feel alone and have no one within your school to bounce things off.”

On the contrary, Participant 2 believed that some professional development is not making the desired impact because “sometimes you have to go to workshops that have no connection to the struggles you are having. Then nothing matters as your real needs are being ignored.” Similarly, Participant 3 felt that though she valued the support given, some were, “quite confusing and overwhelming at times.”

A call for change. The mixed beliefs about the effectiveness of the professional development echoed across the dataset. The findings to the interview question about the possible reasons why some of the professional development worked or did not work provided further clarity to this discourse. The key findings of the reasons why some PDs did not have the desired impact are summarized in comments from Participants 1 and 2. Hence, thoughts must be given to the statements that, “some PDs were too general and did not fully capture the needs within your class or teachers’ specific area/s of struggles” (Participant 1) and “the need to add teachers’ voice to the selection process of those PDs that they need” (Participant 7). Besides, care must be taken on the timing of PDs, as some were planned after the fact that teachers had to struggle through a process before being provided with information and support (Participant 4).

Many participants also believed that there is a need to capture local practices alongside those that are from abroad. While Lesson Studies have been a common practice in the system, there is a need to create a database of video lessons in neighboring schools. Subsequently, Participant 3 stated that,

> Lesson study works. Furthermore, cross planning works as you and your team teacher get a chance to plan together and bounce ideas off each other. Nevertheless, if we had a lesson bank where we could just go back, see the lessons, refresh our ideas, and see the process happing again. You could modify the watched lessons and develop a good understanding of how to teach it.

Participants 4 and 5 echoed thoughts similar to those echoed by Participants 3. They believed there is a need to give teachers more autonomy to say what they need. In addition, data collected from walk-throughs and formal lesson observations should be used to plan targeted support rather than just used to assign a grade. Furthermore, there is a need for “more activity based workshops, more support and guidance and opportunities to see how lessons can develop and unfold" (Participant 4). Removing the barriers to the success of the current professional development model may be a step in the right direction. Participant 6 suggested that the process could begin with surveying teachers to solicit their opinions.

The overall findings on the quality and impact of professional development showed that there was consensus among participants that PDs help to provide some level of support in the implementation of the RME framework. When compared to the previous years, participants believed that the current power mathematics resource online database provides structure and positive direction to the overall teaching of mathematics. Hence, there is a sense of hope among participants that although the mathematical goals have been lifted this year, they are more confident that the power mathematics resource and targeted PDs will lead to increased motivation and persistency.

Interpretation and Discussion of Findings

Current Instructional Practices.

Research question 1 (RQ1) was designed to collect data on teachers 'current instructional practices. As such, the theme related to this area showed that teachers use varying instructional practices. In interpreting the findings related to teachers' current instructional practices, it was noted that most practices were in line with the literature reviewed in this research and the key principles of the RME framework. The discussion of the key instructional practices is presented below.

Whole class interactivity/collaborative learning. Lesson plan, professional development manuals, and data collected during the interview helped me to show that most teachers encourage the use of whole class interactivity during mathematics lessons. Yuanita et al. (2018) supported the thinking that collaborative learning, as used by the participants, made learning a group effort. As identified by the participants, the learners work together to solve cognitively challenging problems. Moreover, opportunities for children to collaborate with their peers are a prominent feature of RME lessons (Treffers, 1987; Yuanita et al., 2018).

Use of context. All teachers employed the use of realistic learning experiences in this research. Mulbar and Zaki (2018) affirmed that when teachers use meaningful context to connect children's previous knowledge to mathematical concepts, they are more likely to conceptualize the abstract nature of mathematics. Similarly, the use of context or realistic mathematics of the participants was also a posited by Lessani et al. (2017). In putting forth the need to contextualize mathematics, Lessani et al. theorized that contextualizing mathematics provides a foundation for children to enter the mathematical experience and make sense of the experience. Hence, when teachers in the local setting contextualized the learning experiences of children, they are building bridges between abstract concepts of mathematics and to what children can easily make a meaningful connection (2017)**.**

While most of the teachers should be praised for contextualizing the mathematical experiences of the children, there is a need to recognize that the provision of realistic experiences is at the lower level of the spiraling process of the RME framework (Treffers, 1987). Hence, efforts must be made to move the children's learning to the level of progressive mathematizing and intertwining, where cross-curricular connections and deep mathematical thinking can take place. Also, children must not only listen to contextual learning experiences but must be allowed to apply mathematics in real ways within their leaning environments or communities (Office of Education Standards, 2020). In addition, further consideration must be given to moving beyond the contexts provided in the power mathematics textbooks to those contexts that are culturally and linguistically relevant to the children being taught.

The use of questioning. Though some participants used different vocabulary words to describe interactivity in their classrooms, all lessons involved children collaborating and solving a problem based scenario or question. The use of questions or cognitively challenging scenarios is in line with the problem solving approach proposed by Yuanita et al. (2018). However, Yuanita, et al. argued that building problem-solving in classrooms that employ the RME framework goes beyond merely asking questions. Questions that are posed should be cognitively challenging and force students to apply multiple level skills to the process (Fraivillig et al., 1999; Laurens et al., 2017). Hence, key consideration must be given to the way that teachers orchestrate mathematical discussions, build on children’s responses, and use higher-order questions to extend children’s thinking (Mulbar & Zaki, 2018).

Based on data collected during interviews, it became evident that most teachers were not confident about moving children through the levels of the RME framework. Hence, limited opportunities were provided for children to make a connection between concepts and how one area of mathematics connected to the other. Teachers lack confidence in effectively supporting children in learning in their zone of proximal development is not unique to the participants in this study, as shown in the study done by Gutierez (2015).

Additionally, some teachers expressed not fully understanding the idea of reintervention and providing meaningful experiences for children to use the knowledge gained to apply to new situations or problems. Then, it can be argued that more work needs to be done in ensuring that teachers fully grasp how to productively move children through the hierarchy of the RME framework (Gutierez, 2015). Poor effective questioning and limited mastery in teaching mathematics were also noted in a few current school inspection reports (Office of Education Standards, 2019, 2020).

Use of power mathematics resources. The use of power mathematics resources was a prominent feature of all lessons. Both documents and interview data supported the claim that teachers used power mathematics resources to support the teaching of mathematics. Power mathematics resources provide support for teachers in guiding the process and providing some scaffolding for teachers who were once uncertain about how to navigate the teaching of mathematics accurately. Providing support for teachers as they seek to implement the RME framework is in keeping with the assertion of Gutierez (2015). Supporting teachers thorough the implementation process was also echoed by Radišić and Josic (2015).

Nevertheless, I believe care must be taken in ensuring that teachers do not lose focus of the key components of the RME framework as they seek to supplement the process with the use of power mathematics resources. While power maths resources provide some levels of structure to the teaching of mathematics, its high emphasis on arithmetic may mitigate the authentic problem solving and reasoning aspects of the RME framework. An overreliance on computation and less emphasis on reasoning may lead to the regurgitation of facts rather than deep conceptual understating.

Strictly shifting from computation to conceptual understanding mathematics conflicts with the core principles of RME (Yuanita et al., 2018). Even as teachers widely embrace the use of this new supporting resource, the onus is on instructional leaders to ensure that IBL is depicted through the effective use of the power maths resources. The RME framework must be evident through children's active engagement in critical thinking, creative problem solving, and the examination of multiple perspectives (Su, et al., 2016).

The data collected on the Year 1 teachers' current instructional practices are encouraging. Good teaching was evidenced throughout the local education system. It was noted that teachers are slowly shifting to the adoption and use of more instructional practices that are in line with the RME framework. This changes teachers' mindset from a position of teaching to one of a facilitator (Darling, 2017). Most importantly, teachers were positive about the impact that the RME framework is having on children.

Some participants argued that children are more confident in expressing their thinking and steps taken to solve problems. The growing confidence of the children was listed by Ozkaya and Karaca (2017) as a positive impact of engaging in IBL. I am hoping that the teachers will continue to support the development of critical thinking, as they supplement the teaching of mathematics with the newly adopted power mathematics resources and guiding curriculum.

Perceptions of Competence and Confidence

RQ 2 was intended to collect information on teachers' perceptions of their competence, motivation, and persistence to use the RME framework to improve students' achievement in mathematics? The quest to examine Year 1 teachers' perceived self-efficacy is in keeping with research conducted by Dybowski et al. (2017). The interpretations of the findings of my study are discussed below:

Wavering levels of confidence and competence. After exploring the data related to teachers' competence and confidence, I surmised that the teachers had wavering levels of confidence and competence. Through interviews, teachers expressed that their levels of confidence were highly variable and dependent on the topic being taught. It should, however, be noted that it is quite normal for teachers to feel uncertain or lack confidence in the implementation of the RME framework. Radisic and Josic (2015) argued that some teachers lack the confidence needed to support children in learning mathematics effectively.

Similarly, Chen et al. (2014) argued that some teachers are not well suited to teach mathematics in inquiry-based learning. I believe that research from the wider field of education and the articulation of the participants in this study should serve as reminders to stakeholders that pedagogical shifts take time (Maass et al., 2017). Hence, targeted support must be fused into the process.

Essential to the discourse on teachers' levels of confidence and competence is the issue of constant change. All participants spoke at length about the constant change in teaching expectations and instructional approaches. The interviewees argued that as soon as they develop some levels of confidence in a procedure, they were asked to undertake something new. Also, there was inconsistency among stakeholders about expectations, resulting in teachers being confused or frustrated. Consequently, they chose to do what they understand, and this often resulted in variation of practices within schools and from school to school. The participants' variation of practices within schools was supported by recent local school inspection reports (Office of Education Standards, 2020).

Maass et al. (2017) highlighted the challenges that teachers may face as they shift from one instructional practice to another. The researchers encouraged teachers to see the process of change as a journey and one that will take time. For me, this understanding is critical if teachers are to develop a mathematical growth mindset. Some teachers in this study highlighted that although the changes and requirements have been challenging, they are motivated to continue. Teachers' willingness to move forward despite obstacles that they face is supported by Harris (2017).

Training and Support in the Use of RME Framework

RQ3. What experiences, resources, and factors do teachers perceive support their confidence, motivation and competence to teach mathematics through inquiry-based pedagogy using the RME framework? was geared to gathering information on the support system that was in place to support the teachers through the implementation process of the RME framework. The findings related to RQ3 are discussed below.

Wrap-around support. Data collected from interviews and professional development (PD) manual showed that teachers received varying support in the implementation of the current mathematics strategy. The Year 1 teachers' primary PDs were lesson studies and coaching support. Supporting teachers through professional learning was also encouraged by Ardiyani et al. (2018). Ardiyani, et al. argued that teachers would need to be supported as they implement the RME framework.

While some teachers may benefit from a single PD, others may require continuous support. Some teachers in this study expressed that their love for mathematics was enough to keep them focused and grounded. The reality of the participants may be different, but there is a need for teachers who are making instructional shifts to be supported (Saleh, et al., 2018). More important is the relationship between teachers' perceived self-efficacy and the attainment and engagement of their students. Güngör and Özdemir (2017) expressed that teachers can only support their students if they feel confident and competent in what they are teaching.

The teachers in my case study articulated thoughts like that expressed by Güngör and Özdemir (2017). During the interview, teachers expressed that they attended several PDs. However, constant changes in expectations and programs impeded their confidence and competence. They also argued that if they are unsure about what to do, how they could teach their students. Voet and De Wever (2017) avouched that teachers have to be confident in what they are teaching if they are to be successful. Hence, the teachers' minimal self-efficacy may be a mitigating factor to children reaching their maximum potential in mathematics (Bandura, 1977).

Consequently, stakeholders must use professional development to close the gap in practice that was identified in this study. Then, it is evident that teachers in this system have access to a wide variety of PDs. Despite this, some teachers continue to experience wavering confidence and competence in the teaching of Mathematics (Maass et al., 2017).

Concerns About Existing Professional Development Model

The discussion in this section is guided by the findings for RQ4. What professional development workshops do Year1 teachers find most useful in supporting their self-efficacy in teaching mathematics using the RME Framework in an inquiry-based learning model?

A call for change. Of the plethora of PDs that Year 1 teachers in this study was exposed to, they expressed that they benefitted the most from engaging in planned lesson studies with their colleagues, workshops, and power mathematics resources. These three professional developments were seen as the most important of all because they build collaboration and provide structure on how to implement the RME framework. Chen et al. (2014) supported the need for teachers to be guided through the implementation of the RME framework.

The participants requested a change in the PDs that they receive. During the interviews, the Years 1 teachers articulated the need for more local practices to be depicted during lesson studies. More importantly, PDs should include teachers' needs. Goos, Bennison, and Proffitt-White (2017) support the call for more focused PDs. In emphasizing the need for teachers' voice to be added to mathematics PDs, Goos et al argued that PDs could be used to improve teachers' instructional practices. However, consideration must be given to what needs the teachers have and design the support accordingly. The teachers in the local settings suggested that school and instructional leaders could use the data that they have collected from lesson observation and walkthroughs as a starting point for planning.

Furthermore, each teacher must meet with the principal or deputy for feedback on his or her observed lesson. I think that the feedback sessions could be used to assess the training needs of the teachers. As supported in the literature (Caddle, Bautista, Brizuela, & Sharpe, 2016), teachers professional learning must be aligned to their instructional needs. To progress senior leaders may need to revisit the way that they plan PDs for teachers. I am recommending that one size fits all PDs must be developed to incorporate the recommendations from the findings; hence, I developed an E-Math learning Lab project to use as a starting point.

The Project

Based on the findings of this project study, teachers at the research sites need continuous access to a professional development model that builds their self-efficacy, motivation, and persistence. Furthermore, the teachers highlighted the need for the professional development database where local practice can be recorded and accessed as needed. The suggestion was also made for more targeted professional development that is in line with teachers' needs. The findings and recommendations from the study along with the substantial amount of literature were used to develop an online project in Google Classroom, which I called E-Math Learning Lab (Appendix A). The E-Math Learning Lab will serve as an online resource and support hub for teachers. The E-Math Learning Lab will include:

- Opportunities for teachers to set up online collaborative learning hubs in Office 365.
- Peer reviewed sample Mathematics lessons collected from local teachers.
- Email and WhatsApp connection portals where teachers can connect with mathematics instructional leaders inside and outside of their current learning hubs and ask for assistance almost 24/7.
- Research-based articles on cultivation mathematics growth mindset.
- Videos of colleagues talking about their success and failures.
- Space to upload videos and lesson before teaching, for peer review and feedback.
- Monthly survey sheets to collect what worked or did not feedback.
- Monthly face-face support with hub schools.
- Questionnaires.

The implementation procedures for the project can be found in (Appendix A). Further details about the E-Math Learning Lab are provided in Chapter 3 of this project study.

Conclusion

The data analyzed from both interviews and documents led to the development of five major themes. These themes covered instructional practices, the participants' self-efficacy, and their viewpoints of the current professional development. All themes provided evidence that explained Year 1 teachers' perceptions of their self-efficacy, motivation, persistence, and competence in teaching mathematics using the RME framework.

The first theme perceptions of competence and confidence featured the construct of self-efficacy and provided answers for RQ 2. The data related to teachers' perceived competence and confidence revealed that (a) teachers' experienced a wavering level of confidence and competency; (b) a relationship between confidence and competence; (c) lack of a clear expectations and constant changes in the curriculum were the primary reasons for wavering confidence; (d) power maths resources supported teachers' confidence; and (e) a growing level of confidence among teachers.

The conceptual framework of self-efficacy was also reflected in the theme - Levels of motivation and persistence. Data relevant to the theme showed that (a) participants' perceived motivation and persistence were ever-changing constructs; (b) power mathematics resources, workshops, and lesson study kept teachers motivated, (c) motivation and persistence were from external sources; (d) teachers need levels of consistency of expectations; (e) participants experience variance in their motivation based on the PD topic; (f) persistence and motivation are closely tied to competence and confidence; and (g) persistence was not always an option. Furthermore, the participants expressed that a sense of learning community within the school system helped them to connect with colleagues and share best practices.

Participants' current instructional practices and answers to RQ1 were clustered around the theme: Current Instructional practices. Overall, participants used a variety of instructional strategies in their everyday mathematics lessons. Data related to this theme described (a) lesson components, (b) the most prevalent instructional practices, and (c) instructional practices that are in line with the RME framework.

According to a review of the lesson plans and data collected from the interviewees, teachers accurately captured and used the following instructional practices in line with the RME framework: the use of realistic experiences, questioning to probe understanding, the use of scenarios, whole class interactive teaching, opportunities for collaborative learning, and engaging children in some forms of problem-solving activities. Notwithstanding the use of many aspects of the RME framework, it was discovered that although participants were more likely to engage in some level of mathematizing, they did not always accurately capture the aspects of intertwining and reintervention of the RME framework.

In seeking answers to RQ 3, the professional developments that participants engaged in were explored. Data were gathered and themed as training and support in the use of RME. It became clear that participants received consistent wrap-around support. The theme also revealed that (a) teachers engaged in professional development; (b) teachers engaged in professional development activities with senior management staff; (c) teachers attended workshops geared towards their grade level; (d) lesson study and coaching support were regular features of their support system; (e) selected persons attended previously held mathematics conferences; and (f) each school has a mathematics resource personnel.

The final research question RQ 4: What professional development workshops do Year1 teachers find most useful in supporting their self-efficacy in teaching mathematics using the RME Framework in an inquiry-based learning model? was constructed to garner interviewees' comments on the quality and effectiveness of the current professional development model. The theme: Concerns about existing Professional Development model emerged. A call for change was also identified as a reoccurring topic. All seven participants believed that some professional development practices needed to be revamped or revised.

Suggestions were made to have more time for lesson planning, the capturing and recording of more local practices, a database where sample lessons related to each topic are modelled in full, and more modelling of lessons by coaches or lead mathematics personnel. The participants' comments also suggested that there is a need for more relevant and focused support. Moreover, in school support should be closely tied to observations made during learning walks and formal lesson observations. Lesson studies, opportunities to meet and plan with colleagues, and the power maths resources were named as the most effective support.

The overall findings in this research suggested that teachers used a range of instructional practices. A gamut of professional development supported teachers in the implementation of the RME framework. Nevertheless, teachers do not perceive themselves as being fully confident and competent in the implementation of the RME. Furthermore, some teachers feel a sense of demotivation as they navigate the implementation of the RME Participants recommended a change in the way they are currently supported. Consequently, I am proposing the E-Math Learning Lab as a hub where teachers can develop their mathematical growth mindset and strengthen their instructional practice.

Section 3: The Project

Introduction

In response to the findings and recommendations of the study, I developed a project, which I named the E-Math Learning Lab (Appendix A). This section contains a description of the project, the reason for the chosen genre, a review of scholarly literature related to professional development, and an implementation plan for the project.

Description and Goals

This project for professional development support is an E-Math Learning Lab in Google Classroom. The project is also suitable for use on Office 365 platforms such as Teams or SharePoint. Access to the internet or a laptop will not pose a problem because each teacher in the public-school system has a laptop with free internet access. Furthermore, each school has an assigned information technology (IT) specialist who supports staff. Implementation of the project across the school system may ensure that all Year 1 teachers have access to professional development resources. This in turn, may aid them in developing a positive mathematical growth mindset, accessing local sample lessons, and learning alongside their colleagues (Appendix A).

Year 1 teachers will access hybrid support through the E-Math Learning Lab as well as having opportunities to schedule private meetings with their coaches or mathematics lead. The support offered will be ongoing. The E-Math Learning Lab could also be an integral part of the existing professional development system where the mathematics lead and coaches can regularly upload materials to support the learning community's needs.

The head of professional development, mathematics coaches, and principals should be made aware of the E-Math Learning Lab first. The forenamed professionals should have the responsibility of maintaining the content of the E-Math Learning Lab. School leaders and mathematics coaches may upload resources specific to their schools. Given that each teacher in the government system has already been assigned an email address, it will be easy for administrators to ensure the E-Math Learning Lab is part of the school's professional development. I have made available all resources needed to administer the learning lab (Appendix A).

The resources provided in the project (Appendix A) were customized in line with the findings of the research. The purpose of the lab is to address the research problem of some Year 1 teachers' lack of competence and self-efficacy to implement the RME framework effectively in an inquiry-based model. In an effort to remedy this issue, coaches could offer targeted support to all Year 1 teachers through the E-Math Learning Lab. Users of the E-Math Learning Lab should be guided by the understanding that it was specifically designed based on research evidence.

The four main goals of the E-Math Learning Lab are listed below:

- to provide all Year 1 teachers with an organized online support system where they can access local model lessons in line with the current mathematics curriculum;
- to enable teachers to use Google Classroom, an already-established online platform, and to communicate with colleagues and specialists about the challenges that they face in the teaching of a topic;

- to build teachers' mathematical growth mindset through the use of professional book studies, research articles, and testimonials from their colleagues; and
- to provide linguistically and culturally realistic mathematical scenarios, rather than the current British based resources.

After the establishment of the online E-Math Learning Lab, administrators will be encouraged and guided to take a proactive approach in personalizing the E-Math Learning Lab for their schools. The findings of the research showed that professional development needed to be aligned with the needs of the teachers. It was suggested that school based needs should be identified through examination of student attainment data, formal lesson observations, and walkthroughs feedback. School leaders must ensure that the lessons and content of their school based E-Math Learning Lab remain relevant to the needs of their school community.

Rationale

The findings from the research study guided the development of the project (Appendix A). A data corpus collected through document analysis and interviews provided a window of opportunity through which local primary teachers' perceptions of their self-efficacy, competence, and current instructional practices in the use of the RME framework could be understood. The data revealed that teachers had wavering levels of confidence, motivation, and competence. In this regard, Choi and Walters (2018) articulated that discussing or talking about mathematics alone does not lead to improvement in instructional practices, mindset, or self-efficacy. Hence, the E-Math

Learning Lab will provide a space where teachers can form learning communities. In these communities, teachers can view their colleagues teaching specific lessons related to the RME framework. Lesson observations will help teachers to see the practicality of the written curriculum. Furthermore, the inclusion of model lessons will address the participants' call for more local model lessons in the implementation of the RME framework.

Desimone (2011) concluded that all effective professional development programs share some standard features: They are focused and of relevant length, encourage active collective involvement, and bear some relevance to previous professional development efforts. According to Desimone, purposefully planned professional development can advance teachers' knowledge and change their perspectives of their knowledge and teaching performance. The proposed E-Math Learning Lab is closely aligned with the guidelines proposed by Desimone and has been purposefully designed in line with the participants' requests for more targeted and relevant professional development. Furthermore, the E-Math Learning Lab should allow for greater collaboration and sharing of best practices among practitioners.

As an online forum, the E-Math Learning Lab could also serve as a conduit for teachers to meet virtually, especially given constraints brought with the COVID-19 pandemic. In addition to preventing disease transmission, virtual delivery of meetings and support would eliminate costs associated with traveling to workshops. Moreover, time away from school could be minimized with the use of a virtual platform. In the interviews, teachers raised the issue of having to travel considerable distances in traffic to attend face to face professional development programs.

Lack of consistency across the system was also taken into consideration. During the interviews, participants claimed that there were disparities in the ways that mathematics lessons were taught from school to school, even though they were following the same curriculum. Notably, school inspection reports supported the claim of inconsistency across the education system, and even within the same school (Office of Education Standards, 2019).

The participants in this study also expressed that there was limited noncontact time to observe their colleagues teaching. For this reason, the E-Math Learning Lab includes a section where teachers can privately or openly ask for support and support their colleagues. Additionally, there will be online opportunities for teachers to engage in the sharing of video clips on their current topics and engage in professional dialogue about next steps. Exemplars and lesson guides will be available in the E-Math Learning Lab (Appendix A).

Ultimately, the goals of the E-Math Learning Lab are to (a) build greater collaboration among teachers, (b) advance teachers' instructional practice in the overall teaching of mathematics, (c) develop teachers' mathematical growth mindset, and (d) provide a safe space for teachers to ask questions, share lessons, and improve students' attainment.

Review of the Literature

The purpose of this project was to garner information regarding Year 1 teachers' instructional practices, perceived self-efficacy, competence, and motivation in relation to the teaching of mathematics using realistic mathematics education. The findings of the research were used to guide the review of the literature. The literature was explored in order to find workable solutions to issues raised by the participants. Key search terms for the literature review were *effective professional development*, *mathematical growth mindset*, *use of Google Classroom*, *the value of blended learning*, *online mathematics professional development*, *designing professional development in line with the needs of teachers*, *changing instructional practices*, and *professional learning communities*.

A number of databases were used to facilitate the search. I searched ERIC, Google Scholar, the Walden University Library database, and ProQuest for relevant peer-reviewed articles. Most articles were retrieved from the Walden University Library database or ERIC. The literature provided information on the effectiveness of Google Classroom as an online forum where professional learning can take place. From this literature, I gained insight into how to develop professional development to meet the needs of professional learning communities.

Effective Professional Development

Bonghanoy et al. (2019) called for relevant professional development that would adequately address the direct needs of mathematics teachers. Similarly, Sagpang, Alejan, and Rellon (2019) stated that there is a need to restructure the current professional development model to match the needs of teachers and ultimately students. Likewise, Bonghanoy et al. highlighted the benefits of adding teachers' voices to discourse related to their professional development needs. Meeting teachers' individualized and collective professional development needs should be of paramount importance to stakeholders (Bonghanoy et al., 2019). A growing body of evidence affirms that teachers who are well supported are much more likely to display higher levels of confidence in the execution of their everyday instructional practices (Wake & Mills, 2018).

Wake and Mills (2018) described the realities of professional development design in a way that resonates with the experiences of participants in this study. Quite often, teachers report that unfocused professional development offerings (a) lack relevance to their local or individual needs, (b) are too long, (c) are poorly timed, and (d) do not lead to improved practice (Lutrick & Szabo, 2012). Hence, it is imperative that teachers' professional learning aligns with evidence taken from student attainment data, walkthroughs, and formal lesson observations (Caddle et al., 2016).

Caddle et al. proposed that professional development is aimed at improving instructional practices and students' learning. Furthermore, Caddle et al. argued that well planned professional learning could motivate teachers to make the changes needed to advance their practice. The proposed E-Math Learning Lab can provide an avenue for teachers to request professional development support and tailor professional development offerings.

While it is important to create professional development to strengthen the teaching of mathematics, Caddle et al. (2016) argued that those who design programs to support teachers in the teaching of mathematics should pay close attention to teachers' pedagogical content knowledge (PCK). The need to strengthen teachers' PCK is in keeping with Shulman's (1986) claim that teachers must know a subject thoroughly in order to teach it effectively. Similarly, Lee, Özgün-Koca, Meagher, and Edwards (2018) postulated that high-quality professional development should strengthen teachers' mathematical instructional practices and content knowledge. Through such programs, teachers and students can move beyond the roles of onlookers and doers, becoming more actively involved as teachers and learners of mathematics (Lee et al., 2018).

Research by Alamri, Aldahmash, and Alsharif (2018) highlighted the importance of stakeholders considering teachers' PCK as they seek to build a knowledgeable and sustainable workforce. Alamri et al. further argued that taking both a top down and a bottom up approach to professional development provides a unique opportunity for mathematics teachers to have targeted support. Likewise, Lee et al. (2018) contended that teachers must be given a model to follow if they are to assume a position of power and competence within the classroom. The model lessons uploaded to the E-Math Learning Lab will serve as a guide to the learning community.

Models will serve to scaffold teachers until they are confident enough to build their conceptual understanding of an established process (Lee et al., 2018). In the E-Math Learning Lab, numerous opportunities will be provided for teachers to see model lessons delivered by their colleagues. The aim of providing model lessons within the E-Math Learning Lab will be to scaffold teachers through areas that they may find challenging. Nooruddin and Bhamani (2019) noted that support and guidance are essential to improve pedagogical practice in the teaching of mathematics.

Through the E-Math Learning Lab, teachers will have access not only to models of teaching, but also to a continuous professional development model that they can revisit at their leisure. Single professional development sessions do not give teachers enough time to develop firm knowledge of the process for implementing practice within the classrooms (Nooruddin & Bhamani, 2019). Researchers have argued that teachers' motivation and passion toward mathematics are unique and that all professional development aimed at improving instructional practice and motivation must be targeted and meaningful for those involved (Day, 2009; DiPaola & Hoy, 2014; Nooruddin & Bhamani, 2019).

Beare, Caldwell, and Millikan (2018) argued that developing an excellent school takes effort and time. Central to this process is the development of a workforce whose members understand how to move from theory to practice. Beare et al., encouraged school leaders must be creative and innovative in how they create learning communities whose members actively support each other. The line of reasoning behind collaborative learning is that teacher isolation can create frustration, burnout, and demotivation, especially among new teachers and those in single-stream schools (Battersby, 2019). The E-Math Learning Lab will function as a hub for collaborative learning and sharing on a virtual platform.

Professional Learning Communities

Currently, there is no universal definition of a professional learning community (PLC). In education, a PLC can be broadly described as involving collaboration by a group of individuals who are driven by a common or shared purpose to improve their practice (Markku, Liisa, Pekka, & Auli, 2018). According to Markku et al, PLCs within the education arena can be organized in such a way that educators garner valuable information from inside and outside their immediate PLC. Given that the main aim of PLCs is to improve practice and ultimately students' learning.

Markku et al (2018) encouraged key stakeholders to focus on how a PLC can be used as a forum to focus on improving learning. Markku et al. further argued that making the paradigm shift from focusing on teaching to focusing on learning is a steep order for many administrations. Therefore, the E-Math Learning Lab will be a place where teachers can learn from each other. Mathematics coaches should also use model lessons and book study to improve teachers' instructional strategies. Ultimately, those who participate in PLC through the E-Math Learning Lab will have access to personalized PDs.

In discussing the use and value of PLCs, Markku et al. (2018) argued that several key factors influence the development and sustenance of school-based PLCs, including the following:

- organizational characteristics of schools as PLCs,
- school culture,
- leadership, and
- capacity building.

Likewise, Muñoz and Branham (2016) put forth the notion of connecting PLCs to data. These data may be student attainment data or information gathered from formal or informal lesson observations.

The amalgamation of PLCs and student data supports the call from Markku et al. (2018) for PLCs to focus on improving learning as much as improving teaching. Critical to this call is the capability of school leaders to strategically connect data to school improvement (Reynolds, 2016). Adding to the discourse on well-developed PLCs, Reynolds contended that PLCs that are successful must be carefully planned, encourage trust, and focus on students' achievement. The ideas presented by Reynolds represent the central trend in literature that is dedicated to the discussion of the development of PLCs. Participants in this research also argued that there is a need for administrators to use the findings from lesson observation to plan professional development for local teachers.

Building trust and team spirit in PLCs should be taken into consideration (DuFour & Reeves, 2016). DuFour and Reeves indicated that teachers need to consider how they and their students will benefit from engaging in PLCs. For this reason, the following questions must be used to guide the development and impact of PLCs: First, what are the needs of the learners? Second, how will the learners' knowledge be assessed? Third, how can we address issues related to things that they have not learned? Fourth, how do we cater to the needs of the more able students?

DuFour and Reeves (2016) further articulated that accurately answering the previously posed questions would ensure that PLCs move beyond addressing only teachers' instructional practices to catering to the needs of students. Likewise, DuFour and Reeves postulated that focusing on instructional practices and learning would ensure that both teachers and students get targeted support within their zone of proximal. After examining DuFour and Reeves' proclamation, I concluded that the E-Math Learning Lab would address the needs for collaborative professional learning.

In developing the E-Math Learning Lab, I took into consideration the body of research on PLCs and active professional development. The development of a professional learning platform that builds collaboration strengthen teachers' practice through model lessons and mentoring and harness the will to change through the nurturing of teachers' mathematical growth mindset. Most importantly, I ensured that the E-Math Learning Lab addresses the need for locally designed lesson scenarios that accurately reflect the native language and experiences of the learners.

Blended or E-Learning Professional Development

In an era of technological advancement, more and more professional learning has moved into the virtual platform taking on a fully online or a hybrid approach. Martin, Kreige and Apicerno (2015) defined hybrid or blended learning as the combination of face to face professional and online learning. In talking about the need to shift from the predominant face-to-face professional development to entirely online or hybrid approach, Battersby (2019) and Misra (2018) argued that face to face professional development could be expensive and time consuming.

Not only is face to face approach time consuming but also can lead to the loss of quality instructional time. Quite often, teachers may be required to leave school before dismissal or school is closed in order to facilitate PDs (Onguko, 2014). Therefore, there is a need to redesign PDs to meet the demands of the 21st century. Hence, the E-Math Learning Lab, a blended approach, implemented effectively, can close the gap for easily accessible professional development. In line with the proclamation of Onguko, stakeholders are implored to use the E-Math Learning Lab as an online forum that can minimize teachers' need to travel to face to face PDs.

While well designed professional development can empower teachers with the tools that they need to be successful, Tarhan, Karaman, Kemppinen, and Aerila (2019) postulated that professional development must be used as a tool for improvement rather than a mere event. Similarly, Sia and Cheriet (2019) affirmed that professional development is an essential tool that can sharpen both experts and novice teachers' skills but is more effective when teachers have access to professional learning at their convenience. To this end, Sia and Cheriet echoed the need to leverage online dais as a medium for teacher training and professional learning. The call for more individualized professional development is based on the premise that the one size fits all approach to professional development is long gone (Iyer & Pitts, 2017).

As evident in research, online professional development is a dynamic shift in the way and the speed at which information can be retrieved. The radical revolution brought by digitization makes online professional learning available to teachers at their fingertips and within their domain and control (Khan et al., 2017). Therefore, the proposed E-Math Learning Lab may satisfy the local teachers' expressed need for more professional learning that is within their local schools or even their homes. Furthermore, since local school authorities and teachers will upload the professional development resources, the content can be tailored to meet the needs of teachers within each school. E-Learning puts the learner in control to manage their time, move at their own pace, and choose content areas that are relevant to their needs (Toufaily, Zalan, & Lee, 2018). Such autonomy is rarely available in traditional professional development (Chang, 2016).

E-Math Learning Lab, a blended learning model, combines the power of face-to-face learning with E-Learning to help teachers cope with the ever-growing demands of engaging in continuous professional development (Anthony, 2019). The rapid changes in education quite often caused teachers to lose faith in their ability to teach effectively (Iyer & Pitts, 2017). The groundbreaking changes occurring in the landscape of education demands quick and efficient professional development and collaborative opportunities for teachers if they are to keep up with the changes in curriculum and levels of accountability. Toufaily et al. (2018) suggested that blended learning is a trusted model that can be used to encourage teacher collaboration and quick access to information and needed support. Especially in the 21st century, where the emphasis is being placed on teachers shifting their thinking and practice to meet the needs of the current generation of learners (Anderson, Boaler, &. Dieckmann, 2018).

Google Classroom as a Professional Development Platform

Easy and quick access to professional development was one of the needs expressed by local participants in this research study. Most of the Year 1 teachers expressed that a large percentage of the professional development that they have engaged in over the last century have focused upon topics that were not tailored to their needs. Furthermore, participants also expressed that there are limited opportunities to meet with their peers. Since there is a need to bridge the gap between the current professional development model and what the participants need, E-Math Learning Lab will be used as a blending learning model in Google.

Google Classroom was developed in the middle of the past decade. Hence, the suitability and effectiveness of Google Classroom as a professional forum is quite limited. However, Liu and Chuang (2016) affirmed that students and teachers responded favorably to the use of Google Classroom. Teachers' desire for Google Classroom was credited to the fact that they can share ideas and collaborate in real time in the forum. Furthermore, Google Classroom is low cost and can reach a larger audience (Espinosa, Estira, & Ventayen, 2017). In support of Google Classroom, Heggart and Yoo (2018) postulated that Google Classroom provides an online forum through which persons can collaborate and engage in global learning communities. Besides, Google Classroom can be used to distribute a large volume of materials (2018).

In considering the use of Google Classroom as the platform for the development of the E-Math Learning Lab, key considerations were given to the need of the local teachers to share and access training materials, collaborate with colleagues, seek clarification, and engage in choosing self-paced personalized professional development. As a consequence, Google classroom is a suitable platform for PDs. Teachers already have access to the Google Suite through the school database and online system, Google classroom is easy to use (Heggart & Yoo, 2018), and is provided as a proficient learning forum that can improve teachers' instructional practices in the teaching of mathematics (Alia & Hamtini, 2019).

From the review of literature, it was noted that Google Classroom is a favorable method for shared learning experiences (Shaharanee, Mohd, & Rodzi, 2018). Through a study, Shaharanee, et al. affirmed that participants who interfaced with Google Classroom found it to be a practical forum that can be used for multiple purposes. Furthermore, the mean value rating of the quality of interaction and communication component of Google Classroom was statistically significant. Most participants felt that the level of communication and interactions were good. Hence, I believe the development of an E-Math Learning Lab in Google Classroom with filling the gap of lack of communication and meaningful engagements, as mentioned by the participants.

E-Learning Labs

Traditionally, Learning Labs were places where persons, mainly young people, meet to practice specific skills under the guidance of a mentor or expert (Association of Science-Technology Centers & the Urban Libraries Council, 2014; Dresang, 2013). In modern times, a great deal of attention is being paid to redefine learning labs (Koh & Abbas, 2015). Learning Labs have some standard features that make them useful. According to Koh and Abbas (2015), Learning Labs provide spaces for active learning and engagements. Furthermore, Learning Labs can be used for sharing videos across electronic platforms (Admiraal et al., 2019).

The sharing of videos can be an essential aspect of E-Learning labs (Admiraal et al., 2019). Hence, the inclusion of videos in the Math E-Learning Lab is in keeping with prevailing trends in other Learning Labs. Uploading videos in the online forum will give teachers in the local setting an opportunity to see local best practices and gain insights into how their colleagues are approaching various topics. Additionally, studies done by Rudolph, Schwabe, and Johnson (2018) highlighted the benefits to be derived from learning labs. They argued that Learning Labs build collaboration, foster independent learning, and provide opportunities to deepen one's skills. To this end, Lahcen and Mohapatra (2020) postulated that Math Labs could be productive for both those who are technically savvy as well as the novice. More importantly, learning labs are avenues through which the teachers can develop intellectual capabilities and personal decision making (Holmes, 2018).

Project Description

The teachers in this study experienced challenges in implementing the adapted Realistic Mathematics Education (RME) framework within their Year 1 classrooms. Data gathered through qualitative measures revealed that although teachers believe some levels of confidence in implementing the RME framework, they were not always confident. Teachers also highlighted that the constant change in the system influenced their stability and ability to teach mathematics effectively. In September 2019, the Education Ministry provided a new mathematics resource – power maths resources - that they hope would help to guide teachers in effectively implementing the current mathematics strategy. While most teachers in this research spoke highly of the power maths resource, a few are still unsure of how to implement the RME framework. The power maths resources have heavy component arithmetic and rather than critical thinking.

It can be argued that although teachers in the study have access to new mathematics resources and professional development, some teachers are still not confident in their ability to teach mathematics using the RME framework. Therefore, they echoed the need for tailored professional developments and a forum where they can collaborate with their colleagues. The teachers' levels of motivation and confidence were also conditional. Hence, the teachers’ overall needs are centered on the needs for purposeful team collaboration and professional learning that boost their confidence, motivation, and instructional practices.

The teachers call for less top down professional development (PD). The teachers call for more strategic PDs is in line with the findings of Goos et al. (2017). Goos et al. theorized that mathematics practices are best changed through PDs that are teacher centered. Moreover, Goos et al. believed that providing opportunities for teachers to collaborate with their grade level colleagues could be a powerful professional learning tool to improve the teaching of mathematics. It is also imperative to note that focused team collaboration can also strengthen practices within the teachers’ school as they develop a mathematical mindset (Faulkner & Latham, 2016).

The E-Math Learning Lab was developed to address the need for (a) easy access to individualized and group professional development, (b) more meaningful team collaboration, (c) research based mathematics activities that can reflect the local language and scenarios, (d) access to local videoed mathematics lessons that focus on questioning and problem solving in the RME framework, (e) formative feedback to guide the development of future PDs, (f) an app where teachers’ can send both private and public messages requesting help or clarification, and (g) a mathematical growth mindset (the use of video testimonials and a book study).

Sample video lessons. Local lessons will be videotaped and uploaded in the Google Classroom. Research affirmed that the inclusion of videos in professional development could provide guidance and support for teachers who want to improve or change their classroom practices (Alles, Seidel, & Gröschner, 2018). Mathematics teachers within the local schools will model sample videos related to each Year 1 topic. All model lessons should be videoed and uploaded to the Google Classroom – E-Math Learning Lab.

Lead mathematics teachers or instructional leaders and other members of the school management team should work together to oversee the planning and implementation of the E-Math Learning Lab. Planning the lessons with the teachers will ensure that developed lessons accurately captured the critical components of the RME framework using local scenarios and language. I developed a rubric outlining the essential components and steps to be followed in the execution of an effective RME lesson. While the content of the sample lessons will be drawn from the local curriculum, teachers will use a guidance document and checklist (Appendix A) to ensure that the planned lesson is in line with the central tenets of the RME framework. The emphasis will be on problem solving and higher order thinking.

According to the findings of this research, most teachers rarely teach towards developing learners' higher order thinking and making meaningful conceptual connections through intertwining key mathematical concepts. Hence, all model lessons should be designed to support teachers in building problem solving through high quality questioning and scenarios (Azizaa, 2018). Findings from Azizaa's research supported the view that teachers should use multiple levels of questioning in order to lift the level and challenge of learning experiences.

Meeting the needs of all learners is imperative in the RME classroom. Findings drawn from the data collected from the participants in this study highlighted that some students displayed undesirable behaviors during mathematics lessons. In addressing students' behavior and motivation for learning, Korong and Maria (2019) argued that there is a correlation between the teachers' approach to teaching and students' motivation for learning. While both intrinsic and extrinsic motivation has an impact on the attainment of the learners, Kopong and Maria argued that teachers must develop lessons that capture and maintain the interest of the learners. Therefore, all model lessons were designed with a focus on high quality teaching. Local mathematical scenarios and strategies for orchestrating productive mathematical discussions were entwined into each activity (Appendix A).

Teachers can upload videos of their lessons. Critical friends in the learning community will scrutinize each uploaded lesson (Aktekin, 2019). Teachers in the online learning community will be encouraged to respond to uploaded videos by categorizing their comments under the headings: "what went well" and "even better if." The feedback form and an RME rubric should be used to record and analyze the uploaded lesson. Creating and uploading videos will serve as a customized learning tool for the teachers (Rudolph et al., 2018).

Furthermore, Year 1 teachers within the E-Learning Lab should be part of a critical friend group. Critical friends provide feedback and support for their colleagues

(Aktekin, 2019). Discussions about modelled and uploaded lessons will be guided by the RME lesson rubric that I have developed (Appendix A). All sample model video lessons and supporting rubric should be discussed with Year 1 teachers during the face to face workshops, before giving them access to Google Classroom.

Testimonial videos. In addition to model lessons, testimonial videos will be included in the E-Math Learning Lab. The E-Math Learning Lab will provide a segment where teachers can access videos that help to grow their mathematical mindset and realize that they can improve their practices and confidence over time (Choi & Walters, 2018). While it is imperative to have model video lessons, Choi and Walters avouched that self-efficacy, a growth mindset, and self-confidence are critical in the learning of mathematics and change of instructional practices. Hence, the key purpose of including a testimonial section in the E-Math Learning Lab was to encourage teachers to connect with others who have embraced challenges and persist (Rattan, Savani, Chugh, & Dweck, 2015).

Changing teachers' mathematical mindset is of paramount importance to the process of instructional transformation (Anderson et al., 2018). Most importantly, Anderson et al. posited that teachers' who embrace a growth mindset are more likely to transfer this positive attitude to their classrooms. Another critical point to consider is that teachers' growth mindset is also essential to the way that teachers carry out their duties (Boaler, 2016). Consequently, teachers need to be mentored in order to develop mathematical skills and growth mindset (Donaldson, 2018). Hence, it is imperative to understand that professional development is critical in the statis of a mathematical mindset.

The realization that teachers with a positive mathematics mindset see themselves as learners and transfer this aspiration to their students is powerful knowledge for PD developers (Chapman & Mitchell, 2018). Studies conducted by Bang and Reio (2016) affirmed that there is a relationship between a person’s self-efficacy and levels of proficiency. The supporting line of reasoning is that persons with low levels of self-efficacy tend to avoid tasks or situations that may reveal their lack of proficiency. On the contrary, Bang and Reio postulated those with high levels of self-efficacy tend to strategically undertake challenging tasks .Furthermore, Bang and Reio highlighted that teachers’ levels of self-efficacy would greatly impact their students' perceived self-efficacy hence, teacher development activities should be geared at developing teachers’ self-efficacy and instructional skills (2016).

Linking theory and practice. While there is a need to see lessons being executed, there is also the need to merge theory and practice (Ralston, Waggoner & Carroll, 2017). Ralston et al. (2017) furnished evidence that highlighted the benefits to be achieved from having preservice and practicing teachers engaging in research reading. One of the most intriguing benefits is that engaging in capstone projects and research in general can improve teachers’ self-efficacy.

Moreover, the benefits derived from engaging in research-based activities also translated into increase belief in self and the application of learning strategies. Above all, Ralston et al advised that students’ learning experiences will be enhanced as teachers’ self-efficacy increases by engaging in the book study, teachers will be exposed to evidence-based practices that other practitioners have tried and the levels of success that they have experienced. Teachers can access at least one research-based article through the E-Math Learning Lab each week.

The exploration of evidence-based practice in school is not new to the discussion on how to improve teaching and learning within schools (Farley-Ripple, May, Karpyn, Tilley, & McDonough (2018). Farley-Ripple et al. discussed the importance of connecting theory and practice. The call was made for policymakers to consider the implication of research-based practice within schools. The essential point of Farley-Ripple et al.'s discourse is the need to ensure that research is in line with the current needs of the practitioners within the field. Hence, the inclusion of links to mathematics research articles will be in line with the areas of interest identified by the teachers.

In conclusion, Prasad, Ishwar, and Dewali (2017) postulated that professional development help teachers consolidate their skills. Consequently, the value of professional learning is true for novice teachers as it is for those who have been practicing for a long time. However, the key to successful professional learning is providing evidence-based support that is focused and relevant to the unique needs of the targeted population (Bonghanoy et al., 2019).

Needed Resources

In bringing all areas of the E-Math Learning Lab together, some key areas and resources will be needed. The teachers who participated in this study expressed the need for consistent and relevant support. Hence, the online forum was chosen because of its ease of access. For this reason, the provision and access to a laptop and internet access are the starting point in the process. Now, all teachers and school administrators have a work laptop and internet access, which were provided by the Ministry of Education and Department of Education Services.

The impetus for this research project is the development of a mathematical growth mindset geared at increasing teachers' self-efficacy. Dweck (2017; 2015) argued that training that is geared towards improving teachers' self-efficacy should include the building of a growth mindset. The theoretical framework of Dweck should be used to guide the book study training sessions. A series of professional book studies were developed to support teachers in cultivating a growth mindset. Mathematics leaders within the school should be in charge of leading the book study professional learning workshops.

In addition to the workshops, teachers should engage in online discussions about the growth mindset in the E-Math Learning Lab. The proposed text for the book study is currently available in the local mathematics library. At the time of this study, one of the mathematics coaches operated the mathematics library. I have developed a guidance document for the book study, in addition to providing online links to articles on growth mindset. Teachers will also have the option of creating an online electronic reflective journals to record their learning journey Dumlao and Pinata (2019) affirmed the use of reflective journals to capture learning experiences.

In reviewing the findings of this research, it was noted that almost all participants echoed the need for sample lessons and resources to be culturally relevant. This call for culturally relevant learning resources is in keeping with research done by Krawczyk (2019). Krawczyk pointed out that students are more likely to respond to learning experiences that they can make cultural and linguistic associations. The E-Math Learning Lab contains an anthology of local scenarios. Each sample scenario is carefully aligned with the existing Year 1 curriculum and aimed at providing some realistic experiences with which the children can be associated. Also, the sample lesson scenarios are geared at improving teachers' skills in contextualizing the learning of mathematics.

The local Social Studies textbooks were examined in order to customize the scenarios for the mathematics lesson. Given that lessons will be videotaped, there will be a need for all lessons to be purposefully planned. The lesson planning guide should be used to guide the planning process. Additionally, teachers must be willing to participate and have their lessons videoed. Schools already have access to cameras and laptops that can be used for videotaping. Supporting human resources are also available in the form of mathematics leads and coaches. A rubric was developed to guide the development and quality of each sample video. Videoing lessons and critically analyzing them opens a gateway to a more analytical practice among the local teaching community.

Time will also be needed for team collaboration within professional learning communities. Provisions for PDs are already in place, so the E-Math Learning Lab could use the current PD platform. However, in the initial stage of implementing the E-Math Learning Lab time will be needed for face-to-face meetings. Teachers within hub schools will need to meet and review the sample lesson and decide on the way forward. Opportunities also need to be given for teachers to use the provided rubric to develop their model lessons to upload to the E-Math Learning Lab. Initially, the development of videos needs to be a guided process. Hence, the need for mathematics leads and coaches in the process.

Roles and Responsibilities of Stakeholders

There are different levels of responsibility in the implementation of the blended professional learning presented for the implementation of the E-Math Learning Lab.

Students. The fundamental purpose of this research was to collect data on teachers' self-efficacy to the teaching of Mathematics to use the findings to improve instructional practices and student learning. Ultimately, the social change impact would lead to more confident learners who are taught by teachers with high self-efficacy. Hence, Year 1 students are expected to exhibit positive behaviors for learning so that teachers can effectively teach using the models presented in the E-Math Learning Lab. Students' behavior for learning is imperative to the overall process. In this study, the teachers reported that students' behavior impeded their teaching, motivation, and self-efficacy. Concerns about students' behavior for learning were also raised by school inspectors (Office of Education Standards, 2018-2019). In future, effective behavior management should be in place to curtail unwanted behaviors.

Teachers. The role of the teachers is to be an active participant in the process. Year 1 teachers will be required to take part in two face-to-face workshops before giving them access to the online forum. As instructional leaders, teachers are also required to plan, teach, and attend planned sessions on lesson development. In addition to planned professional development, teachers will also be required to engage in online PDs in

Google Classroom. The teacher could choose to use their laptops or download the Google Classroom App to their phones. Teachers will also need to participate in the video lessons creation and analysis. Numerous testimonials and comments about uploading resources will be sort from teachers. Lastly, teachers should provide summative feedback on the workshops and the E-Math Learning Lab. An E-Math Learning Lab App will be available for teachers to download to their phones.

Mathematics leads/coaches. The school leaders and mathematics coaches will have administrator privileges in Google Classroom. As administrators, they can provide research-based articles, add sample lessons, and provide online coaching support. The help of the coaches/mathematics leads will also be needed to encourage a community of practice and support teachers within their local schools. Instructional coaches/mathematics leads will also help in the two face to face activities in the hybrid approach (Appendix A).

School leaders and other administrators. School Leaders and other administrators are gatekeepers to the success of the E-Math Learning Lab and associated PDs. Hence, they will play the roles of encouraging teachers to attend the planned face-to-face PDs to support the launch of the Learning Lab. Given that the outcome of the research and the E-Math Learning Lab will be shared with senior leaders and Department of Education Services personnel, they will be expected to use the findings of the study as a basis for encouraging teachers within the local school district to participate in the Learning Lab.

Technical support. Assigned school technicians should be available to support teachers who may have technical challenges navigating the E-Math Learning Lab. To familiarize the technicians with the E-Math Learning Lab, an overview of the Learning Lab will be completed prior to the launching of the Learning Lab. Also, technicians will have access to a manual that was developed to support the navigation of critical aspects of the E-Math Learning Lab.

Potential Barriers

Some potential barriers to the implementation of the E-Math Learning Lab and supporting face-to-face PDs are: (a) lack of support from local principals to make time in their PDs calendar for teachers to attend the initial face to face PDs, (b) the willingness of teachers to participate in videotaped lessons out of fear of not being competent enough, (c) teachers' lack of experience in blended learning (Parks, Oliver, & Carson, 2016) and, (d) teachers' attitudes towards the implementation of E-Math Learning Lab as an added burden and as such resent attending workshops (Battersby, 2019).

Potential Solutions to the Barriers

In dealing with the issue of school leaders lack support and provision for school leaders to allow teachers to attend the face to face PDs, mathematics instructional leads could have a dialogue with the lead for teacher professional development and request that the PDs be added as compulsory days to the monthly calendar. Teachers in the local school district are often required to attend PDs that are placed on the national PD calendar. In addition, mathematics leaders could discuss the matter with their assigned senior school improvement officers (SSIOs). SSIOs oversee schools and their development plans; hence, the SSIOs could encourage school administrators whose schools were rated as weak in the teaching of Mathematics to use the E-Math Learning lab as a platform for improvement. Likewise, school leaders should be encouraged to add the use of the E-Math Learning Lab to their school improvement plan (SIP) to set strategic goals for the development of schools.

In overcoming the challenges that are associated with teachers not being motivated to engage in the E-Math Learning Lab, school leaders would be the driving force behind this change. Teachers' professional quality and instructional development are monitored using an Evaluation Performance Management System (EPMS). School principals manage this monitoring system; hence, the principals could add participation in the E-Math Learning Lab as a goal for the Year 1 teachers within their schools. Given that, the principals monitor teachers' progress towards their goals in the EPMS, teachers may feel a sense of obligation to participate. Besides, if active participation in the E-Math Learning Lab was tied to an already existing program, teachers would less likely see it as an added burden.

Another strategy that school leaders could use is walk-through and lesson observation findings to drive participation in the E-Math Learning Lab. Teachers would be required to visit the E-Math Learning Lab to collaborate with colleagues within other schools in order to improve their practices in teaching mathematics. Follow-up discussions with teachers could focus on how they used E-Math Learning Lab to make changes to their instruction.

Like many other learners, teachers may argue that they lack experience in how to learn in an online learning platform (Vaughan, 2007). Considering that teachers' readiness is essential to the process (Rasouli, Rahbania, & Attaran, 2016), school-based information and communications technology personnel will stand ready to offer support on how to navigate Google Classroom. Another solution is that the developer support manual - Navigating E-Math Learning Lab in Google Classroom - could be used as an ease of reference. The manual should be reviewed during the launching process of the E-Math Learning Lab.

Proposed Implementation and Timetable

The E-Math Learning Lab would be best suited to launch in the summer semester prior to the ending of the school year. This would give the Year 1 teachers time to become familiar with its content and evaluate its content and likely effectiveness before the beginning of the next academic year. Feedback should be used to improve the E-Math Learning Lab and conduct further PDs during August, as this month is marked as teachers' back to school preparation time. The E-Math Learning Lab should be operational within the academic school year in which it is implemented. An implementation plan is available (Appendix A).

Project Evaluation Plan

Evaluation of the E-Math Learning Lab will follow an outcome evaluation model rooted in the concept of an appreciative inquiry. The fundamental purpose of an outcome evaluation is to measure or see the change that occurs in participants after being exposed to a product or situation (Zuma, Boodhoo, & Louw-Potgieter, 2019). In this case, the focus will be to see if the Year 1 teachers' self-efficacy and instructional practices of implementing the RME framework and supporting Power Maths resource changed during the academic year. The measure of change is closely aligned to level 4 of Rossi, Lipsey, and Freeman's (2004) hierarchy of evaluation, a formative measure that focuses on outcomes. Therefore, the summative outcome evaluation measures for the E-Math Learning Lab will be guided by two broad outcome-based evaluation questions:

- Are the Year 1 teachers who participated in the E-Math Learning Lab more confident and competent in implementing the RME framework and supporting Power Maths resource aimed at improving children's problem solving and arithmetic skills?
- Are the Year 1 teachers who participated in the E-Math Learning Lab more positive about the quality and focus of mathematics professional development?

Appreciative Inquiry

Adding appreciative inquiry to the evaluation process serves an extra layer to the data collection process for the project. Through appreciative inquiry, authentic feedback on the effectiveness of the E-Math Learning Lab will be collected from the participants. Three guiding questions similar to those put forward Govender and Edwards (2009) will guide the inquiry process:

- Question 1: Describe your experience using the E-Math Learning Lab. This statement is aligned to the discover stage and was developed to encourage teachers to express what they appreciate about the E-Math Learning Lab.

- Question 2: What do you appreciate about the E-Math Learning Lab? This question is aligned to the dream phase and encourages respondents to visualize promising prospects and reveal valuable aspects of the program.
- Question 3: How can the E-Math Learning Lab be improved? This question concerns what improvement participants would like to see in the E-Math Learning Lab and possible ways of implementing them.

The use of broad questions in appreciative inquiry is essential as they allow participants to express themselves freely. Open ended questions allow the researcher to collect rich qualitative data from participants (Creswell, 2007; Merriam, 2009). With the use of the three broad questions, I will gather data about the E-Math Learning Lab. All data gathered will be analyzed, and findings used to improve the effectiveness of the E-Math Learning Lab.

Justification for Outcome-Based Evaluation

Using an outcome evaluation approach is essential in this research. Participants in this study argued that PDs aimed at improving their practice were not always focused and meaningful. There is a need to ensure that PDs reflect the teachers' voice. Most importantly, the interview data indicated that Year 1 teachers in the local school districts have wavering confidence and varying levels of mathematical competence. Considering this, the aim of the E-Math Learning Lab was to improve practice, build confidence, and personalize professional learning. As such, all evaluation measures must assess if these key goals were attained.

The use of appreciative inquiry will also be used to gain participants' perceptions of the E-Math Learning Lab strengths, and effectiveness in improving their confidence, competence, and motivation to teach mathematics (Cooperrider, Whitney, & Stavros, 2005). Johnson (2004) argued that the process of appreciative inquiry yields valuable information about participants' feelings towards an implemented program. Additionally, Johnson avouched that data gathered through the process of appreciative inquiry could be used to tailor an intervention program to meet the specific needs of the target population. Meeting the needs of the participants is critical in this study; hence, employing the use of appreciative inquiry will ensure that participants have a say in the content of the E-Math Learning Lab. Encouraging the input from employees about their professional learning is in keeping with the postulation of Bergmark and Kostenius (2018). Research conducted by Bushe and Kassam also highlighted that employees feel a sense belonging as they contribute to the development of their own and organizational development.

Evaluation Timeline

Due to the design of the E-Math Learning Lab, teachers will use the Stream section of Google Classroom to provide formative feedback on what is working well for them, as well as further support that they need to improve their practice. The overall evaluation of the E-Math Learning Lab should be completed towards the end of the academic year in which it is implemented. The timeline for the overall evaluation was chosen for May to June, as teachers would have eight months to interface with the Lab and become more competent with its usage. An evaluation document is provided to guide the process (Appendix A).

Instrument and Data Collection

Data should be collected using the recommended questionnaire (Appendix A). The development of the questionnaire was guided by the purpose of the E-Math Learning Lab and the two evaluation questions:

1. Are the Year 1 teachers who participated in the E-Math Learning Lab more confident and competent in implementing the RME framework and supporting Power Maths resource, aimed at improving children's problem solving and arithmetic skills?

2. Are the Year 1 teachers who participated in the E-Math Learning Lab more positive about the quality and focus of mathematics professional development?

The questionnaire (Appendix A) should be uploaded in Google Classroom in the beginning of May. This gives participants a total of two months to complete the questionnaires. The participants will privately email their responses to their school leaders or Mathematics Instructional Leads. The instructional leaders will also have the option of downloading the questionnaires and distributing them to their Year 1 teachers or using the drop box. Participants should be encouraged not to write their names on the questionnaires. The data collection process must be completed by the end June of the school year in which the E-Math Learning Lab was implemented.

Mathematics instructional leads and school leaders should analyze responses from the questionnaires. The findings should be used to refine and customize each school or leaning hub E-Math Learning Lab. Data from the participants should be used to prepare an internal document, The Current State of Mathematics Teaching at the Year 1 Level. This document should include the findings and proposed next steps for improvement.

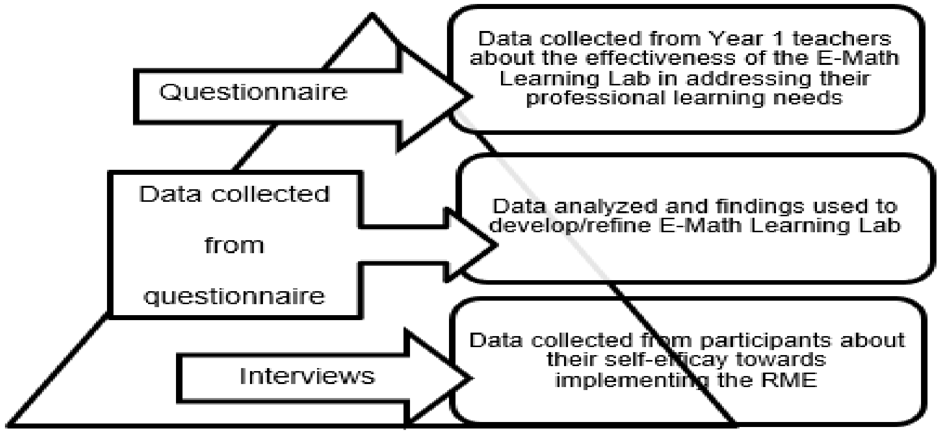

Figure 2. Components of the e-math learning lab evaluation process

Project Implications

Social Change Implications

The E-Math Learning Lab was developed to provide a forum for targeted professional learning. Given the nature of the E-Math Learning Lab, practitioners will collaborate and increase their professional knowledge and instructional skills. The use of online learning platform is a paradigm shift in the local community. Before the introduction of the E-Math Learning Lab, face to face PDs or workshops would have been the only means of professional learning. Hence, the introduction of an online forum will bring about a social change, as the teachers will realize that online platform can be an essential online collaborative process where they can socialize and learn from their colleagues. It is hoped that teachers will begin to see improvement in their practice as a collaborative process.

Given that the teachers at the Year 1 level will have access to specially designed professional learning, they will be more assured that their viewpoints will be used to improve the quality of their teaching and learning. Social change will also be seen in the way that teachers begin to reach out to their colleagues and mathematics instructional specialist for support. The teachers' quest for support would have been from the understanding that it is okay to seek help as they seek to develop their mathematical growth mindset. Developing the mathematical mindset of the teachers was a critical element of the E-Math Learning Lab.

Another indication of social change is teachers' improved instructional practices, competence, and confidence. Given that there is a correlation between teachers' self-efficacy and students' attainment and motivation (Bandura, 1977), the following social change may become evident within the classroom: (a) students display a growth mindset towards learning mathematics, (b) students are engaged during mathematics lessons, and (c) overtime students' attainment in mathematics will increase.

Local Community

Besides the benefits of the implementation of the E-Math Learning Lab to public school stakeholders, the idea could also be extended to teachers and stakeholders in private schools who may also need support in the teaching of mathematics. The idea and usage of the E-Math Learning Lab could be extended to practitioners at all levels of the education system. The replication of E-Math Learning Lab at varying levels of the education system will build camaraderie between both private and public schools. Ultimately, the change will be visible in both public and private primary teachers who are more confident and efficient in working with their colleagues using an online learning platform. The use of E-Math Learning Lab as a learning exchange forum would be the first of its kind in the local community.

Staff in public schools could also benefit from the knowledge and skills of the primary teachers in private schools that use a British based curriculum. Joining forces with these teachers through video-based lessons in the E-Math Learning Lab could strengthen the public school teachers' instructional practice. Evidence gleaned from a review of current inspection reports would suggest that students' attainment in the Islands' private schools is higher than those in the public sector (Office of Education Standards, 2018-2020). Hence, building a culture of collaboration between private and public schools is potentially useful. Both parties would have opportunities to share best practices and learn from each other. Hence, there is a social change opportunity for both parties to access a reservoir of online resources and support through the E-Math Learning Lab. Before this study, the establishment of the E-Math Lab, there would have been no locally organized online forum through which teachers across the Islands could engage in professional learning.

Far-Reaching Impact

Through this project, I aim to build collaboration and improve teaching practice. As teachers' instructional practices and confidence increase using the E-Math Learning Lab, this experience may transfer to their students using media tools in teaching and learning. Given the current support system that is in place to support parents, teachers could replicate E-Math Learning Lab in Microsoft Teams as a support system for parents and students. Having an online support system would be beneficial to parents who may lack the skills needed to support their children effectively. Therefore, the use of the E-Math Learning Lab could bridge the gap between home and school. Through uploaded sample videos by teachers, parents could see how to help their children on a specific topic or skill. The adaptation of the E-Math Learning Lab could also eliminate the need for parents to attend mathematics workshops and parent conferences, especially if it is conducted through Microsoft Teams. Ultimately, stakeholders could consider setting up a regional E-Math Learning Lab using Google Classroom or Microsoft Teams.

Section 4: Reflections and Conclusions

My passion for teaching and learning drove the exploration of a group of Year 1 teachers' instructional practices and perceived self-efficacy, competence, and motivation related to the teaching of mathematics using RME in four primary schools in a British Overseas Territory. As a special education needs coordinator, I am always curious about barriers to children learning and how they can be addressed. The voyage to discovery was a mixed experience for me. I had some rewarding moments, meeting with the teachers and hearing their successes and challenges. Perusing the curriculum, training manuals, power mathematics, and lesson plans have helped me to have a better understanding of how mathematics is being taught and the support that teachers received.

On the contrary, the long journey through the research process and project development has daunted my spirit many times. This section captures my reflection on the process, the project, recommendations, implication, application, direction for future research, and how I have emerged as a scholar.

Project Strengths and Limitations

The proposed E-Math Learning Lab has the potential to address the issues that emerged from the findings of the research. Strengths of the E-Math Learning Lab and supporting face to face workshops are summarized below:

The online aspect of the E-Math Learning Lab means that teachers can access the lab from anywhere at any time (Rudolph et al., 2018; Toufaily et al., 2018). After the introductory workshops, teachers will have access to the online forum where they can review sample lessons, and ask questions using the E-Math Learning Lab application

(App). Easy accessibility is guaranteed as Google Classroom also has an App that can be downloaded to teachers' phone, desktop, or laptop. The use of the Apps will ensure that teachers have control over what they engage in with immediate feedback. Holmes (2018) argued that teachers' use of Google Classroom online forum builds their capabilities.

The E-Math Learning Lab in Google Classroom will address the need for targeted active PDs. Learning Labs are where persons can collaborate and share ideas (Koh & Abbas, 2015). In this instance, the proposed E-Math learning Lab in Google Classroom will provide an avenue for teachers to use the "share" section of Google Classroom to upload approved lessons and request peer or coaches feedback (Admiraal, 2019; Shaharanee et al., 2018). Uploading videos will provide visual support for teachers so that they can see best practices from their colleagues. Teachers can suggest topics that they would like to discuss. The E-Math Learning Lab will provide a level of freedom that is essential in the local setting, as teachers do not always have a voice in the development of their PDs.

Rudolph et al (2018) argued that Labs could build collaboration. Likewise, Markku et al. (2018) supported the need for professional learning communities in improving teaching and learning. The E-Math Learning Lab was designed to address the need for meaningful collaboration in an online forum. Moreover, holding PDs through the E-Math Learning in Google Classroom is inexpensive when compared to bringing overseas presenters for one or two days workshops.

The literature on Learning Labs, Google Classroom, and blended learning highlighted the challenges that are associated with these platforms. Good and Schumack

(2013) argued that online platforms are useful in presenting content to a large group. However, one of its most significant limitations is the lack of authentic collaboration (Good & Schumack, 2013). Given that participants are in a virtual learning space, they may experience isolation or participate in incognito (Fedynich, 2013). Wynants and Dennis (2018) argued that professionals need to humanize online learning forums if participants are to feel connected and remain involved in the process. Consideration must be given to making regular face to face visits with the teachers as well as to the E-Math Learning Lab; otherwise, the E-Math Learning Lab may lead to a lack of social presence (2018).

Another limitation of the E-Math Learning Lab is that learning within an online forum may not be ideal for some teachers (Wynants, & Dennis, 2018). Some teachers argued that they like to have in person interactions and receive immediate feedback. As such, the E-Math Learning Lab may prove overwhelming for them (Raspopovic, Cvetanovic, Medan, & Ljubojevic, 2017). The development of online learning platform should always take into consideration the learning styles of the participants (Fedynich, 2013; Good & Schumack, 2013). The E-Math Learning Lab was not developed on teachers' learning styles and neither was this considered; therefore, local coaches and mathematics leads need to consider the learning styles of teachers when engaging them about teaching practices. Data gathered from teachers on the effectiveness of the E-Math Learning Lab should be used to personalize the Lab to meet the needs of each school.

Recommendations for Alternative Approaches

In Section 1, I focused on the gap in practice as it relates to the uneven implementation of the RME framework among Year 1 teachers in the BOT. One of the limitations of this study was the small number of participants who took part in the study. Given the small sample size (seven participants); the findings of the study cannot be generalized in other settings. In this study, I focused on only one grade level. The inconsistent implementation of the RME framework is evident across all year groups; therefore, I am recommending that follow up research be done in other primary grades.

Also, the data collected were from two sources - interview and document analysis. While these media yielded valuable information, there was a need for lesson observation. Lesson observations would show how teachers implement the RME framework in their daily lessons. Lesson observations would also provide an avenue through which researchers could verify if what teachers said during their interviews take place in their classrooms. Adding an observation component to data collection will provide more data on where the misunderstanding about the RME is and answer the question as to why some teachers are still not effectively implementing the RME framework. Discrepancies identified during lesson observations may also provide accurate information on where teachers are failing. The data from lesson observation could guide targeted PDs for teachers.

The findings from this study and professional literature confirmed the need for teachers to receive continuous professional development. Focused continuous PDs for all teachers would be the ideal approach to improve the use of the RME across all primary grades. While the E-Math Learning Lab was designed to meet the needs of Year 1 teachers, the need exists to extend the same level of support to other teachers within the primary system. I recommend that the professional development arm of the Ministry of Education and mathematics instructional leaders work together to create sample lessons beyond those proposed by the power mathematics resources. School leaders must gather data on the impact of power mathematics resources and students' engagement in in authentic problem solving. While the power mathematics resources bring some levels of clarity to the teaching of mathematics, I believe that it is primarily arithmetic based; hence, deep reasoning may be a missing element.

Scholarship, Project Development, and Leadership and Change

The journey towards becoming a scholarly practitioner is never an easy one (Foot, Crowe, Tollafield, & Allan, 2014). Assuming a scholarly identity requires a paradigm shift from one level of academia to another. Foot et al. argued that the process of becoming a scholarly practitioner is closely aligned to self identity and transformation. Foot et al. also avouched that change occurs when the learners' self-efficacy and persuasion about the process sets the stage for how the process of change unfolds. For me, I began with the persuasion that I was able to complete my doctoral degree successfully. After exiting the classroom and coursework section of my study, like Foot et al., I realized that completing the prospectus and doctoral study was not easy. Like the participants in this study, I developed wavering levels of confidence along the journey to completion.

According to Alexander, Taylor, Greenberger, Watts, and Balch (2012), becoming a scholar is a process that required self-analysis and purposeful effort. Alexander et al believed that purposeful effort is essential, as a scholar is one who must be determined to move to a higher realm in order to demonstrate academic expertise and authority. Hence, I selected and purchased textbooks and read literature on qualitative case study design and analysis in order to build academic competence.

As the process of transformation began in my doctoral life, it became more apparent to me that my writing should be succinct and grounded in literature. More importantly, as an emerging scholar, I developed a quest for knowledge and evidence-based practices (Foot et al., 2014). Like other scholars, I started to see positive feedback as fuel for my growth. Therefore, I formed alliances with other professionals in my field and began the process of adding my scholarly voice to the field of education using qualitative research.

Overall, I have learned about scholarly writing and scholarship by conducting this research. It became clear to me that in conducting scholarly research, I must employ ethical principles and practices. Hence, all scholar researchers are required to pursue a certificate in conducting research with human subjects. Additionally, scholars must remain current and relevant. For this reason, I focused on procuring references that were in published within the last five years. It was also imperative to learn the nuances of the American Psychological Association (APA). The precise requirements of APA referencing have helped me to develop a keen eye for details and grammatical errors. As an agent of change and a scholar, I must remain relevant in a changing world; hence, I look forward to learning more about the introduction of APA 7th Edition.

Project Development

The findings of this research were used to guide the development of the project study. I contemplate multiple ideas about how to develop a model for PD that could best address the needs of the teachers. There was a need to address easy access, culturally relevant materials, and sample videoed lessons. The teachers also emphasized the need for targeted support. Finding a project with a new approach for the teachers was not an easy task. However, after pondering the findings of this study, I developed the E-Math Learning Lab.

Initially, I wanted to make the E-Math Learning Lab as a full online support system. However, I weighed the pros and cons of full online PDs and then decided to make the E-Math Learning Lab a hybrid learning platform. I refined the project into having two full days of PD before the launching of the online version of the E-Math Learning Lab. The in person workshop would give teachers opportunities to interface with the proposed materials and online forum before being asked to take on the E-Math Learning Lab on their own. Another face-to-face aspect was a professional book study. While the project does not cover all aspects of mathematics across the primary grades, it can meet the needs of the teachers, as expressed in their interviews.

Reflecting on the development of the lab also highlighted the importance of thinking things through and ensuring that they are realistic in scope. I mentally conceptualized the E-Math Learning Lab and discovered that the development of the lab was a rigorous process. I spent hours reviewing the mathematics curriculum and supporting power mathematics resources to ensure that the proposed activities were culturally relevant and in line with the curriculum. More importantly, I spent time analyzing the findings of the research and the current reality of the teachers.

The development of the lesson rubric was also a challenge. I had to revisit the review of literature on the components of the RME framework. Accuracy of the RME rubric was important. It was essential for the rubric to be clear, as it will be like the RME manual for best practice in teaching mathematics. Most importantly, I had to ensure that the project was clear enough to be implemented by anyone.

The project evaluation was another area that I considered deeply. While teachers could give their feedback and ask for support throughout the process, the overall evaluation of the project was guided by the concept of an outcome evaluation model and appreciative inquiry. These two project evaluation methods were chosen after searching the literature on project evaluation. Outcome evaluation measures if a project meets its set goals. On the other hand, the use of appreciative inquiry will ensure that the feelings and experiences of the participants are collected and used to refine the E-Math Learning Lab. The complete evaluation will take place at the end of the academic year in which it was implemented. The E-Math Learning Lab is a new PD model for the teachers.

Professional Growth

I could not have understood and respect the doctoral journey without undertaking it myself. Looking back on the process, I am awed at how far I have come over the past 5 years. The most significant gain is the shift in my writing style and quality. I possess the gift of oral articulation but underestimated my ability to write as a scholar. Today I am happy to see how my writing has improved. I must mention that my transformation was not without challenges and setbacks. Yet, I have managed to pull myself through the process to begin writing at the graduate level.

As it relates to my growth as a researcher, I am now more aware of the overall research process, but more so about qualitative research. I have conducted other research but never at this level. As I navigated the research process in this study, I came to recognize that I lacked some basic knowledge as to how to analyze qualitative data. Hence, the data analysis of this research was the most challenging aspect for me. I sought support and guidance in this area and was able to master the process after collecting data from the field. Astoundingly, I am now supporting undergraduate students in qualitative action research. I am very excited to continue perfecting my craft as a researcher and a scholar. I am also excited to use the knowledge garnered from researching Year 1 teachers' competency, confident and self-efficacy in implementing the RME framework to support teachers within my local setting.

Reflections on the Importance of the Work

This research finds its significance in the fact that at the time of this study, some students in the local setting were not meeting their mathematics targets. Teachers had wavering competence and competence in their ability to teach mathematics, using the RME framework in an inquiry-based model. Hence, this research and project hold a high level of importance to the local setting and me. Through this research, policymakers, mathematics specialists, coaches, and school leaders will have a baseline understanding of the PD needs of the teachers. For the first time, all stakeholders will have organized data that captured the teachers' voice and their lived experiences in implementing the RME framework.

Moreover, the E-Math Learning Lab is a revolutionary way of offering PDs in the local setting. Teachers will benefit from the focused PDs and targeted support that they may receive in order to improve their instructional practices. Ultimately, the students will receive better quality teaching to advance their learning of mathematics.

The knowledge and skills that I have gleaned from this project study have placed me in a position of knowledge about how to develop targeted PDs in online learning forums. Since the development of the E-Math Learning Lab, I have developed three other online forums within my school. I developed a Reading Café in SharePoint that will serve a similar purpose to those of the E-Math Learning Lab. I also developed a pilot E-Math Learning Lab in SharePoint for the mathematics lead to familiarize herself with Learning Labs.

As a special education needs coordinator (SENCO), I have developed an online forum called SENCOs Rose Room to collaborate with fellow SENCOs. The SENCOs Rose Room mirrors the components of the E-Math Learning Lab; however, the information and focus are different. My passion and quest for developing learning labs came out of this study. Not only am I able to develop these online PD platforms, but change the way that PDs are offered. I now see myself as an agent of change in the way team members collaborate and access professional learning. Most importantly, my research has the potential to start the conversation on how to improve the teaching and learning of Mathematics.

Implications, Applications and Directions for Future Research

Findings from the quest to understand Years 1 teachers' mathematical practices and self–efficacy in implementing the RME framework in their classrooms have added to the existing body of knowledge on the topic. In the local setting, the findings of this study can be used to understand better the reasons why teachers struggle and the type of support that they crave. The E-Math Learning Lab will provide a forum through which teachers can customize their PDs and access support.

Teachers' limited competency and confidence in teaching mathematics is not unique to the BOT in which this study took place. Therefore, this study may spark conservations among stakeholders across the Caribbean region where attainment in mathematics is of concern. Given that improvement in the teaching of mathematics is of concern to our regional partners, the E-Math Learning Lab may be used beyond the scope of this study to collaborate with other primary teachers in private schools and across the region.

Globally, researchers continue to seek information on teachers' self-efficacy in implementing the RME framework in primary grades. However, as previously stated, there has been no research in the featured BOT. Consequently, this research should be used as a baseline for understanding the challenges that some primary teachers face and the implication for practice. Furthermore, the proposed E-Maths Learning Lab should be used as a support hub for teachers to customize their PDs and collaboration.

Policymakers and school leaders must consider the needs of teachers when planning future PDs and in school support.

Social Change

If the findings of this study and the proposed project are used to guide the development of PDs for teachers, then their self-efficacy towards implementing the RME framework may improve. Considering that, there is a correlation between teachers' self-efficacy and their students' attainment, and then students' mathematical growth mindset and mathematical attainment may improve as their teachers become confident. Increased attainment in mathematics will boost the confidence of both teachers and students.

The office of education standards also publishes achievement in mathematics in inspection reports. If teachers do well in the teaching of mathematics, it will be published nationally in the report. Parents and the wider community will then see that public school teachers are employing effective strategies in the teaching of mathematics. The social change could be far reaching as the students move from primary to secondary and earn a level 1 or 2 passes in mathematics. Eventually, students will apply their mathematical skills to real life situations and their evolving physical landscape.

Applications

The findings of this research should be the driving force behind planning effective support for the Year 1 teachers in the local setting and employing the E-Math Learning Lab as the initial learning forum is recommended. After that, mathematics coaches and school leaders must modify the original content considering the evaluation data collected at the end of the implementation of the E-Math Learning Lab. In the second year, the E-Math Learning Lab must be extended to other grades.

Notably, teachers' lack competency and confidence in teaching mathematics are not unique to the BOT in which this study took place. Therefore, this study may spark conservations among stakeholders across the Caribbean region where attainment in mathematics is of concern. Given that improvement in the teaching of mathematics is of concern to our regional partners, the E-Math Learning Lab may be used beyond the scope of this study to collaborate with other primary teachers in private schools and across the region. However, the local setting must maintain control of the domain and content to be uploaded.

Recommendations for Future Research

The use of a qualitative approach to understanding teachers' self-efficacy in the application of the RME framework yielded valuable information about the instructional practices of the participants. The data collection process did not involve the use of lesson observation or other grade levels. Hence, future research should consider the use of lesson observation in order to provide a clearer understanding of the actual teaching and learning in the classroom. Lesson observation will also provide more data that are authentic to RQ 1, which focused on the current instructional practices of Year 1 teachers.

Another critical point for consideration is the vast amount of time that data collection took. Because the interview was used to collect data, I had to wait for the participants to decide on a convenient place and time to meet. Future research could consider the use of surveys in a quantitative approach. If the use of a quantitative approach is not deemed appropriate, mixed method research may be used. The use of survey research can be used to gather information from a wider population than just Year 1 teachers. Collecting data from all teachers will ensure that the local authority captures the voice of all primary teachers as it relates to their self-efficacy in implementing the RME framework. Additionally, a program evaluation should also be completed on the use of power mathematics resource. Evaluating the use of the power mathematics resources will help policymakers and the mathematics specialist to determine the effectiveness of resource.

Conclusions

The pursuit of understating seven Year 1 teachers' instructional practices perceived self-efficacy, competence, and motivation as it related to the teaching of mathematics using RME in four primary schools in a BOT yielded valuable information. Data collection involved documentation scrutiny and interviews. The findings in this qualitative case study were consistent with other studies on the implementation of the RME framework. The findings revealed that the teachers had wavering levels of confidence and competence when implementing RME framework. Although teachers praised the introduction of the new power maths resources as useful, they expressed that the constant change in the system continues to dampen their competence and confidence; hence, the teachers wanted constant changes to stop. They also wanted professional learning experiences that were in line with their specific needs. In this regard, the teachers suggested that the data from walkthroughs and formal lesson observations as the basis for planning professional learning.

The participants' instructional practices were mostly in line with the central principles of the RME framework. However, the findings of this study affirmed that most participants did not move beyond the lower levels of the RME framework. Some participants recognized the need to move children from directly entering the mathematics experiences through practical problem posing to making meaningful connections and mathematizing. Considering the existing gap in practice, the E-Math Learning Lab was developed to address the concerns of the participants and the noted instructional gaps from the findings. Teachers need further guidance and support on how to implement the RME. Additionally, the findings of this project study also highlighted the need for locally designed lessons scenarios and sample lessons.

The E-Math Learning Lab comprises of locally designed videotaped lessons, a teaching rubric, and culturally relevant lesson scenarios. Given that the E-Math Learning Lab was constructed in Google Classroom teachers can collaborate in the online and access self-paced professional development and personalized support. Teachers may also use the E-Math Learning Lab to reach out to their local coaches for face-to-face or online. The E-Math Learning Lab provided a learning platform for improving teachers' instructional practices, building their mathematical growth mindset, and fostering collaboration among colleagues. Ultimately, the teachers will become agents of social change who are highly motivated to teach mathematics and improve students' attainment.

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Appendix A The Project

Findings from the study on primary teachers' mathematical practices and self–efficacy in implementing realistic mathematics education revealed the need for more focused PDs and collaboration in the local setting. The findings of the study and related scholarly articles were used to develop an E-Math Learning Lab in Google Classroom. The presentations and documents below outlined the key details and implementation procedures.

This Presentation Includes:

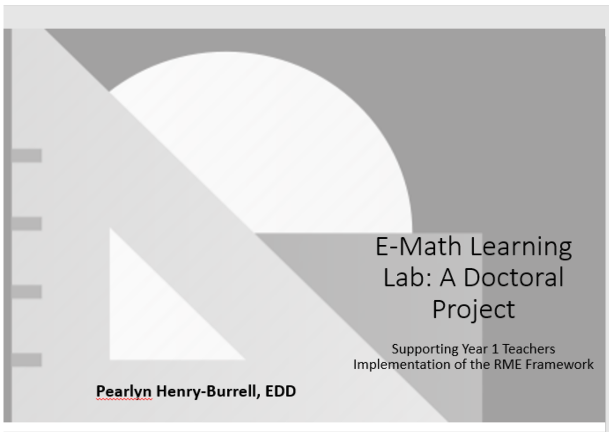
- An Overview PowerPoint outlining the findings of the research and the proposed E-Math Learning Lab to address the findings of the research.
- A detailed E-Math Learning Lab document with the purpose, goals, learning outcomes, and target audience.
- A document outlining the critical components of Google Classroom.
- A development curriculum, including itemized lists of the curricular components and details regarding the implementation of the E-Math Learning Lab.
- Video lessons covering the topics in Mathematics Curriculum.
- Mathematics Growth Mindset manual.
- RME Rubric/ Look Fors document.
- A book of local scenarios to contextualize Mathematics.
- Mathematics Growth Mindset Book study guide.
- E- Math Learning Lab evaluation questionnaire sheets for teachers and stakeholders who attend the PDs.

Peruse the materials in this section and see how best you can implement the E-Math Learning Lab. Feel Free to reach out to me with any questions or comments.

Data collected from interviews and document analysis affirmed that teachers needed more targeted PDs, their voices to be added to the development of PDs. Additionally, some participants indicated that they needed more local model lessons that they can access after face-to-face PDs. Consideration should also be given to the fact that most teachers expressed levels of confidence, competence and motivation with, most teachers only used the lower levels of the RME framework. The themes presented on the slides encapsulated the key findings of the study.

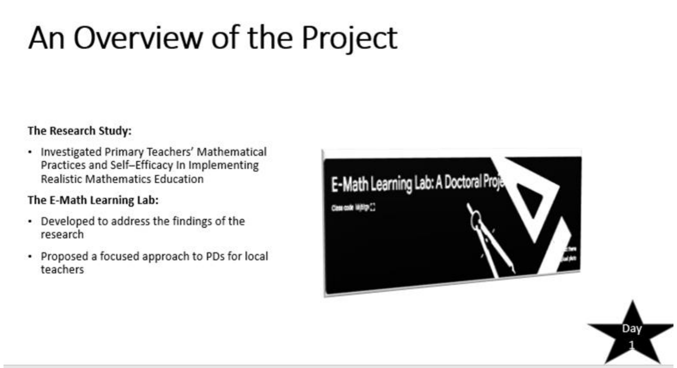
Introductory Presentation

PowerPoint Presentation



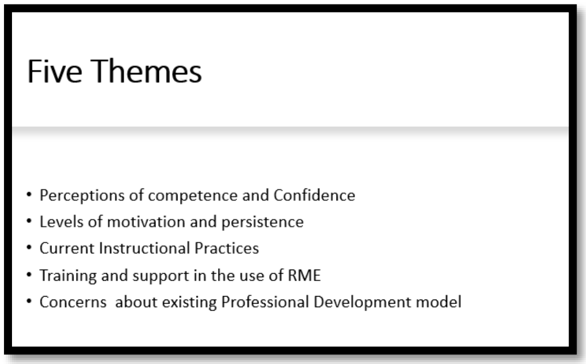
Slide 1

Note. All visible images were public domain unless otherwise indicated.



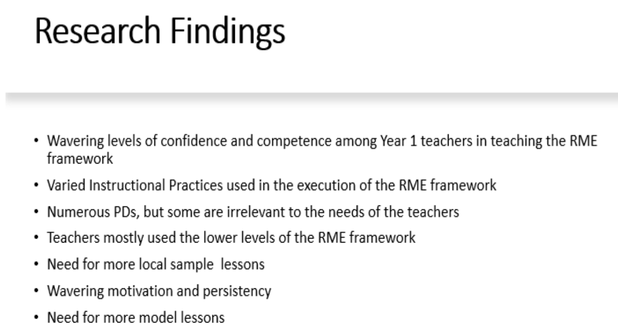
Slide 2

Notes. Data collected from interviews and document analysis affirmed that teachers needed more targeted PDs, their voices to be added to the development of PDs. Additionally, some participants indicated that they needed more local model lessons that they can access after face to face PDs. Consideration should also be given to the fact that most teachers expressed levels of confidence, competence, and motivation, with most teachers only use the lower levels of the RME framework. The themes presented in the slides below encapsulated the key findings of the study.



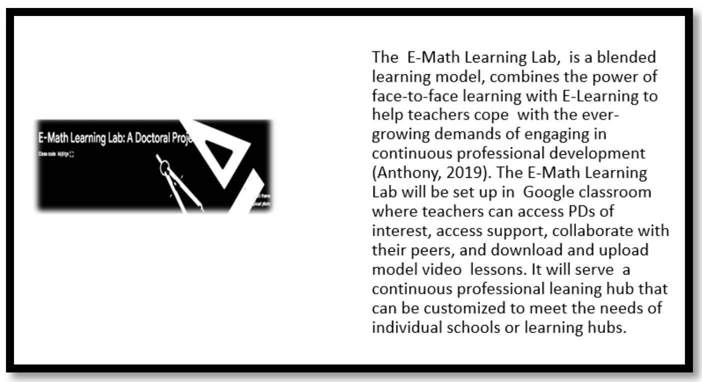
Slide 3

Notes. Data gathered from interviews and document analysis showed that teachers used a variety of teaching strategies, most of which are in line with the RME framework. However, most of these strategies are covered with the lower levels of the RME framework. Hence, lesson plans analysis affirmed that almost all teachers started their lessons with realistic experiences, provided opportunities for independent and collaborative learning, and attempted to question children about their thinking. Continuous PDs formed a part of the teachers' support system. Nevertheless, some teachers echoed the need for their voices to be part of the process as to what PDs provided. Also, sample lessons, as provided by power maths, should be customized to capture local practices and authentic experiences.



Slide 4

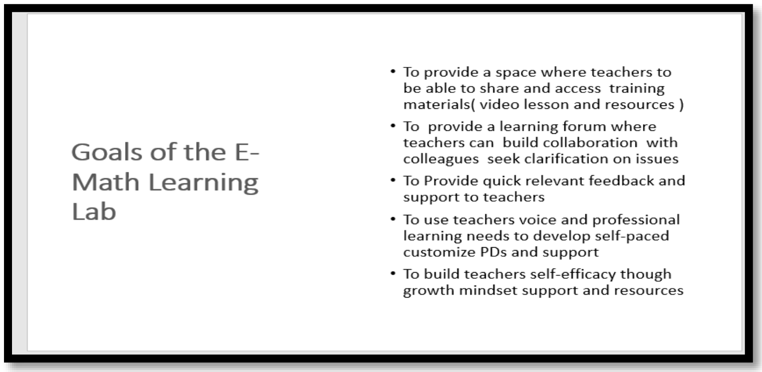
The slide above showed the key findings and provided an understanding as to why the E-Math Learning Lab was developed.



Slide 5

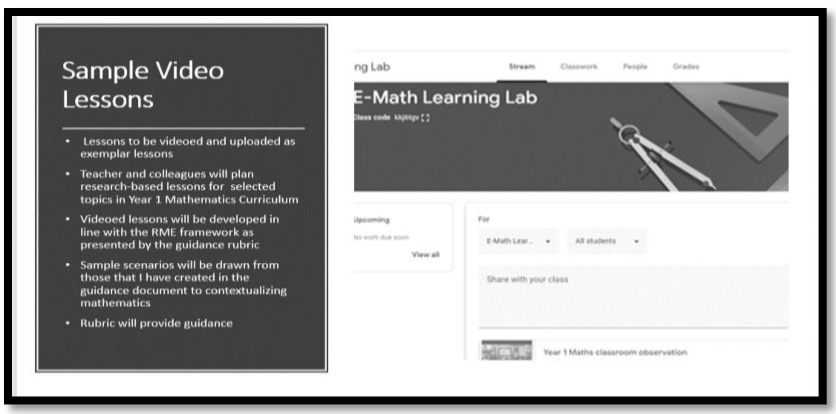
Notes. Connect the above slide with the findings so that participants can see the importance of the E-Math Learning Lab in addressing the findings of the research.

Notes. Discuss the above goals with the findings of the research and have the participants discuss if they see the connections and record their thoughts.



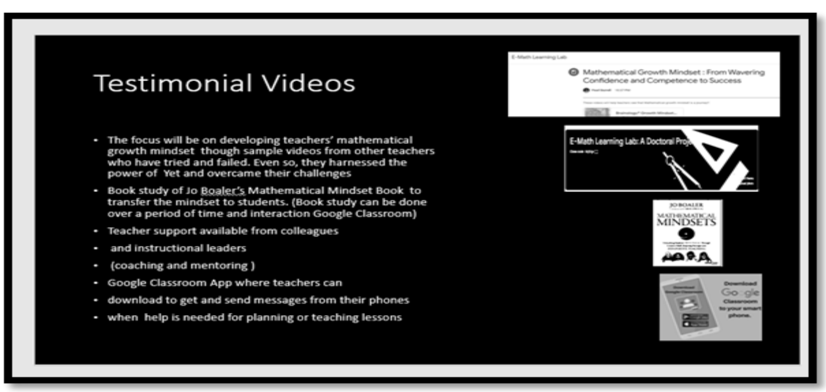
Slide 6

Notes. Review the components of the Learning Lab along with participant as they use their computers to navigate the portal as you speak. Refer to the handbook.



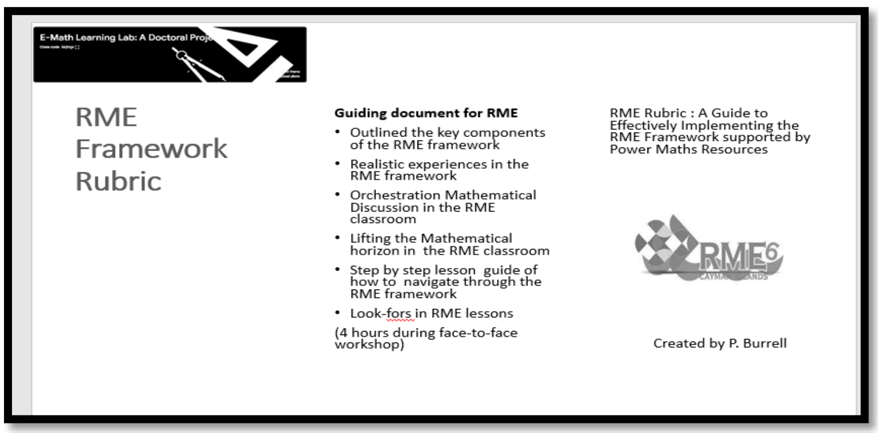
Slide 7

Notes. Discuss the model sample lessons and connect with the Rubric for RME. Let participants follow with their rubrics and dissect the lessons.



Slide 8

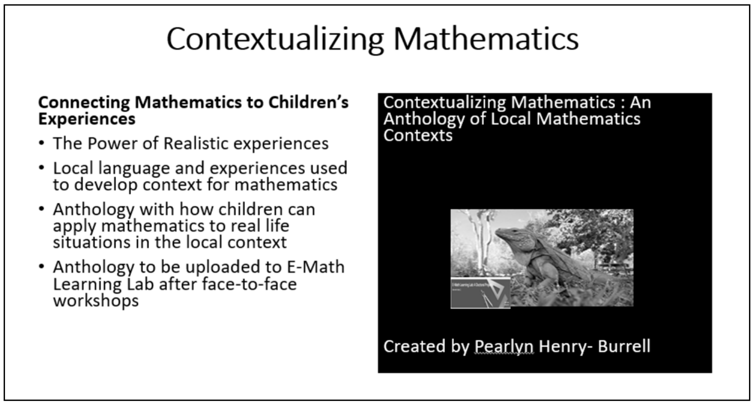
Notes. Discuss this slide with teachers' wavering levels of confidence and how we can support each other through the process. Introduce the *Growth Mindset* text and let the participants know what will be featured in the session. In upcoming slides, teachers will be guided on how they can upload videos to the E-Math Learning Lab. The Guide will provide specific guidance. Also, talk about Google Classroom for a mobile phone.



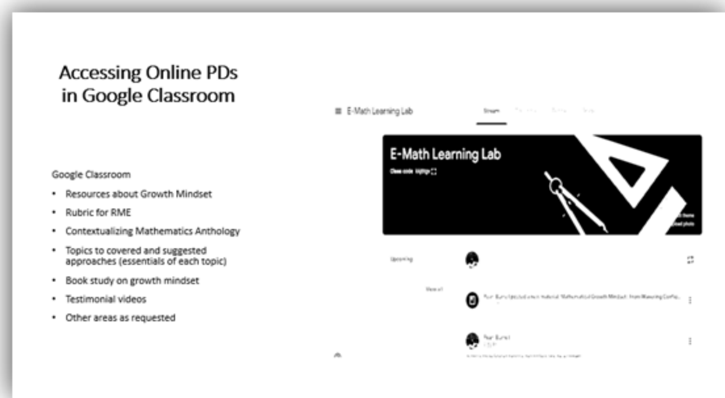
Slide 9

Notes. Talk about the RME and the various components. Connect with findings research and talk about the varied instructional practices that were found during the research. Ask participants to discuss. Support slide with the RME Framework Rubric and discuss components of the RME framework rubric and how to apply.

Notes. Acknowledge that the need for contextualizing mathematics and connect to data from research and the need to address this concern. Have teachers go through the booklet and see how they can connect the information to their classroom experiences.

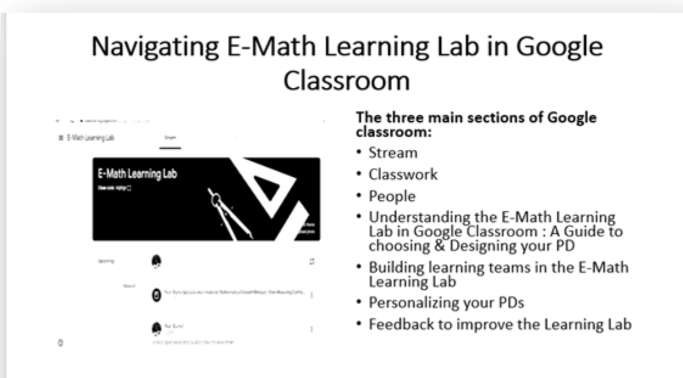


Slide 10



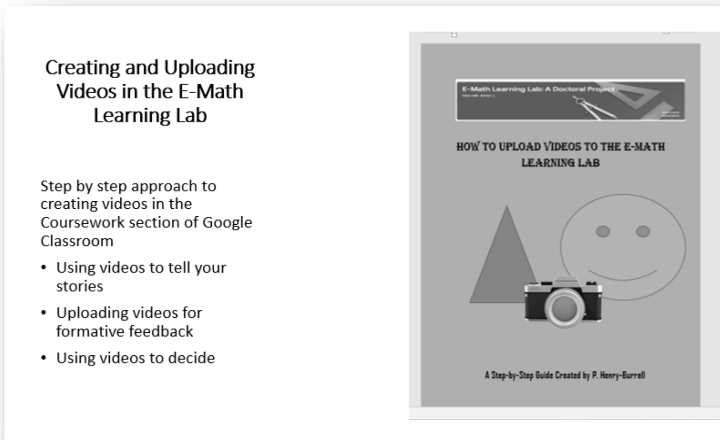
Slide 11

Notes. Talk about the need for targeted PDs and explore how teachers can access PDs online as well as request personalized PDs online.



Slide 12

Notes. Give opportunity for practice and let participant follow online with their laptops.



Slide 13

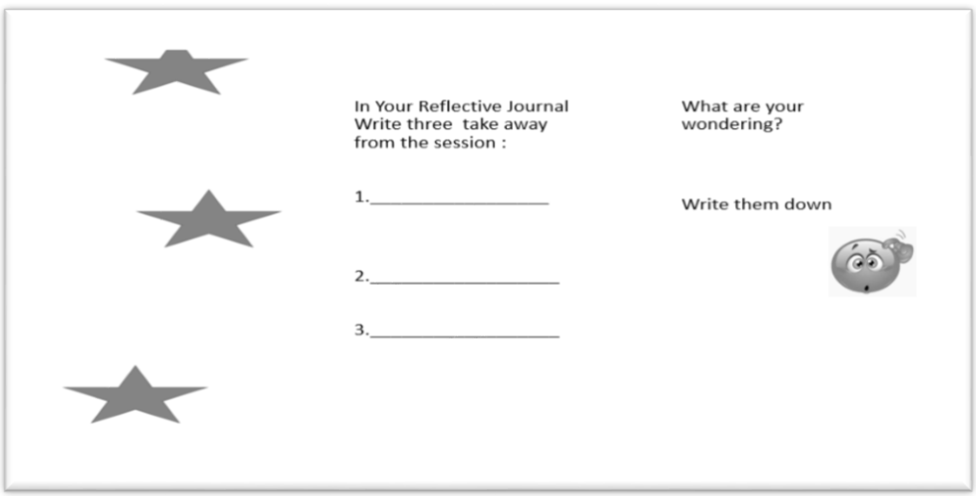
Notes. Talk about how to upload videos in the E-Math Learning Lab. Use both the RME Rubric and Guide on how to upload videos. Emphasize the quality of lessons that should be uploaded using the RME Rubric as a guide.

Slide 14

Provide opportunities for participants to practice accessing the different parts of the lab.

Slide 15

Notes. This slide should be used to help teachers to understand how to send an email to their colleagues or reach out to a mathematics coach privately. The private email feature is vital, as it allows the teachers to seek support privately and for coaches to reach out to individual teachers to provide targeted support.



Slide 16

Notes. This slide was designed for beginning the reflective process and gathering the teachers' thoughts. Review the critical points on Slides 6& 7. Hand out journals and discuss the purpose of having a reflective approach to teaching. Participants should write their responses to the prompts on the slide. Reflective journals should be used for the duration of the E-Math Learning Lab.

The E-Math Learning Lab

The E-Math Learning Lab is a continuous blended support approach that is designed in Google Classroom to address Year1 teachers' professional development needs in a British Overseas Territory. The fundamental purposes of the E-Math Learning Lab were to address the need for:

- Easy access to individualized and group professional development.
- More meaningful team collaboration.
- Research-based mathematics activities that can reflect the local language and scenarios.
- Access to local videoed mathematics lessons that focus on questioning and problem solving in the RME framework.
- Formative feedback to guide the development of future PDs.
- An app where teachers can send both private and public messages requesting help or clarification, and a mathematical growth mindset (the use of video testimonials).

The E-Math Learning Lab was developed after perusing the literature on effective professional development to address the issues raised by the teachers. While literature played a pivotal role in the development of the project, the findings from the primary teachers' mathematical practices and self-efficacy in implementing realistic mathematics education framework were the primary source.

The E-Math Learning Lab is comprised of the following components concerning the identified needs of the Year 1 teachers:

Sample video lessons. Local lessons will be videotaped and uploaded in the Google Classroom. Research affirmed that the inclusion of videos in professional development could provide guidance and support for teachers who want to improve or change their classroom practices,

An RME rubric. The rubric outlines the essential components and steps to be followed in the execution of an effective RME lesson. It can also be used as an evaluation document to see what aspects of a lesson were present or absent from a lesson.

Four face-to-face and online book study group sessions on developing mathematical mindsets. Each book study session should last for two hours during term 1, starting in August during teacher in service sessions. The featured book will be *Limitless Mind* by Jo Boaler.

An anthology. An anthology of realistic scenarios aligned to the topics covered in Year 1, written in local language and captured local scenarios to improve contextualizing mathematics

Testimonial videos. In additional to model lessons, testimonial videos, I will include videos in the E- Math Learning Lab. Testimonial videos could help boost teachers' confidence.

Research-based articles. Research-based articles for teachers to build their own knowledge base learning skills in the teaching of mathematics. Mathematics leads should carefully select research articles.

A guidebook. The guidebook will contain strategies on effectively choosing & designing PDs in line with Lesson Observation, Needs of learners and personal needs.

An app. Teachers can choose to download and use the E-Math Learning Lab app to send both private and public messages to request intensive support

The E-Math Learning Lab will, which I explicitly designed in line with the findings of this research, has four main goals:

- To provide teachers with an organized online support system where they can access local model lessons in line with the current mathematics curriculum.
- Use Google Classroom an already established online space, to communicate with colleagues and specialists about the challenges that teachers may be experiencing in the teaching of a topic and get targeted support.
- To build teachers' mathematical growth mindset through professional articles and testimonies of colleagues who overcame challenges and how they grew through the process.
- Provide local sample mathematical scenarios that use the local language of learners, rather than those that are British based, to help teachers to better contextualized learning.

Implementation of the E-Math Learning Lab has the potential to elevate teachers' self-efficacy and competence in implementing the RME framework and the teaching of mathematics overall. A through the description of the E-Math Learning Lab is outlined in the document; these include:

- The key players and their responsibilities.
- The needed resources and equipment.
- The key content of the E-Math Learning Lab.
- The sequence for the face to face sessions.
- An implementation schedule.

- An evaluation measure for the E-Math Learning Lab.

Some essential documents are attached. These include a RME rubric, an Anthology of local mathematics scenarios, a manual of how to navigate the E-Math Learning Lab in Google Classroom, a sample questionnaire instrument for teachers and other relevant stakeholders to use when evaluating the impact of the E-Math Learning Lab, and teaching plans for lesson study and book study sessions. Details of the major players' roles and responsibilities are outlined. School and mathematics leaders should take the main lead in implementing the use of the E-Math Learning Lab within their schools. Additionally, school leaders should work with their senior school improvement officer and head of professional development to ensure that training is published on the monthly PD calendar sent to public schools. Putting the PD sessions for the E-Math Learning Lab on the PD calendar will ensure that prospective participants across the country become aware of the scheduled meetings.

School leaders and mathematics instructional leaders must be committed to helping staff scheduled team collaborations and supporting them through the process in planning their PDs using the data gathered from students' assessment results, lesson observations, walkthroughs and the teachers' own identified needs. Given that each school gets a budget, school leaders will need to ensure that they source any needed Mathematical Minds books titled *Limited Minds*, before the start of the Fall Term in August. Furthermore, there is also a need for the mathematics lead to use comments and evaluation results from teachers to update or revise the learning lab. The management of the E-Math Learning Lab should be committed to the mathematics lead/coach within each school. The mathematics lead/coach will be called upon from time to time to provide individualized or group support. Sharing the responsibility of the E-Math Learning lab will ensure that no one else is overburdened with its management.

There is a list of resources and materials that will be needed for the E-Math Learning Lab. Notably, the schools have the essential resources needed for the implementation of the E-Math Learning Lab. All teachers have access to a personal laptop and internet access. However, there may be a need for more books for the book study.

The implementation guide for the E-Math Learning Lab can be found in this section of the study. The Lab can be implemented immediately, once the time is available for the introductory presentation during August’s planned PD session. The E-Math Learning Lab should be up and running by the end of term 1 if principals permitted their instructional mathematics leaders to oversee the running of the E-Math Learning Lab within their schools or learning hubs.

The progression of support offered through the E-Math Learning Lab is outlined in this project study. The outline includes face to face support, the introductory presentation, and book study sessions. There will also be a focus on the RME rubric and how it can be used to advance the teaching of mathematics using the RME Framework. Lesson study could be done either at individual schools or in learning hubs. Hubs are preferred in schools with a single stream. If this is done, teachers could have another grade level partner to collaborate. Lesson studies will also be featured in the E-Math Learning Lab. As such, mathematics school based instructional sessions will include focused support from mathematics instructional specialists. The support will be aligned with the topics to be covered in the current Year 1 curriculum. Teachers could also access personal support face to face or via the E-Math Learning Lab, where they can schedule via email. Different persons will have different responsibilities. The responsibilities are listed below:

School leaders.

Working with the Professional Development lead, senior school improvement officers and school principals should work together to ensure that the E-Math Learning Lab introductory PowerPoint presentation is scheduled for the in service session in August.

August.

- Encourage/Allow teachers to attend the planned face to face PDs to support the launch of the Learning Lab.
- Provide segments in school staff meetings to collect feedback on E-Math Learning.
- Work along with teachers, mathematics instructional leads/coaches to develop personalized PDs for teachers based on data collected from lesson observation and walkthroughs.

Mathematics instructional leaders/coaches.

- Photocopy PowerPoint presentation of the introductory session for E-Math Learning Lab.
- Booklets with sample scenarios, and RME checklist.

- Develop E-Math Learning Lab in Google Classroom before the introductory session.
- Provide support to teachers within their schools to access the E-Math Learning Lab.
- Design sample lessons with teachers for E-Math Learning Lab and upload
- Print all handouts for instructional sessions.
- Print questionnaires for teachers who would like to use paper-based.
- Upload all electronic copies of manuals to Google Classroom.
- Maintain an active presence in the E-Math Learning Lab in order to support teachers.
- Coordinate all hub meetings to ensure the teachers can collaborate both online and face to face, as requested by teachers.
- Make sure all teachers have their laptops ready for demonstration during instructional sessions and support those who need support.
- Get textbooks for Book Study and conduct book study with teachers.
- Work with principals to design lessons on E-Math Learning Lab in order with data collected from lesson observation and walkthroughs.
- Observe lessons and provide feedback to teachers in line with the RME rubric.

Teachers.

- Accept the invitation to join class E-Maths Learning Lab in Google Classroom.

- Work with school leaders and mathematics instructional leaders to develop their personalized PDs in E-Math Learning Lab.
- Maintain weekly contact with mathematics instructional leaders within the E-Math Learning Lab.
- Take part in two face to face workshops prior to gaining full access to the online forum.
- Plan lessons following guidelines given by instructional leaders and the RME rubric.
- Engage in online PDs in Google Classroom and comments about uploaded resources.
- Lastly, teachers will be asked to provide summative feedback on the workshops and E-Math Learning Lab.

Technical support.

- Be available to support teachers who may have technical challenges navigating the E-Math Learning Lab.

Students.

- Exhibit positive behaviors for learning.
- Apply taught strategies in the learning process.
- Collaborate with peers during whole class interactivity.

Note. The E-Math Learning Lab is a blended model PD support system. This system can be customized to meet the needs of the schools.

Needed resources, materials, and equipment.

For face to face introductory presentation.

Equipment: Available at all Local School:

- PowerPoint Projector/Promethean Board.
- Photocopier/Printer.
- Laptops.
- Wireless internet access.

Materials (available at all local schools).

- Printer ink.
- Printer Papers.
- Participants' individual folders.
- Photocopied presentation.
- RME Rubrics.
- Manuals for as outlined in the presentation.
- Guidebooks photocopied.
- Booked room for the presentation.
- Electrical connections for laptop computer.

Face to face book study

- PowerPoint Projector/Promethean Board.
- Photocopier/Printer.
- Laptops.

- Wireless Internet access.
- *Limitless Mind* by Jo Bowler (one for each participant).
- Copies of presentations for teachers to follow.
- Book study guidance notes.
- Evaluation sheets for all participants to evaluate session.
- Reflective journal for each participant.
- Resources uploaded to E-Math Learning Lab.
- Booked room in the school for PD session.
- E-Math Learning Lab set up in Google Classroom for teachers to access.
- Highlighter for teachers to highlight sections of text.

Worksheets for session 3 sessions

***E-Math learning lab online**:*

- Access to Google Classroom.
- Wireless internet access.
- Teachers' email addresses (Gmail).
- Technician support to help with any difficulties those teachers may have.
- All resources listed in the electronic form to be uploaded to E-Math Learning Lab.
- Questionnaires to collect data on the effectiveness of E-Math Learning Lab.
- Video camera for videoing lessons during lesson study.

Resources (financial)

- Money to purchase copes of Limited Mind text.
- Money to by refreshments for participants during face to face meetings.

Notes. *Most schools already have most of the resources, materials, and equipment listed above.*

A suggested implementation timeline is outlined below. The school leaders and or mathematics lead should manage the implementation process. Modifications may be needed from school to school, based on the needs of the teachers.

Proposed Implementation Timeline.

At the beginning of the academic year (August):

- Set up E-Math Learning Lab in Google Classroom.
- Send emails to teachers about how to join Google Classroom
- Upload all documents to the E-Math Learning before the introductory presentation.
- Check with PD coordinator to ensure that E-Math Learning Lab is added to the training calendar.
- Print and photocopy all resources needed for the introductory session.
- Ensure that the ICT personnel are aware of the program and how he/she can support it conduct the introductory PD to the E-Math Learning Lab.

Within the first term (September-December).

- Begin book study to build confidence -Mathematical Mindset (session 1).
- Discuss RME rubric so that teachers become aware of best practice.
- Arrange online /coaching sessions for teachers to access as needed.
- Upload all research based article links to Learning Lab for self-directed learning.
- Prepare journal books for teachers to begin documenting their process.
- Encourage teachers to engage in lesson study via E-Math Learning Lab.

Within term 2 (January-April).

- Conduct Book Study (session 2) upload session outline to E-Math Learning Lab for teachers to access prior to face to face meeting. Upload PowerPoint presentation to Learning Lab.
- Upload RME video lessons for teachers to see, comment on, and seek clarification. Direct teachers to rubric online.
- Be available for online support and consultation in helping teachers to navigate term 2 topics. Use RME rubric and local scenarios booklet.
- Plan draft support with teachers using results from term 1 walkthrough, lesson observation, and students' assessment data. Upload lessons to the E-Math Learning Lab for an interactive process.
- Conduct a lesson study observation to see the implementation of RME. Upload videos to E-Math Learning Lab for community analysis with rubric.
- Review local scenarios booklet through the E-Math Learning Lab (use review rubric to guide the process).

- Add resources as requested by teachers.
- Monthly update in a staff meeting about E-Math Learning Lab.
- Gather term 2 formal lesson observation data in preparation for targeted support in term 3.

Within term 3 (Mid-April, May & June) session 3 of book study

- Upload PowerPoint Presentation to E-Math Learning Lab.
- Upload evaluation rubric for lesson study to E-Math Learning Lab.
- Upload findings from term 2 walkthroughs and formal lesson observations for teachers to discuss the support that they may need via private emails.
- Upload questionnaire for teachers to give their perceptions of and experiences with the E-Math Learning Lab survey.

May-June

- Collect, analyze, and discuss findings from questionnaire data in the final staff meeting of the year with staff.
- Use findings from questionnaires, observations, and reflective journals to revise E-Math Learning for next academic year.

Scope and Sequence Model for E-Math Learning Lab.

The following areas of the E-Math Learning Lab should be available in various terms of the academic school year.

Introductory presentation. Should be available both face-to-face and online. All components of the introductory presentation should be available in the E-Math Learning Lab after Term 1. The face to face should only be available in Term 1.

Professional book study. The book study should begin in Term 1 and last throughout the academic year. All book study sessions should be face to face with resources available online through the E-Math Learning Lab.

Model lesson study. Lesson studies should be both face to face and online. Analyzing model lessons should be across all three terms. Lessons should be uploaded to E-Math Learning Lab for teachers to analyze.

Research articles. Research articles should be available online only. Teachers and mathematics coach should purposefully select articles. Coaches should begin adding articles to the E-Math Learning Lab in Term 1.

Evaluation Timeline.

Due to the design of the E-Math Learning Lab, teachers will be able to use the Stream section of Google Classroom to provide formative feedback on what is working well for them, as well as further support that they need in order to improve their practice. However, the overall evaluation of the E-Math Learning Lab will be done towards the end of the academic year that it was implemented. The timeline for the overall evaluation was chosen for May to June as teachers would have eight full months to interface with the Lab and become more competent with its usage.

Instrument and data collection. Data will be collected using questionnaires that are aligned with the E-Math Learning Lab. The development of the survey was guided by the purpose of the E-Math Learning Lab and the two evaluation questions:

Are the Year 1 teachers who participated in the E-Math Learning Lab feeling more confident and competent in implementing the RME framework and supporting power maths resources, aimed at improving children's problem-solving and arithmetic skills?

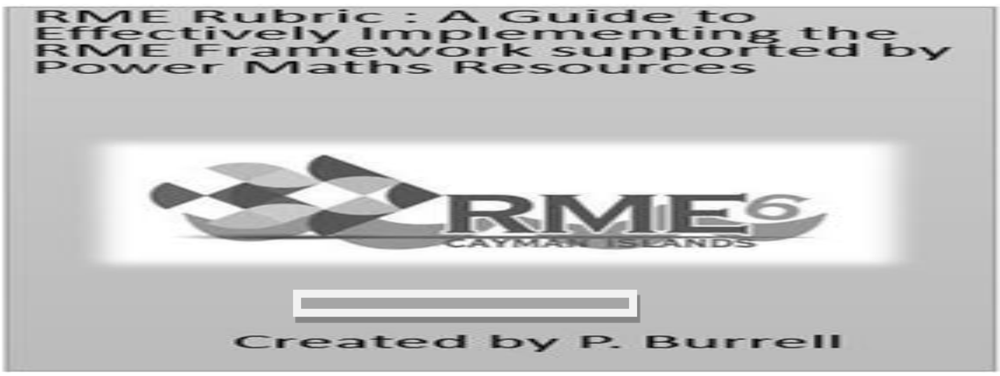
Are the Year 1 teachers who participated in the E-Math Learning Lab feeling more positive about the quality and focus of mathematics professional development?

Data collection will be done using a questionnaire. The questionnaire will be uploaded in Google Classroom at the beginning of May. This gives participants a total of two months to complete the questionnaires. The participants will privately email their responses to the school leaders or Mathematics Instructional Leads. The instructional leaders will also have the option of downloading the questionnaires and distributing them to their Year 1 teachers. They will then have a drop box where participants drop their responses without being named. The data collection process must be completed by the end of June, of the school year of in which the E-Math Learning Lab was implemented.

Key stakeholders. Responses from the questionnaires will go to Mathematics Instructional Leads and school leaders so that they can use the feedback from the Year 1 teachers to refine their own customized E-Math Learning Lab. Information should be collected on all aspects of the E-Math Learning Lab-lesson study, testimonial, email support, individualized PDs, book study, and streaming. Data collected from the participants should be used to prepare a document called, The Current State of Mathematics Teaching at the Year 1 Level.

Realistic Mathematics Teaching Rubric

A critical element of the E-Math Learning Lab is supporting teachers for teachers to teach mathematics using the RME. Hence, a rubric was developed. The sample cover is shown below.



See details of rubric below: Rubric/ Look Fors should be used during the planning of lessons and as a guide for assessing key areas of lessons during observations.

Primary School
Realistic Mathematics Education Lesson Planning Rubric & Look-Fors

Realistic Mathematics Education Defined

The idea of realistic mathematics in our context refers to active learning that is in line with inquiry-based learning. In this paradigm, children play and active role in their learning as they navigate the learning path though a series of contextualized planned learning activities. Each activity lifts the learning to a higher level of understanding and mastery. Significantly, the learning starts at a low level so as to engage all learners and move them to a higher domain. The Power Math resources used in the local setting provided textbooks that are designed to connect children's own understanding to more sophisticated and formal ways of doing mathematics.

Set-Up

- teacher working with whole group (at beginning of lesson) or small group of children (generally 4 to 6 during practice stage of lesson) using focused scenarios and activities to solve contextualized problems
- children articulating their solutions in whole or small groups and justifying their thinking
- children who are not working with the teacher in guided learning are working productively in learning groups or independently completing their given tasks through discovery and application of learned concepts

Rubric/ look-for continued

Setting the Stage

- ☐ teacher creates a classroom culture where children feel safe to express their thoughts, even if they are different from their peers'
- ☐ teacher ensures that scenarios are relevant to children's everyday experiences and mathematics outcome
- ☐ teacher begins lesson with a strong, but brief, contextualized problem-based scenario for children to think about and solve
- ☐ teacher encourages the children to discuss the problem-based scenarios and support the children in any areas of challenge by effective question posing, but leaves a few challenges to overcome during the lesson
- ☐ Prepare atmosphere and rules for discussion

During the Lesson

- ☐ begin lesson with a realistic problem-based scenario
- ☐ use suitable mathematical models found in real life to support realistic problem-based scenario
- ☐ explain realistic problem-based scenario to those who need further support
- ☐ encourage whole class or group-based interactivity where children collaborate with their peers to solve the problem-based scenario
- ☐ teacher seeks multiple solutions to problem-based scenario and compare responses
- ☐ teacher deflects responses and have children compare and justify their thinking/ answers
- ☐ teacher clearly selects answers and use them to support and extend children's thinking
- ☐ teacher elicit, support and extends children's thinking through leveled open-ended questions that are closely related to real life situations
- ☐ if necessary, teacher supports struggling learners using mathematical models and guided questioning
- ☐ teacher provides levelled tasks for children to consolidate their leaning and connect realistic problem-based experiences to mathematical concepts and arithmetic calculations. Power Math Resources can be used at this stage of lesson
- ☐ teacher monitors students' activities when solving problems/doing tasks and encourage children to make connections among concepts
- ☐ teacher provides feedback and encouragement and
- ☐ teacher assesses children's successes and challenges to inform future instruction

After Main Lesson

- ☐ teacher provides opportunity for children to reflect on the lesson and chosen strategies (whole group, partner, or individual)
  - o discussion of problems solved, and strategies used
  - o sharing of exemplary problem-solving skills/strategies
  - o discussion of challenges encountered and how they were overcome
- ☐ teacher provides opportunity to extend and respond to any
  - o queries that children may have
  - o further support needed
- ☐ teacher supports investigation of new concepts, mathematical vocabulary and problem solving in greater detail
- ☐ teacher assesses students' understanding of mathematical concepts and procedures though questioning or assigned tasks

Supplement 2: Anthology of Local Scenario

The purpose of this anthology is to provide a range of suggested local scenarios that teachers can use to connect learning contexts to children's everyday activities or real world experiences. Teachers can use the base provided to connect as appropriate with related lessons.

Table 1A

Year 1 Mathematics Lesson Sequence and Suggested Local Scenarios: Autumn Term

Unit	Mathematics Strand	Suggested Local Realistic Scenarios
Unit 1	Number to 10	• Scenarios related to blue iguanas at local botanical garden or on [redacted] farm. • Scenarios related to rock iguanas in [redacted]. • Problem based scenarios related to turtles at local Turtle Farm. • Problem based scenarios related to tourists visiting the local Turtle farm or Dolphin Cove. • Problem based scenarios related to going to movies at the local theater in [redacted].
Unit 2	Part Whole relationship within 10	• Most of the above scenarios in Unit 1 can be used in other units • Talk about tickets to local cinema. • Connect scenarios to going to [redacted] Park. • Talk about taking local school drivers taking them on field trip to the Dolphin Cove.
Unit 3	Addition and Subtraction within 10	• Create problem based scenarios related to shopping at [redacted] Supermarket • Connect problem based scenarios to going on a field trip to the airport. • Use Problem based scenarios related to visiting the local farmers' market in [redacted]. • Use problem based scenarios related to going to fast food establishments such as Burger King or Wendy's. • Connect problem based scenarios to caring for animals at the Humane Society or Paws Shop. • Connect problem based scenarios to going to the [redacted] Beach. • Connect problem based scenarios to packing shelves at [redacted] Supermarket.
Unit 4	2D & 3 D Shapes	• Connect problem based scenarios to building going on a shape hunt at [redacted] Park. • Connect problem based scenarios to needing 2D and 3D shape objects to build a pieces of equipment for their local playground. • Connect problem based scenarios to gifts for to their yearly Christmas gift and food drive. • Connect problem based scenarios to building toys for the children in Reception. • Connect problem based scenarios to building a shape city similar to that seen when they visited [redacted]. • Connect problem based scenarios to local need for architects to design houses along the [redacted] beach strip. • Connect problem based scenarios to design a bird cages for birds at the bird sanctuary in [redacted].

Table 2A

Year 1 Mathematics Lesson Sequence and Suggested Local Scenarios: Spring Term

Unit	Mathematics Strand	Suggested Local Realistic Scenarios
Unit 1	Introducing Length and Height	• Connect problem based scenarios to measuring a plot of land along [redacted] road to build houses. • Measuring a plot of land to plant flowers at the botanic garden. • Connect problem based scenario to number of picture frames needed for a given space in a new building at [redacted]. • Connect problem based scenarios to local building as it relates to tiling or fencing. • Connect problem based scenarios to finding the length of dock for fishing in [redacted]. • Connect problem based scenarios to their classmates' heights or classroom. • Connect problem based scenarios to designing playground resources for the Reception playground. • Connect problem based scenarios to working at [redacted] and was asked to measure pieces of materials to make a chicken coop. • Talk about length/ height of materials needed to make a bird bath for a given number of [redacted] Parrots.
Unit 2	Subtraction within 20	• All previous scenarios related to subtraction can be used. • Connect problem based scenarios to children moving to other school districts. • Connect problem based scenarios to families travelling for vacation. • Connect problem based scenarios to tourists returning to cruise ship. • Connect problem based scenarios to fishing at the [redacted] Dock. • Connect problem based scenarios to a safe length for an aquarium for dolphins at the Dolphin Cove.
Unit 3	Numbers to 50	• Connect problem based scenarios to any chosen ideas previously presented. • Connect problem based scenarios to local phonebook directory collection drive • Connect problem based scenarios to number of children taking school bus. • Connect problem based scenarios to number of tourist on a cruise ship. • Connect problem based scenarios to the number of craft vendors in the local craft market.

Table 3A.

Year 1 Mathematics Lesson Sequence and Suggested Local Scenarios: Summer

Unit	Mathematics Strand	Suggested Local Realistic Scenarios
Unit 1	Division	• Connect problem based scenarios to local place of interests, shopping experiences at local supermarkets, and visitors to islands. • Connect problem based scenarios to sharing lunches, snack and things use in their everyday lives. • Connect problem based scenarios to sharing among friends during play time. • Connect problem based scenarios to fitting sodas in to soda crate for shipping. • Connect problem based scenarios to putting bread from Captain's Bakery into a tray to bring to [redacted] Supermarket.
Unit 2	Halves and Quarters	• Connect problem based scenarios to dividing pizza from Domino's Pizza. • Connect problem based scenarios to eating bread from Captain Bakery with friends. • Connect problem based scenarios to travelers. • Connect problem based scenarios to persons boarding a plane or ship. • Connect problem based scenarios to visiting the Turtle Farm. • Connect problem based scenarios to visiting [redacted]. • Connect problem based scenarios to other relevant scenarios previously stated. • Connect problem based scenarios to buying at the farmers market. • Connect problem based scenarios to going on a picnic at the [redacted] Park.
Unit 3	Halves and Quarters	• Connect problem based scenarios to direction and position of local places of interest in the local community.
Unit 4	Numbers to hundred	• Connect problem based scenarios to any relevant scenarios previously stated. • Connect problem based scenarios to Pirate's Week. • Connect problem based scenarios to Batabano in the street. • Connect problem based scenarios to number of boys or girls in class, teachers, vehicles, and other related scenarios.

Local animals.

The blue iguana is essential to the BOT and can be used to create realistic experiences for children.

Figure 1A. Blue iguana.

Sample problem based scenarios.

- How many blue iguanas are at the Turtle Farm if each section holds X animals and there are X animals?
- Create a lesson focus that shows an iguana coming /leaving a farm with fruits and vegetables. Make a connection with plants or farms since most iguanas in the local setting quite often seen on local farms or at the local botanical garden.
- Ways of grouping a given number parrots, turtles, iguanas, turtles, or crabs to bring to the local Queen Elizabeth Garden.
- Animals can be compared/classified by sizes and colors. Connect to local contexts. For example, John went to Willie's farm and saw 12 iguanas,

- (show pictures of iguanas on farm) How could the farmer arrange them by size to bring them to the local botanical garden?

The local supermarkets

Including the local supermarkets within the learning of the children, provide an exciting way for children to make meaningful connections between mathematics and their experience of shopping with their parents. Most children have real experiences in food establishments. Hence, it is essential to bring it into their learning experiences.

Figure 2 A .Local supermarket.

Suggested problem based scenarios.

- Deciding how many items to be on a shelf of a certain size.
- Sorting foods according to type.
- Finding the right containers to hold a certain volume of objects.
- Calculating how much money needed to purchase a given number of items.
- Deciding the number of objects that can use packing coolers, shelves, crates, food in a basket.
- Calculating change from a sum of money.

- Solving how many coins can fit in a cash register that has a given amount of money.
- Deciding how much to pay for food at the deli.
- Solving the total number of items on a given shelving.
- Solving how much needed to make a sandwich, meat, or fruit platter for a given number of persons.
- Choosing the quantity of ingredients needed to make local dishes.

Local attractions.

Figure 3A. Local under water scene.

Most students make trips to local attractions. These trips could be as part of their curriculum or just relaxing with their family members. Whatever the purpose of their trips may be, they have some kinds of experiences about the local attractions or place of interest. Connecting children’s learning experiences to these places will ensure that they can make connection them more meaningful to the students.

Suggested Problem Based Scenarios:

- Solve problems related to paying to enter a place of interest.

- Deciding how many persons can go in a submarine from Atlantis Tour.
- Deciding how many tourists from a cruise ship fit in the Mission House at any one time.
- Using mathematical skills to decide the materials needed to build a fishing rod to go fishing in the east end of the BOT.
- Using arithmetic skills to calculate how much a given number of persons should pay the taxi driver to take them to a place of interest.
- Using arithmetic skills to calculate how much a given number of tourists should pay for lunch at Coconut Joe Any other local places can be added here.
- Number of people who can eat at a restaurant on Seven Mile Beach that has a certain number of tables with a given number of chairs.
- How can they use the given materials to build new benches for Dart Park?
- How many tourists could I fit in a room of a given size at Rum Point?
- A given number of tourists visited the Bat Caves in the Sister Island. If each tourist paid a given amount of money, how much did they pay in total?

Remember. Find local places of interests, connect to the topic to teach, and create problem based scenarios for the children to solve. This approach can be used for all units. The aim is to allow the children to feel connected to the problem based scenario that has been posed.

Figure 4A. Festivals and celebrations mask.

The BOT celebrates many events throughout the year. Most children and their parents take part in these yearly events. It is therefore essential to take these natural happening and make them part of the children realistic mathematics experiences. Just as how the children enjoy these events, they may come alive during their lessons. One of the primary purposes of RME is for children to reinvent their mathematics experiences through experiences that children can connect. Considering that children learn better, when they make meaningful connections, efforts must be made to bring the children's lived experiences into the learning arena.

Suggested problem based scenarios.

- Some visitors came from Cuba to celebrate Pirates' Week in the BOT. If these visitors came on six different ships, and each ship carried 30 visitors each, how can I find out how many visitors in total?
- Batabano was advertised for August if this month is January, how can I find out how many months I have left to prepare for Batabano?

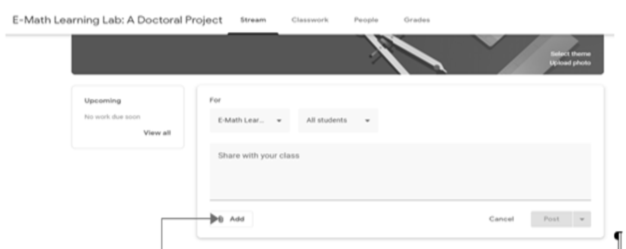
- For Pirate's Week vendors are allowed to sell along the street in George Town. If each the sidewalk is X meters long, each stall needs to be X distance apart. Help the event organizer to find out how many stalls can hold on each side of the street.
- A visitor to the island wants to find the best place to buy a costume for the upcoming Kaboo Music festival. She wants to buy X centimeters of fabric for her headdress and a certain amount for her dress if her dress takes twice amount fabric as her.
- Headdress and she used X amount for her headdress. How could we help her find out how many fabrics needed for her headdress and overall garment?
- Connect problem based scenarios to making a performance stage for Batabano.
- Connect problem based scenarios to collecting money from patrons who were entering the Coco Festival.

Continue thinking about how you can connect the local celebrations across the curriculum. Work in your hubs and in the E-Math Learning Lab to further develop your bank of scenarios related to the units and strands that you are teaching. See the connection table for some more ideas of local scenarios.

Uploading videos in E-Math Learning Lab using stream.

Step 1. Click on the Stream section of the E-Math Learning Lab in Google Classroom.

Step 2. To share with the class, click on the Add icon, as shown below:

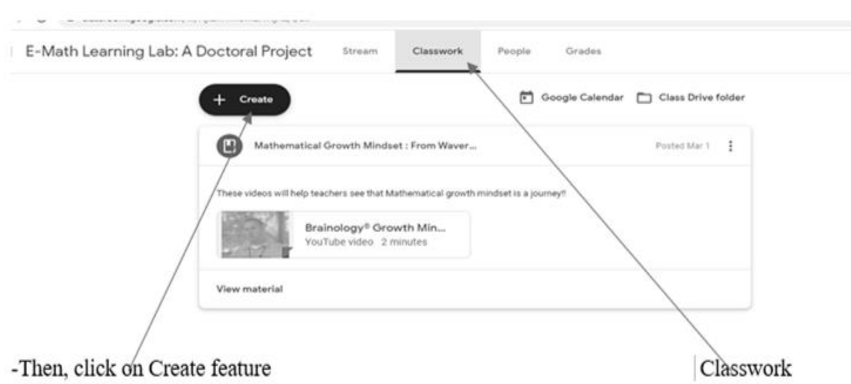


Click here to add a videos or other resources that you would like to share with your colleagues. A drop down menu will appear.

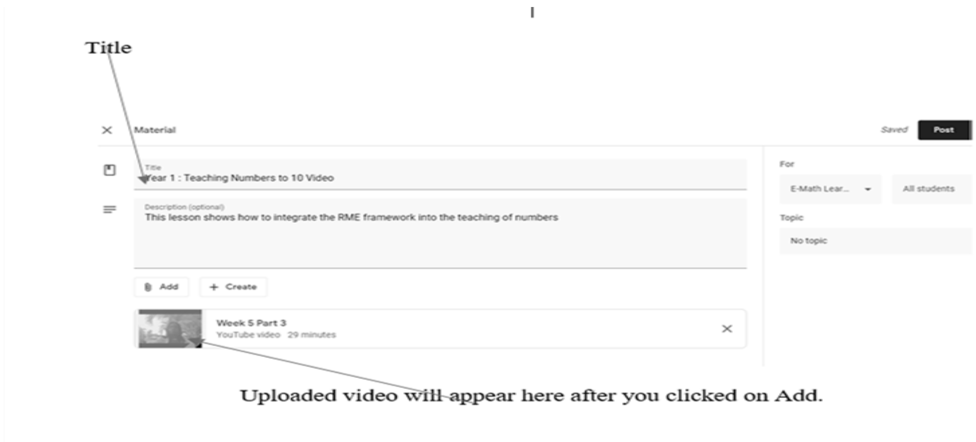
Step 3 : Select the place where the video or resources are stored from the drop down menu. See below:

Select where your video is stored . This can also be used upload other resources. Alternatively, videos can be uploaded using the Classwork Feature in the E-Math.

Follow the steps below. Select the Classwork feature, and the Create feature will appear on the left-hand corner of your screen in the E-Math Learning Lab. Click on the Create feature to start uploading.



Select Material from in the drop down menu and click to upload resources. You can add a title to the video.



The Create feature can be used to design Microsoft Office materials

Professional Development Plan

Supplement 4: reflective journal for the book study.

The purpose of this reflective journal is to capture the learning journey of Year 1 teachers as they seek to empower themselves in becoming more focused professionals who see themselves as teachers and learners of mathematics. The process of transformation will begin with a book study about how to defy the limits that teachers put on themselves and embrace a mathematical growth mindset. The book study spans one school year. The whole idea of connecting the book study to the E-Math Learning Lab is to ensure time is given for reflection and application of content learned at each session. The Lab provides an opportunity for a colleague to collaborate and self reflect before and after each session.

Session 1 Reflection		
Date :	**Time :**	**Place :**
This week we focused on:		
I used to think:		
Now I have learned :		
Now I will try to :		
Areas to focus on:		

Notes: Teachers will keep reflective journals until the end of the 3 sessions.

Session 2 Reflection		
Date :	**Time :**	**Place :**
This week we focused on:		
I used to think:		
Now I have learned :		
Now I will try to :		
Key take away :		

Notes: Teachers will keep reflective journals until the end of the 3 sessions.

Session 3 Reflection		
Date :	Time :	Place :
In this Book Study we focused on:		
I used to think:		
Now I have learned :		
How I will use the information learned to improve my practice		
Summary of Impact of Book Study	What went well:	
	What needed to be improved :	

Notes: Teachers will keep reflective journals until the end of the 3 sessions.

Notes. Teachers will keep reflective journals until the end of the three sessions.

Supplement 5. Book study outline and PowerPoint presentations.

Featured Text. Limitless Mind: Learn, Lead, and Live Without Barriers (Boaler, 2019)

Session 1. Outline Duration three hours of face to face

Objectives.

- To build a growth mindset through research based information from the featured text.
- To collaborate as a learning community to apply research based information to self and real life context, to enhance their self-efficacy.
- To develop an understanding of how teachers can set children up for success when they embrace the Growth Mindset idea.

Materials needed.

- Featured text.
- PowerPoint.

- Laptop and projector for the presenter.
- Journal books printed and ready for distribution.
- Chart paper for teachers to record their thoughts and for KWL Chart.
- Post-its.
- Flipchart markers.
- I Saw, and I Wondered Sheets (1 per participant).
- Handouts for activities (tables to be completed).
- Mason jars to use as affirmation jar.
- Colored popsicle sticks (craft sticks).
- Closed container for completed cards.
- Video for videoing the session.

Before session.

- Everyone reads the featured text before the meeting /will be available in E-Math Learning Lab as well as hardcopy.
- Read: Chapter 1: How Neuroplasticity Changes Everything.
- Chapter 2: Why We Should Love Mistakes, Struggles and Even Failure.
- Read the introduction about the six keys and write three takeaways, confusion, or questions that they may have.
- Be ready to share with their colleagues.

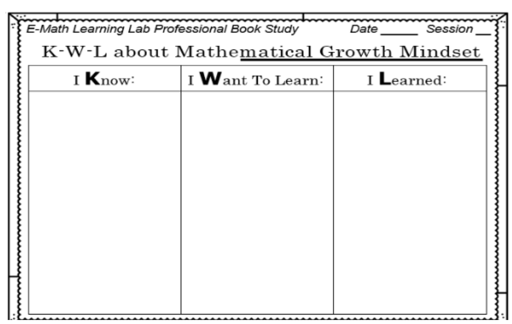
Teachers will use the Stream feature of the E-Math Learning Lab to converse with their colleagues before the beginning of each session.

During the book study: Face to face

Part 2

Teachers discussed among themselves the six keys and talked about the three takeaways, confusion, or questions that they may have and selected persons share the overarching thoughts from the group. Each group creates a ‘"What I Know," "What I Want to Know," and "What I Learned." (KWL) the chart to capture their interpretations and relevance of the chapters read. Teachers will revisit the KWL Chart at the end of the session to complete the "What I Learned." section of the chart. The chart should also be used to see if what they wanted to learn was actualized.

The KWL chart should be used as a review tool at the beginning and end of each session.


E-Math Learning Lab Professional Book Study Date_____ Session___

K-W-L about Mathematical Growth Mindset

I Know:	I Want To Learn:	I Learned:

Part 3 PowerPoint presentation and discussion of chapter 1: Neuroplasticity.

Changes everything

- Instructional Leader /Coach refocuses the group and leads the discussion on the reasons for the book study -See slide 3 of session 1 PowerPoint presentation.
- Discuss the relationship between the needs identified in the research study and the content of the featured book. See slide 4 of the PowerPoint presentation below.

- Teachers should work in small groups to discuss chapter 1. The teams work together to develop critical questions and comments about what they have read. Use slide 5 as the basis for discussion.
- Chapters 1 focuses on the first key to a growth mindset. Encourage teachers to connect text to self and students (p. 2-75 of the featured text).
- The instructional leader should ensure that opportunities are given for teachers to link the content of their real life and professional experiences. This will allow the participants to see how the content relates to their own experiences, and it can be transferred to your various settings.
- The instructional leader asks group members to select a scribe who will write on behalf of their group. Scribes record the key points from their group discussions on a chart paper and displayed in the presentation room for all to view.
- Participants should then be encouraged to engage in "gallery walk" to view the ideas of other participants on display. During the "gallery walk," participants

complete the table below to capture three practices that can contribute to a growth mindset:

On my Walk I Read :	I Believe I Can:
1.	1.
2.	2.
3.	3.

- Participants will return to their groups and discussed their selected information.
- Participants should provide evidence from the featured text and gallery walk to support their selections.
- Play soft mediation music and encourage participants to close their eyes and visualize themselves taking on the growth mindset written on their papers or those expressed by their colleagues.

Give 15 Minutes Break. Part 4 After Break:

Chapter 2: Why we should love mistakes, struggle, and even failure.

- Participants should be encouraged to review and discuss the information that they have read in chapter 2. By completing the thinking stems in the table below.

Post-Reading Thinking Stems
I Read and I wondered:
I found out that :
I would like to know more about :
I would like to challenge myself to :

- The instructional leader encourages participants to put their completed folded cards into a covered container. Participants will randomly select papers from container and read responses. The instructional leader uses the opportunity to discuss the responses.
- Keep drawing and discussing at different intervals throughout section 4.
- Introduce Slide 6 of PowerPoint and encourage participants to give oral feedback. Talk about the power of making mistakes and learning from them. Discuss chapter 2 in light of a growth mindset. Divide pages 61-68 among the participants and has them reading and discussing.
- Draw participants' attention to the "Step of Struggle" on p. 64 of featured text. Encourage participants to use post-its to draw the step that they are on and write why.

- Discuss the power of having a positive mindset and connect with the “pit” on page 64.
- Discuss steps to overcome challenges by reviewing p. 61-68. Reemphasize the importance of maintaining a growth mindset in difficulty.
- Discuss slide 7. Talk about how teachers can unlock their potential. Review the two keys identified so far and ask teachers to talk about what may be blocking their mindsets and which key holds the potential to strengthen their mindsets. Participants support discussion with pieces of evidence from the texts.
- Participants use craft sticks to write a positive statement to self. Talk with elbow partners how the positive message will help them to get out if the “pit” that they experience from time to time.
- Introduce slide 9. Make connections with the need for teachers to embrace their students’ growth and use their mistakes and challenges as fuel for their development.
- Encourage participants to read pages 52-70 and write some research -based considerations that must be followed in order to motivate their learners.
- Teachers work in groups to complete task sheets to reflect their findings. Encourage participants to design a learning pit similar to the one on p. 64 to represent some of the challenges that their students may have and how they can support them to overcome these challenges. Participants must provide evidence/scenarios from the text to support their thinking.

- Select some more responses from the mystery box and discuss.
- Each group will retrieve their KWL chart made at the beginning of the session and work together to complete the L section of the chat to show what they have learned from the session. Each group presents their KWL chart and discuss how the session meets or did not address their learning needs.
- The instructional leader should take a picture of each KWL chart to upload to the E-Math Learning Lab at a later date. Uploading the KWL chart to the E-Math Learning Lab will ensure that the participants can have access to the information after the face-to-face session is completed.

Part 4: Reflection

- Participants encouraged to complete an exit ticket before leaving the session.

Name :	Date :	Session :
Two Stars : What went well today		
Two Wishes (Even better if):		
Two things that I will try with my students:		
I promised myself that I will :		

After Session1 Activities.

Instructional leader:

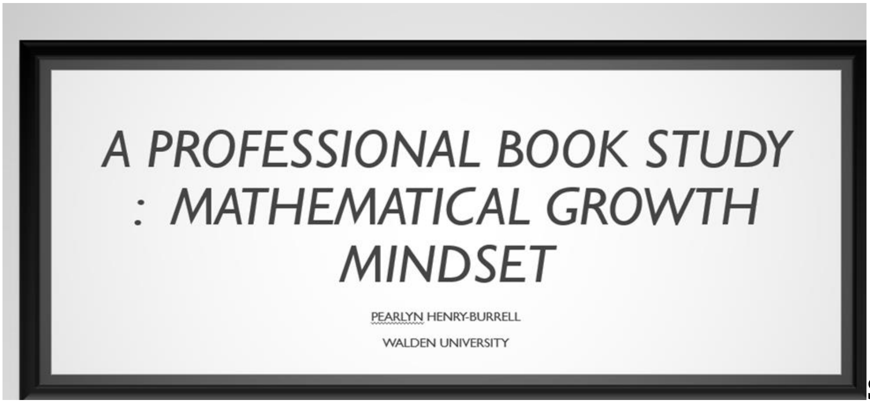
- Instructional leader uploads video of the session for participants to have access to upload KWL chart and all other handouts for participants to access.

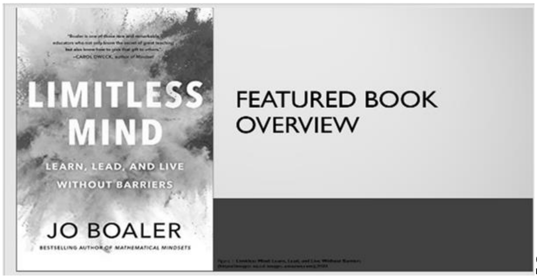
- Post outline of Chapters 3 and 4 for in assignment section of Lab for participants to read before the next session.
- Post follow up questions to exit tickets and use data to refine session 2.
- Contact each participant using the E-Math Learning email feature to update strategies they have used and the support that they may need.

***Participants*.**

- Complete session one journal entry before the next session.
- Contact instructional leader to discuss any support that he/she may need.
- Review presentation in E-Math Learning Lab.
- Upload a mathematics lesson where the RME framework is used.
- Comment on how they feel about the model lesson.
- Tell how the knowledge gained from gained from the book study integrated into the observed lesson.
- Give testimonials of their growth or lack thereof (by the end of term 1).
- Comment on colleagues' videos and offer guidance on the next steps, using the model of two stars and two wishes.

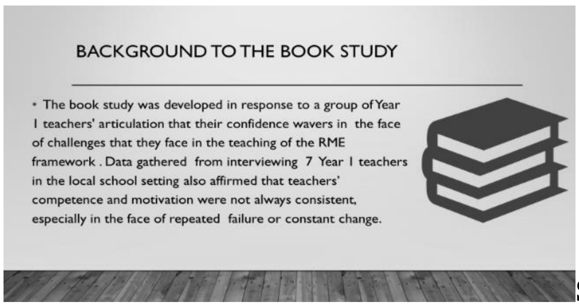
Supporting PowerPoint presentation for session 1. All visible images are public domain unless otherwise indicated**.**


A PROFESSIONAL BOOK STUDY
: MATHEMATICAL GROWTH
MINDSET
PEARLYN HENRY-BURRELL
WALDEN UNIVERSITY
Slide 1



Slide 2

- All participants must have access to their books before the face to face study.



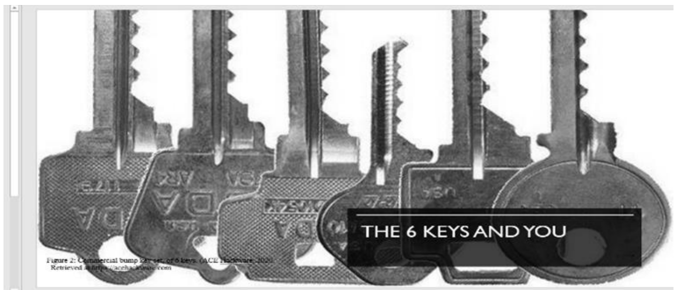
Slide 3

- Discuss the reason for the book study and what you hope to achieve.
- Connect with previous introductory PowerPoint presentation that the participants would have access to in the E-Math Learning Lab.
- Discuss information on the slide.

Slide 4

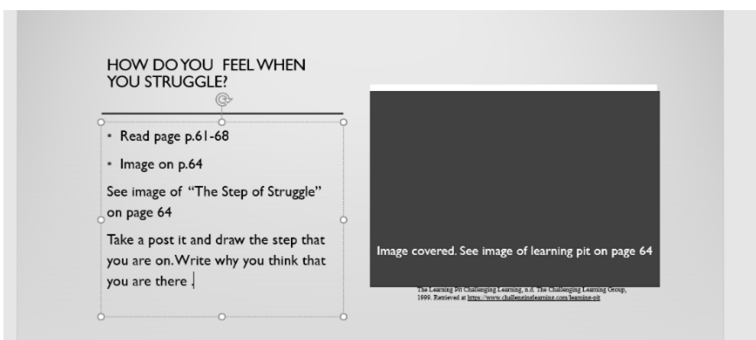
- Go through the PowerPoint and highlight the features of the book.
- Show how the features are connected with the identified needs of the participants.
- Look at the table of contents and remind the teachers of the areas to cover.

- Tell how each section of the book is connected with the overall goal of the professional book study.



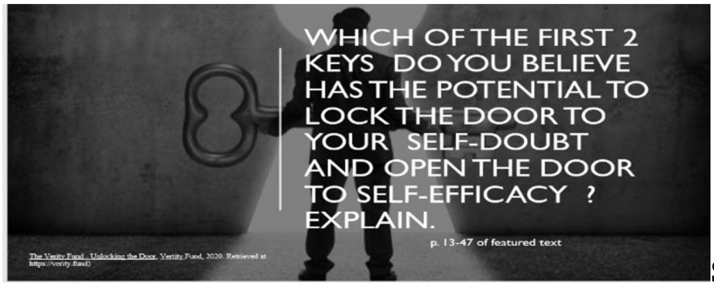
Slide 5

- Use the image on slide 5 to spark discussion on the purpose of keys and how it applies to their everyday situations.
- Discuss with participants the introduction of the book and the two keys mentioned in their readings.



Slide 6

- Take about the challenges that teachers and students can face.
- Encourage participants to tell some ways that have dealt with challenges.
- Read suggested pages on slides and follow the details in the session outline.
- Focus participants' attention on page 64.



Slide 7

- Talk about the importance of the two keys mentioned in chapters 1and 2.
- Connect the power of having a growth mathematical growth mindset and improved instructional practices.
- See detailed session outline on how to use Slide 7.

Slide 8

- This slide is related to chapter 2. Discuss how we can face.
- Take comments for participants and assign chapter 2 for reading.
- Reemphasize how one can navigate challenges and constant change.
- See detailed session outline on how to use Slide 8.

Slide 9

- This slide sets the stage for teachers to begin thinking about how they can transfer the power of growth mindset from themselves to their students.
- Participants should read chapter 2 and follow the steps outlined in session one presentation.
- Use featured text to guide discussion.

Slide 10

- Slide 10 should be used a prompt to guide the reflection process.
- Review KWL Chart.
- Collect exit tickets from participants.

See session one outline for detailed notes and guidance.

Lesson schedule for session 2. Session 2 is aligned to chapters three and four. This session should take place during the beginning of the first month, in term two.

Objectives.

- To build a growth mindset through research based information from the featured text;
- To collaborate as a learning community to apply research based information to self and real life context, to enhance their self-efficacy; and
- To develop an understanding of how teachers can set children up for success when they embrace the growth mindset.

Materials needed.

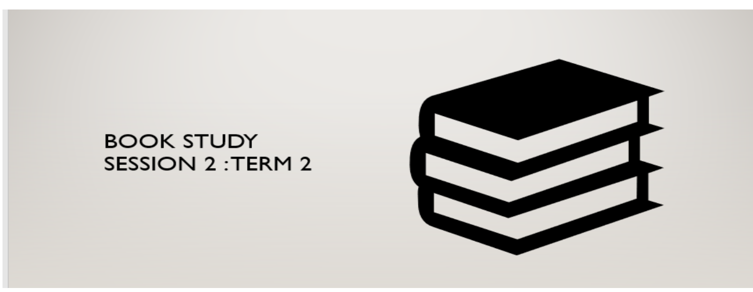
- Featured text.
- PowerPoint.
- Laptop and projector for the presenter.
- Journal books printed and ready for distribution.
- Chart paper for teachers to record their thoughts and for KWL Chart post-its.
- Flipchart markers.
- I Saw, and I Wondered Sheets (1 per participant).
- Handouts for activities (tables to be completed).
- Mason jars to use as affirmation jar.
- Colored popsicle sticks (craft sticks).
- Closed container for completed cards.
- Video for videoing the session.

Before session 2.

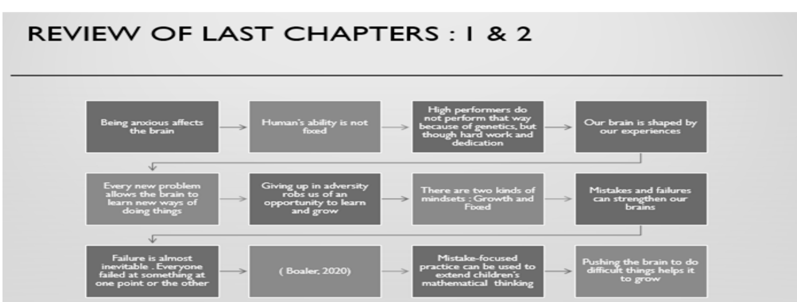
Instructor to upload all learning resources to E-Math Learning Lab in Google Classroom.

- Send out details and outline of meeting to teachers.
- Everyone reads featured text before the meeting/will be available in E-Math Learning Lab as well as hardcopy.
- Read: Chapter 3: Changing Your Mind, Changing Your Reality.
- Read Chapter 4: Chapter 4: The Connected Brain. Teachers will use the Stream feature of the E-Math Learning Lab to converse with their colleagues before the beginning of each session. Be ready to share with colleagues.

PowerPoint presentation for session 2.



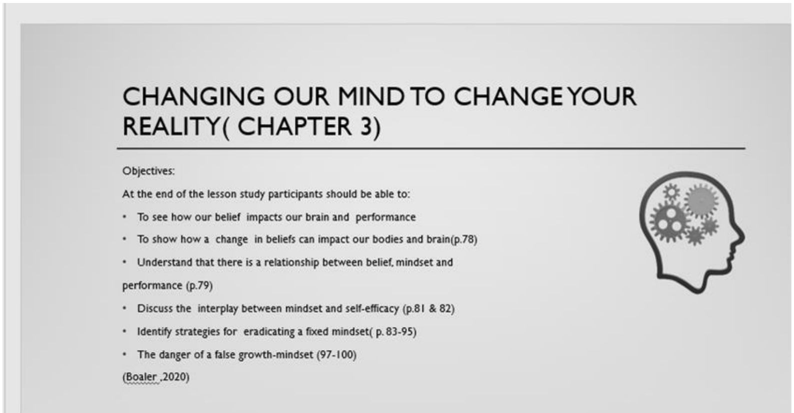
Slide 1



Slide 2

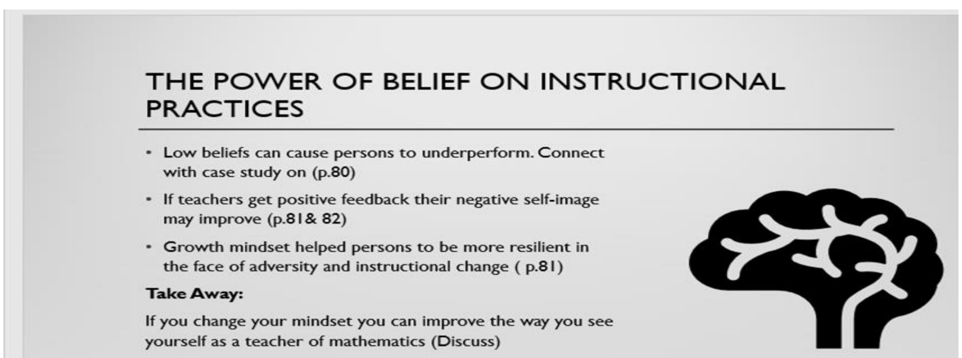
- This slide should be uploaded to E-Math Learning Lab.
- Review topics on the PowerPoint and have participants follow in their books.

- Encourage participants to work in small groups.



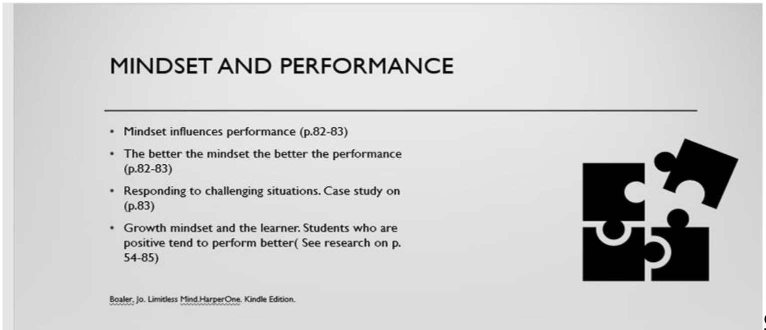
Slide 3

- Brainstorm participants' ideas before discussing content on the slide.
- Encourage reading of related texts as shown on the slide.
- Make time for group sharing and discussion of content.



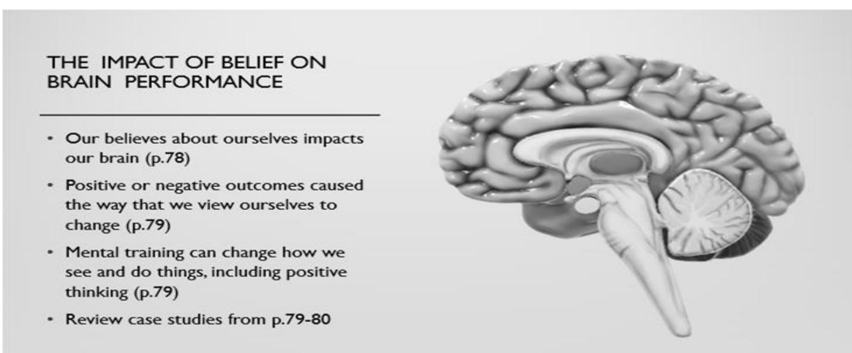
Slide 4

- Brainstorm participants' ideas before discussing content on the slide.
- Encourage reading of related texts as shown on the slide.
- Make time for group sharing and discussion of content, especially growth mindset.
- Have an oral reflection on the slide and discuss the takeaway point in terms of teachers' reflection on self and practice.



Slide 5

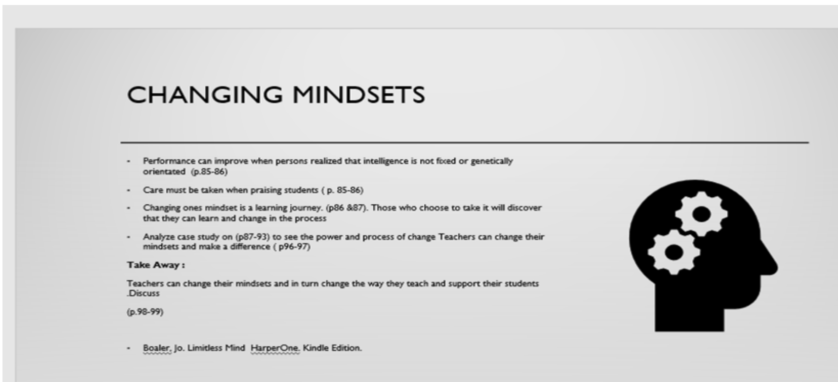
- Brainstorm participants’ ideas before discussing content on the slide.
- Encourage reading of related texts as shown on the slide.
- Make time for group sharing and discussion of content, especially growth mindset and its impact on their ability to feel confident to teach mathematics.
- Have an oral reflection about the content on the slide about how participants can embrace a growth mindset (see related content in the book).



Slide 6

- Brainstorm participants’ ideas before discussing content on the slide.
- Encourage participants to tell if they can relate to the texts shown on the slide.

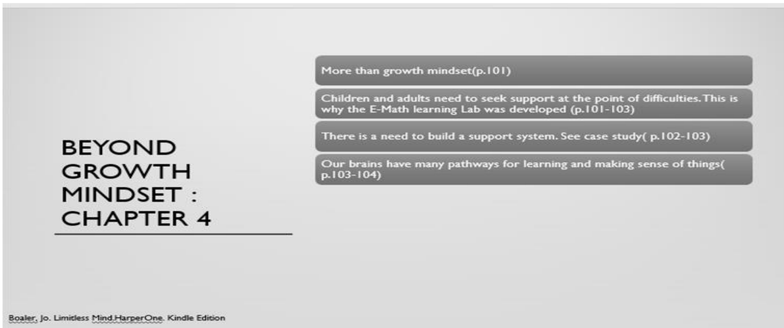
- Make time for group sharing and discussion of content, primarily the construct of belief and its relationship to self-efficacy.
- Have an oral reflection on the case studies and have participants relating them to their own teaching experiences.



Slide 7

- Brainstorm participants' ideas of how mindsets can be changed.
- Encourage participants to read texts as shown on the slide.
- Make time for group sharing and discussion of content and focus on changing mindsets.
- Have an oral reflection on what mindset they may need to change and how changing this mindset could help them to be better teachers.
- Wrap up chapter 3.
- Give 15 minutes break.

Resume with Chapter 4.

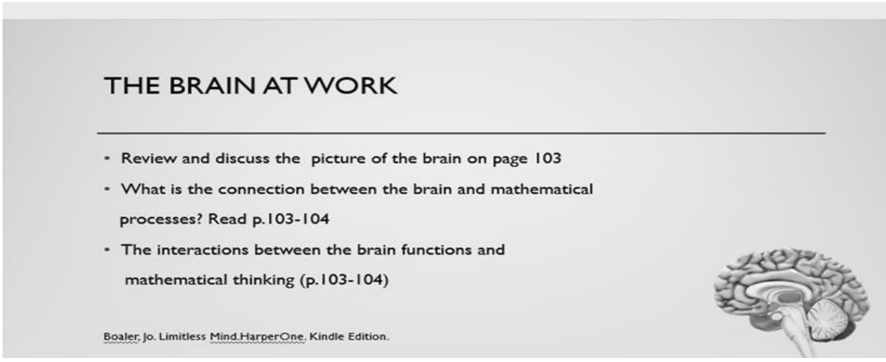


Slide 8

- Give an overview of the chapter by completing the form below:

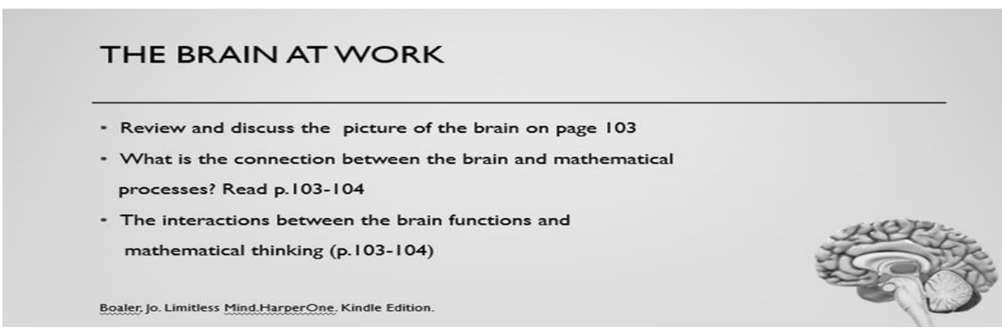
Post-Reading Thinking Stems
I Read and I wondered:
I found out that :
I would like to know more about :
I would like to challenge myself to :

- The instructional leader encourages participants to put their completed folded cards into a covered container. Participants will randomly select papers from container and read the responses.
- The instructional leader uses the opportunity to discuss the responses.
- Keep drawing and discussing at different intervals throughout the session.
- Discuss content on slides after participants read related sections of the book.



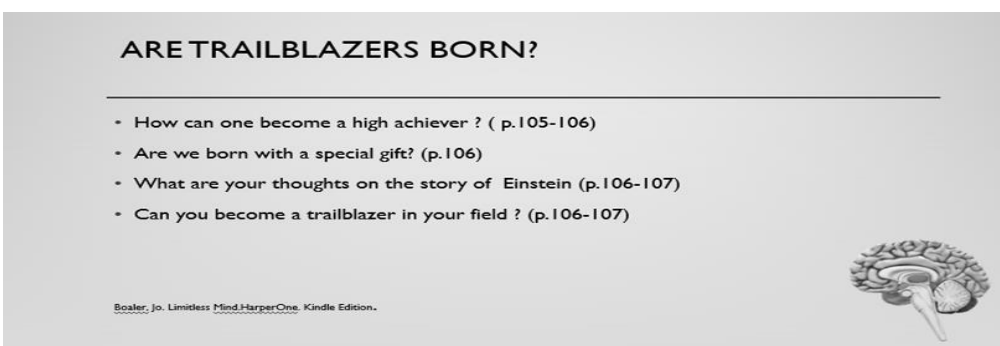
Slide 9

- Read and discuss the content.
- Focus on how the brain is wired to change and learn.



Slide 10

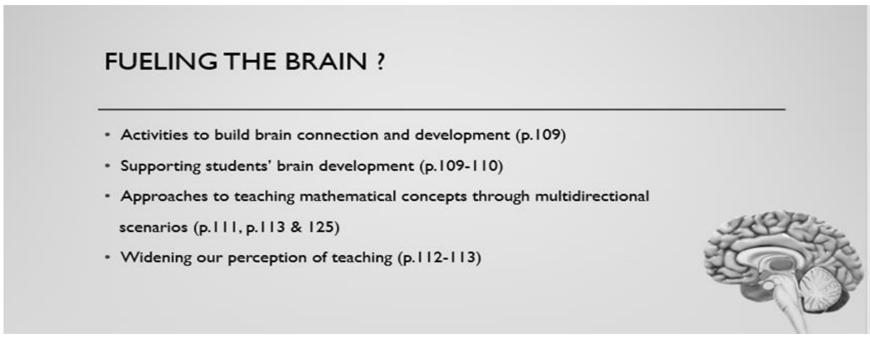
- Talk about the ability of the brain to think and master complex issues.
- Discuss the image of the brain and the various functions.



Slide 11

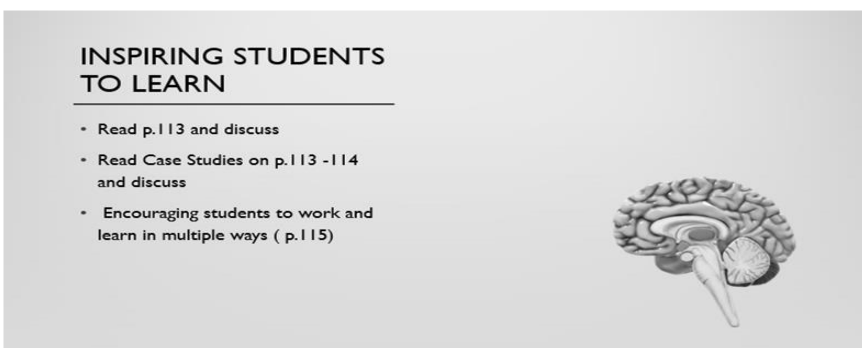
- Discuss the topic on the slide and record responses.

- Encourage participants to read the text and discuss their findings about trailblazers.
- Talk about how they can apply the concept of change to their situations and tell how they can apply it to their situations and improve their practice.



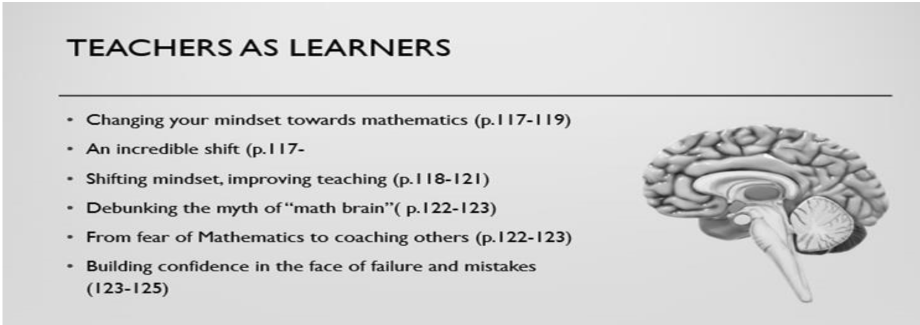
Slide 12

- Discuss embracing a new perspective to teaching.
- Discuss how teachers could change their mindsets and improve practice.
- Discuss with teachers how they can support students in making meaningful connections.



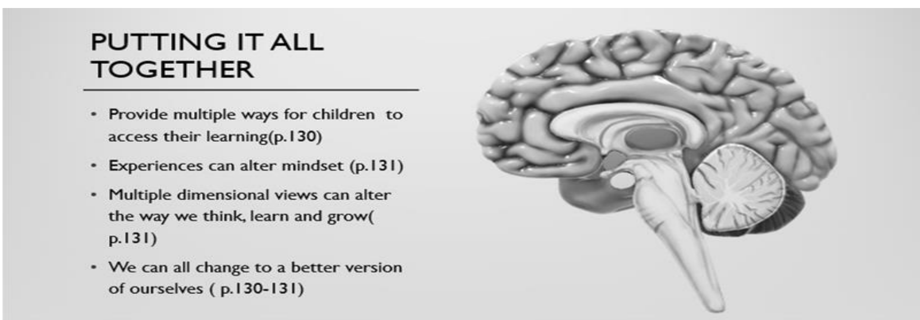
Slide 13

- Discuss how teacher can support students to build their mindsets.
- Support teachers in relating case studies to their current practice.
- Discuss how teachers' mindset may affect students' performance.



Slide 14

- Discuss how teachers can change their mindset.
- Discuss what contributed to a growth mindset.
- Talk about how they can remain confident even after a repeated failure.



Slide 15

- Review details on slide and topic covered with teachers.
- Encourage teachers to commit to change by writing a new goal.

Slide 16

End of session reflection.

- Participants encouraged to complete an exit ticket before leaving the session.

Name :	Date :	Session :
Two Stars : What went well today		
Two Wishes (Even better if):		
Two things that I will try with my students:		
I promised myself that I will :		

After Session2 Activities. Instructional Leader*:*

- Instructional leader uploads video of the session for participants to access.
- Upload KWL chart and all other handouts for participants to access.
- Post outline of Chapters 3 and 4 for in assignment section of Lab for participants to read before the next session.
- Post follow-up questions to exit tickets and use data to refine session 3.
- Contact each participant using the E-Math Learning email feature to update strategies they used and the support that they may need.

Participants.

- Complete session 2 journal entry before the next session.
- Contact instructional leader to discuss any support that he/she may need.
- Review presentation in E-Math Learning Lab.
- Upload a mathematics lesson where the RME framework is being used.
- Comment on how they feel about the lesson.

- Tell how the knowledge that they have gained from the book study was integrated into the observed lesson.
- Give testimonial of their growth or lack thereof (by the end of term 2). Comment on colleagues' videos and offer guidance on the next steps, using the model of two stars and two wishes.

Session 2 Reflection **In session 2 we focused on:**
I used to think:
Now I have learned :
Now I will try to :
Areas to focus on:

Notes: Teachers will keep reflective journals until the end of the three sessions.

Lesson Schedule for Session 3

Session 3 Focus on Chapters 5 & 6. Term 3

Objectives.

- To build a growth mindset through research based information from the featured text;
- To collaborate as a learning community to apply research based information to self and real life context, to enhance their self-efficacy; and
- To develop an understanding of how teachers can set children up for success when they embrace the Growth Mindset.

Materials needed.

- Featured text.
- PowerPoint.
- Laptop and projector for the presenter.
- Journal books printed and ready for distribution.
- Chart paper for teachers to record their thoughts and for KWL.
- Chart Post-its.
- Flipchart markers.
- I Saw and I Wondered Sheets (1 per participant).
- Handouts for activities (tables to be completed).
- Mason jars to use as affirmation jar.
- Colored popsicle sticks (craft sticks).
- Closed container for completed cards.
- Video camera for videoing the session.

Prior to Session 2:

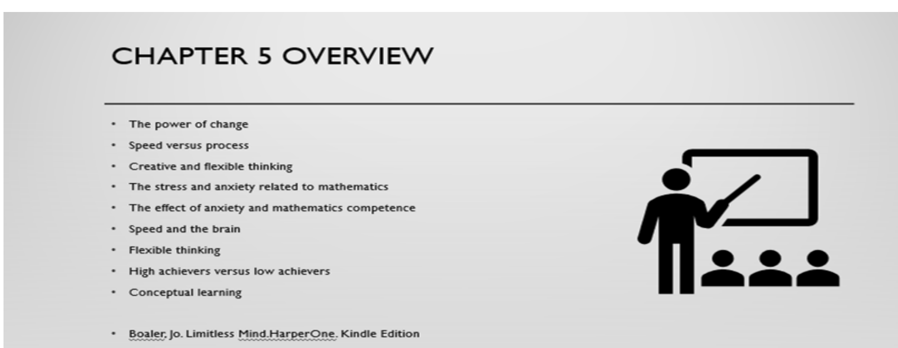
- Instructor uploads all learning resources to E-Math Learning Lab in Google Classroom.
- Send out lesson study overview on E-Math Learning Lab prior to the start of the next meeting.
- Everyone reads featured text prior to meeting /will be available in E-Math Learning Lab as well as hardcopy.

- Read: Chapter 5: Why Speed Is Out and Flexibility Is In!
- Read Chapter 6: Chapter 6: A Limitless Approach to Collaboration.
- Read Conclusion: Living Without Limits.
- Teachers will use the Stream feature of the E-Math Learning Lab to converse with their colleagues, prior to the beginning of each session.
- Be ready to share with their colleagues.

PowerPoint presentation for session three. Chapters five and six.

Slide 1

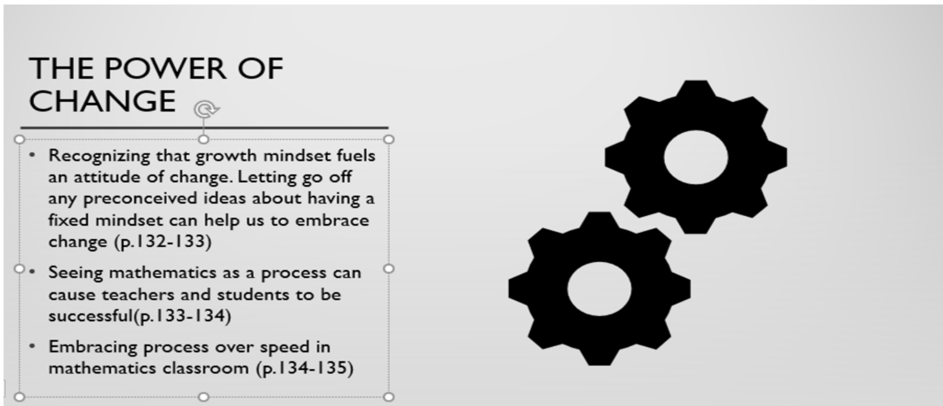
- Session 3 must be done in the last term of the academic year.
- Session 3 should be done within the first month of the term.



Slide 2.

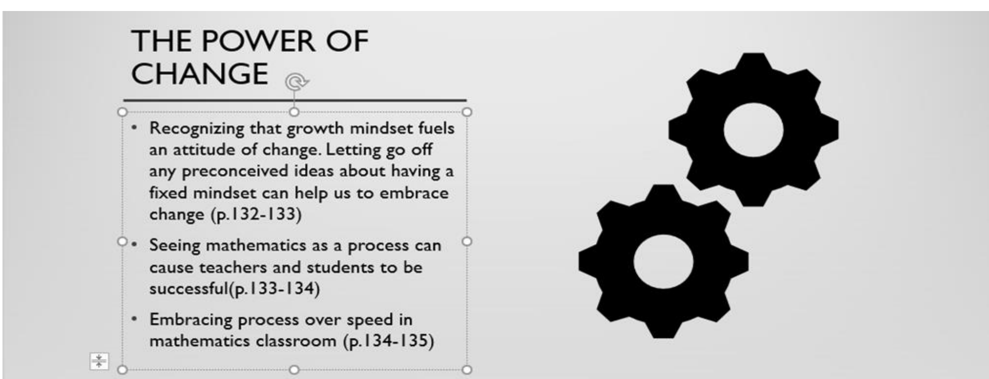
- Discuss the power of change.

- Connect content book.
- Go over the content to be study.
- Review the objectives of the book study and the aim for self change.



Slide 3

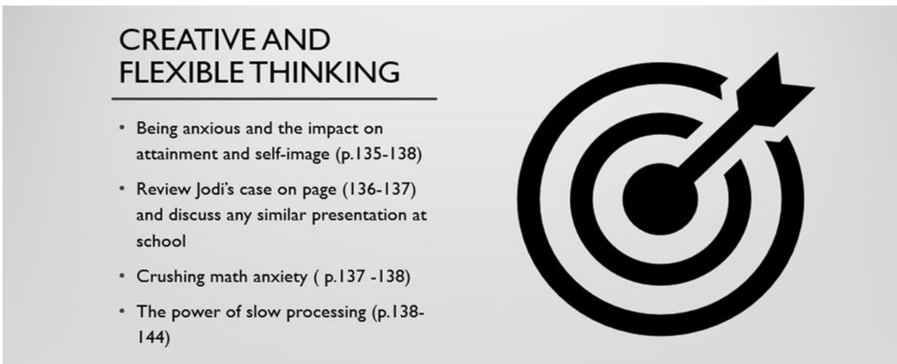
- Discuss change and how this growth mindset applies to the teaching of mathematics.
- Discuss the teaching of mathematics and how teachers can support the children through the process.



Slide 4

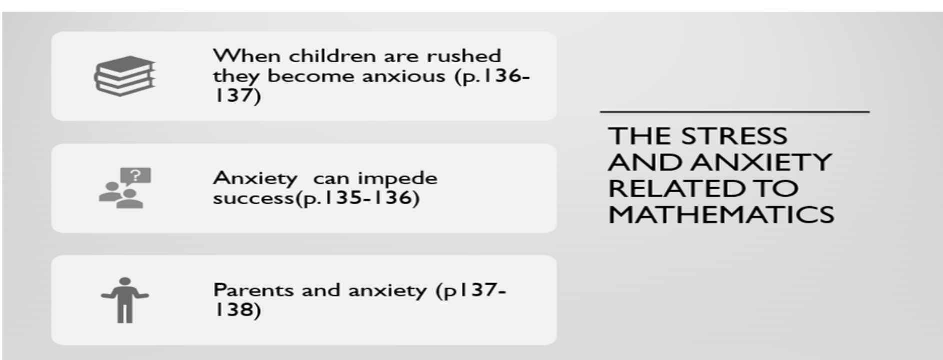
- Discuss mathematics as a process.
- Discuss growth mindset and its power to change practice.
- Outline strategies for changing one mindset.

- Use instructions on slide to discuss topics.
- Connect to the featured text.
- Discuss Growth mindset and let participants know that change can happen, connect to research in featured text.



Slide 5

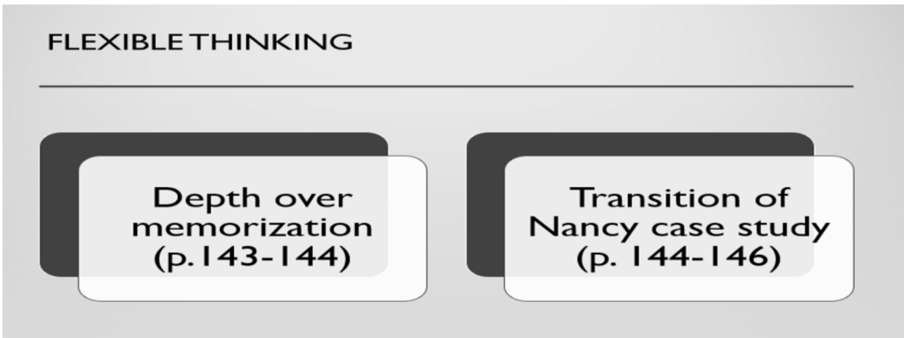
- Anxiety leads to self doubt.
- Review Jodi's case with the aim of teachers reflecting on their own practice.
- Encourage teachers to connect with their own class and self concept.
- Talk about what caused anxiety and how it can be subsided.



Slide 6

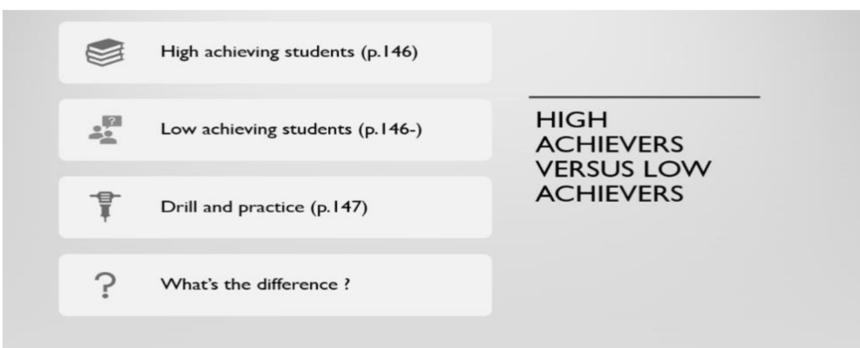
- Discuss slide as presented.

- Encourage participants to share their individual story/stories.
- Discuss why parents are anxious for their children.
- Subsiding fear through growth mindset and approach to teaching.



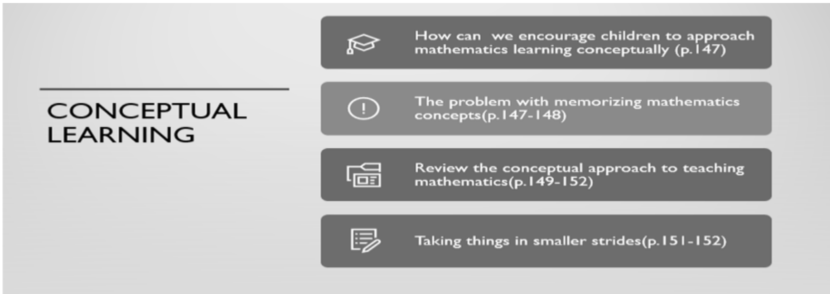
Slide 7

- Encouraging deep learning.
- Discuss how teachers with growth mindset can influence attainment.
- Discuss Nancy's case and encourage discussion around it.



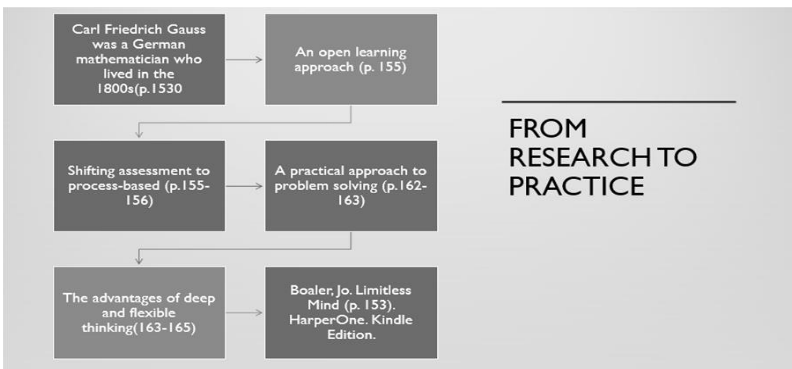
Slide 8

- Teachers' self-efficacy affects students' attainment.
- Changing instructional practice to improve practice.
- High and low achievers.



Slide 9

- Review conceptual learning with the aim of teachers adapting the practice.
- Talk about embracing the process of learning and change.
- Discuss beyond memorizing facts.

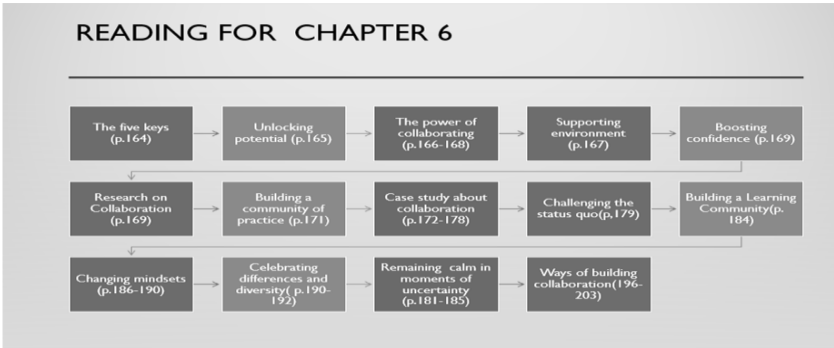


Slide 10

- Review case studies and discuss implication for teaching and learning.
- Focus on application during the discussion of this slide.
- Review chapter 5.

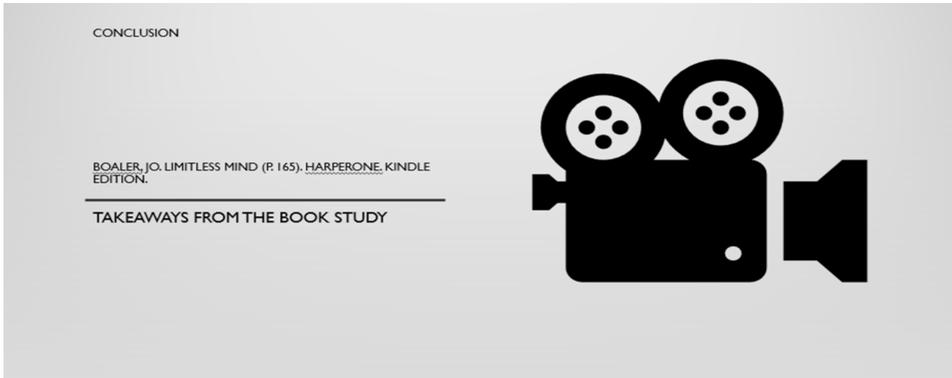
Slide 11

- Introduce chapter 6 and use the upcoming slide to guide process.



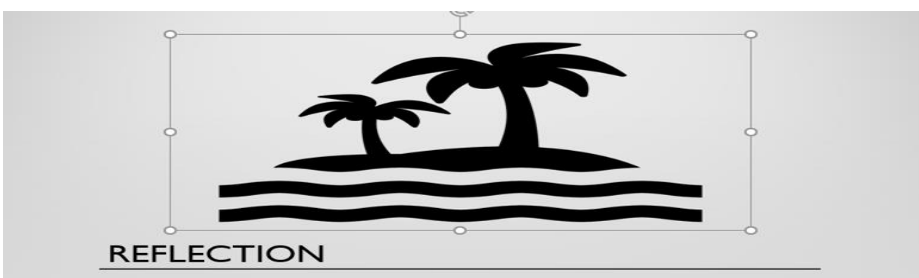
Slide 12

- Use slide to guide for discussing chapter 6.
- Focus on connecting all areas learned and see how teacher can make the connection between theory and practice.
- Emphasize growth mindset and all participants to talk about how they thought process may have changed.
- Discuss building professional learning communities with colleagues and pairs -especially in times of difficulties.
- Talk about collaborating through the E-Math Learning Lab. Encourage a collaborative community of learners -connect with a classroom that supports inquiry-based learning.



Slide 13

- Group work to discuss take away and write affirmation statement to say how they will change (see procedure in session 1).
- Review KWL Chart from session 1.
- Discuss the need to move learned information into practice to change fixed mindset about teaching of mathematics.
- Ask teachers to talk about strategies that they have tried and what they have seen.



Slide 14

- Participants encouraged to compete an exit ticket below prior to leaving session.

Name :	**Date :**	**Session :**
Two Stars : What went well today		
Two Wishes (Even better if):		
Two things that I will try with my students:		

After session three activities.

Instructional Leader.

- Instructional leader uploads video of session for participants to access.
- Upload KWL chart and all other handouts for participants to access.
- Post overall presentations to E-Math Learning Lab.
- Post follow-up questions to exit tickets and use data to decide support.
- Contact each participant using the E-Math Learning email feature to update the strategies that they used and the support that they may need.

Participants:

- Complete session 3 journal entry to be used for PD evaluation.
- Contact instructional leader to discuss any support that he/she may need.
- Review presentation in E-Math Learning Lab.
- Upload a mathematics lesson where the RME framework was used.
- Teachers comment on how they feel about the lesson as well as how the knowledge gained from the book study was integrated in the lesson.
- Give testimonial of their growth or lack thereof (by the end of term 3).
- Teachers upload testimonial videos to Google Classroom in E-Math Learning Lab.
- Encourage teachers to comment on colleagues' videos uploaded to Google Classroom -E-Math Learning Lab.

- Colleagues offer guidance on uploaded lessons by offering the next steps, using the model of two stars and two wishes.

Date: ________________	Session 3 Reflection
In this Book Study we focused on:	
I used to think:	
Now I have learned :	
How I will use the information learned to improve my practice	
Summary of Impact of Book Study	What went well:
	What needed to be improved:

Notes. Teachers will keep reflective journals until the end of the three sessions.

Instructional Leaders' Guide: Lessons for E-Math Learning Labs

Designed by: Pearlyn Henry-Burrell

I developed this booklet to show the key things that should be considered when developing mathematics lessons for the E-Math Learning Lab. It will also help instructional leaders and teachers to see how they can use uploaded lessons, develop, and refine the teaching of mathematics. This guidance document should be used in conjunction with the RME Rubric, which sets out the key features of the RME framework. This document will also help teachers and instructional leaders learn how to:

- Develop and upload the lessons in E-Math Learning Lab.
- Design lessons for the learning community to analyze.
- Share new skills and knowledge that they have gained.
- Use the already established practice of lesson study to plan research based lessons.
- Use formative feedback to enhance their pedagogical practices.

Consider these questions before uploading lesson videos to the E-Math Learning Lab.

- Will the uploaded lesson make the community more aware of best practice?
- Will the uploaded lesson show children learning in a context that is engaging and challenging?
- Will the uploaded lesson help other members of the learning community to better understand how to address the need of all learners?

- Is the uploaded lesson a model lesson or one for the community to critique and help you develop further?
- Will the uploaded lesson help to build collaboration among the learning community members?
- Will the uploaded lesson in line with the fundamental practices outline in the RME rubric?

Lesson objectives and support request form.

Objective/s of the lesson(what would you like the community learners to do?) **By the end of the model lesson members of the teaching community should be able to:**
I would like you to help m : (Mandatory for persons whose many objective is to seek support)

*This form must be uploaded to the E-Math Learning Lab along with the video lesson***.**

Members of the learning community must analyze uploaded lessons. Figure 3 can be used to guide the review process. Teachers should provide their colleagues with constructive feedback. Feedback received should be used to modify the lesson.

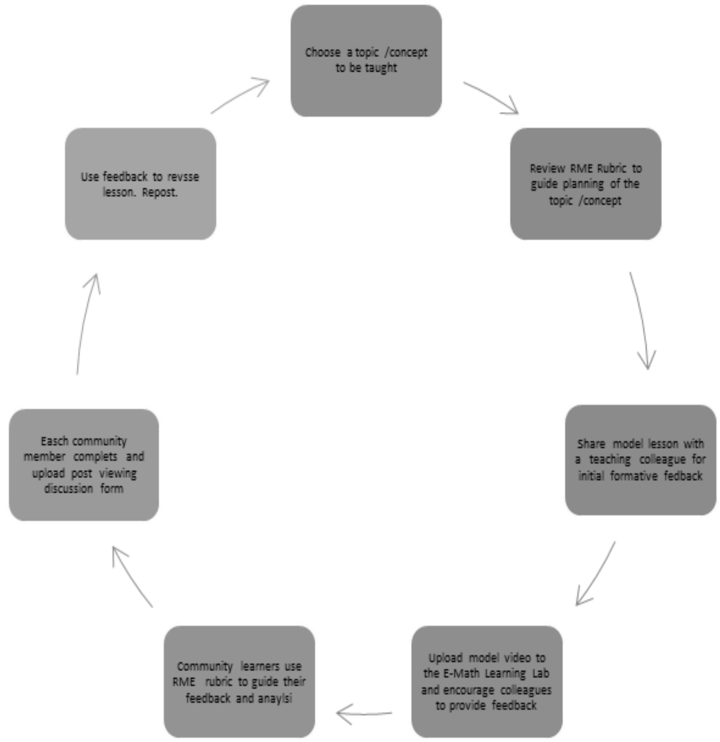


Figure 5A. The process for model lessons.

Lessons posted in the E-Math Learning Lab should form the discussed. Figure 4 shows the process that should be followed in order to have a productive discussion.

Figure 6A. Post viewing discussion flow.

Discussion Protocol. Feedback should be geared supporting and improving pedagogic technique (especially if the lesson was presented for ideas on how to improve)

- Focus on what the teacher and students are doing rather than on the teacher himself /herself.
- Be objective in your feedback.
- Substantiate your claim with facts. “I think, because I saw it.”
- Celebrate and thank the member for sharing his or her lesson.
- Politely present next steps.

Post Viewing Discussion Record Form for E-Math Learning Lab		
Title of Lesson:______________________________**Presenter**__________________		
I think :	Because I saw :	Even better if :
Overall comments:		

Note. This completed form must be sent privately to the person/s who uploaded the video lesson for analysis.

E-Math Learning Lab Evaluation Questionnaire Activity Sheet 1

1. Check all the E-Math Learning Lab activities that you have participated in:

Introductory session □	Commenting on colleagues' posts □
Book study session 1 □	Evaluating lessons □
Book study session 2 □	Designing lessons with colleagues □
Book study session 3 □	Requesting support from coaches □
Uploading of lessons □	Using sample lesson scenarios □
Uploading testimonial videos □	Reading research-based articles □
Providing feedback on lesson study sessions □	Using the instructional leaders' guide □

2. **Collaboration**

Please check your response to each statement	**Agree**	**Disagree**	**Sometimes**
I collaborated with members of my own grade level			
I mostly collaborated with members of my own school			
I collaborated with members from other schools			
This professional learning helped to build collegial collaboration			

3. **Features**

Please check your response to each statement	**Agree**	**Somewhat**	**Disagree**
The E- Math Learning Lab improved my self-efficacy towards the teaching of Mathematics			
I felt like I was in control of my own PD in the E-Math Learning Lab			
I actively participated in the learning process			
I felt like a part of a learning community			
Most aspects of the PD could be directly applied to my every day teaching needs			

4. **Effectiveness**

The below E-Math Learning Lab areas/activities were effective in improving my knowledge and practice in using the RME framework :	**Agree**	**Somewhat**	**Disagree**
Book study session 1			
Book study session 2			
Book study session 3			

The below E-Math Learning Lab areas/activities were effective in improving my knowledge and practice in using the RME framework :	**Agree**	**Somewhat**	**Disagree**
Book study session 1			
Book study session 2			
Book study session 3			

E-Math Learning Lab Evaluation Questionnaire Activity Sheets 2

Introductory session			
The RME Rubric			
RME digital lesson for upload guidance document			
Designing lessons with colleagues			
Uploaded sample lessons □			
Uploaded testimonial videos			
Formative feedback form colleagues and coaches			
Sample lesson scenarios			
Online research-based articles			
Personalized PDs by coaches/ instructional leaders			
Which area/s did you find most effectively?			
Which area /s need improvement?			
What were you hoping to see/do that did not happen?			
What are some features that should be add to or be removed from the E-Math Learning Lab?			

E-Math Learning Lab Evaluation Questionnaire Activity Sheet 3

5. **Overall effectiveness of the E-Math Learning Lab**

On a scale of 1-5 with 5 being the highest and 0 the lowest: □ How effective was the E-Math Learning Lab in meeting your professional development needs as it relates to the teaching of the RME framework ? ________
On a scale of 1-5 with 5 being the highest and 0 the lowest: □ How effective was the E-Math Learning Lab in meeting your improving your competence and confidence to teach mathematics using RME framework ? _______

Thank you! Your input is vital to the further development of the E-Math Learning Lab

Reference List

Boaler, J. (2019). *Limitless mind: Learn, lead, and live without barriers*. New York, NY: HarperCollins

Appendix B: Interview Protocol

Interview Questions

Research Questions: Primary Teachers' Mathematical Practices and Self – Efficacy In Implementing Realistic Mathematics Education

Duration: 45mins-60 minutes

1. Walk me through the steps of a daily math lesson.
2. What is your understanding of the following components of the RME framework?
    a. Realistic Experiences/contextual problems?
    b. Interactivity?
    c. Conceptual/Mathematization?
    d. Intertwining?
3. What aspects, if any, or the section of the RME framework do you use during your mathematics lesson?
4. Tell me how you use the following in your math lessons:
    a. Realistic experiences,
    b. Encourage interactivity
    c. Support mathematizing
5. Give me some examples of how you encourage guided intervention in your mathematics lessons.
6. What is your interpretation of inquiry-based learning?
7. What might that look like in your mathematics lessons?
8. What aspect of the framework did you master or not master in that lesson?

9. How do you facilitate RME as an inquiry-based learning approach, in mathematics daily?
10. What are your thoughts about using the RME framework during your mathematics lesson?
11. Explain your motivation towards teaching Math using the RME approach?
12. Talk to me about your feelings of competency in implementing the RME framework.
13. How do you perceive your level of persistence, even after repeated failure in implementing the RME Framework?
14. Tell me about a time when you had a successful mathematics lesson were able to effectively use the strategies that are aligned with the RME framework. What made that lesson successful?
15. Talk about your feelings of competency in teaching mathematics using the RME framework.
16. What professional development support helped you to overcome the challenges that you face/may have faced when using the RME framework in your mathematics lessons?
17. Describe any professional development activities that you engaged in that were successful in helping you with the RME framework.
18. What support have you received to strengthen your pedagogical skills in the teaching of mathematics?

19. What is beneficial/detrimental about receiving support with implementing the RME framework in your classroom?
20. What is satisfying/rewarding about the support, resources or experience that you have received that helped you to be more confident in your ability to teach mathematics using the RME framework?
21. What "support system" for ongoing monitoring of the delivery of the RME framework is in place?
22. What are the possible reasons why some of the professional development worked /did not work?
23. What should be done differently?
24. What should be done that is not currently being done?
25. What is being done, that should be stopped?

Do you have any questions for me?

Appendix C: Document Review Protocol

Protocol is aligned with selected sections the RME framework has put forward by Treffers (1991).

Elements of the RME Framework	Evident in Professional Development Manual/Curriculum	Not Evident in Professional Development Manual /Curriculum
The designed professional development manual and written curriculum framework reflect the mathematical teaching methods recommended by the RME framework.	Notes	Notes
The designed professional development manual outlines how teachers should support whole class interactivity in the mathematics classroom.		
The designed professional development manual shows that teachers will or received training in the "reality principle' of the RME framework.		
The designed professional development manual shows that teachers will or received		

training in how to execute the “level principle’ of the RME framework.		
The designed professional development manual shows that teachers get support in how to design mathematics lesson plans based on the realistic approach?		
The designed professional development manual shows a well-developed support plan for teachers as they move towards the implementation of the RME framework.		

Document Review Protocol as Aligned with the RME Framework

Alignment with the RME Framework (Treffers (1987) – Lesson Plan.	Comments
Lesson plan shows where lesson will begin with a realistic experience (*Phenomenology*).	
Evidence that lesson will draw on everyday contexts, the use of imagined" realities as stated in the RME (*horizontal mathematization*, Gravemeijer, 1994).	
Evidence that students will engage in exploration/investigation/problem solving during the lesson (horizontal mathematization, Gravemeijer, 1994).	
Information on how the teacher will ensure that fundamental concepts and language of mathematics are promoted during the lesson is documented in the lesson plan. (horizontal mathematization, Gravemeijer, 1994.	
The lesson plan contains progress of students will use models and symbols for progressive mathematization:- as they move	

From a concrete level to a more formal level by using models and symbols (Treffers 1987) - *vertical mathematization*, Gravemeijer, 1994.	
Evidence that lesson will encourage multiple paths to a solution or multiple solutions (Treffers 1987).	
Evidence that students will engage in collaborative /group learning to communicate their ideas to their peers (peer-to-peer, to group, to class).	
Evidence that students will critically assess mathematical strategies.	
Planned lessons show teachers' competence (self-efficacy construct) in developing lessons that are in line with the planning lessons that are in line with the RME.	